"Novel Drilling Technology Combining Hydro-Jet and Percussion for ROP Improvement in deep geothermal drilling"

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DELIVERABLE D3.2

"Report on Social Impacts"

ABSTRACT

As a follow-up to D3.1(Report on Environmental Impacts), D3.2, Report on Social Impacts, addresses public understanding, public acceptance, and attitudes towards geothermal drilling. The purpose of this research was to determine how a novel drilling technology interacts with the social acceptance of geothermal energy. The term acceptance refers to both sociopolitical and community acceptance. Geothermal development and operation may have unfavorable effects on ecosystems, human health and economy, which are also investigated in terms of social acceptance. To explore public acceptance towards deep geothermal drilling, an online questionnaire based on the findings of our previous research on the environmental impacts of deep geothermal drilling in the ORCHYD project was designed. This research addresses a literature gap, by conducting one of the few surveys of the public acceptance of (deep) geothermal drilling.

The questionnaire included multiple-choice items for demographic information, and Likert-scaled ratings for NIMBY (not in my back yard) attitudes towards the technological, environmental, material, energy, socioeconomic, cultural, institutional and (geo)political aspects and impacts of geothermal energy and deep geothermal drilling. The survey was conducted among a diverse group of people in different countries. Multivariate statistical techniques including Principal Component Analysis and Cluster Analysis were used for the analysis of responses, with the aim of discovering similar societal attitude groups. The analysis identified three different clusters with distinct attitudes towards geothermal drilling operations and geothermal energy as a whole. The report concludes with suggestions on the ways that public perception of geothermal drilling and geothermal energy can be enhanced, based on the cluster analysis and the concept of energy tribes, with distinct worldviews on the environment, energy, and geothermal development.

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AFFILIATION(S):	UPRC			
FURTHER AUTHORS:				
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1 Introduction

This report on social impacts (D3.2) marks the completion of the social impact assessment (Task 3.2). Social impact assessment (Task 3.2) considers the social impacts found in Task 3.1 and links them to sociocultural issues and social acceptance of ORCHYD. In this report, an online cross-national questionnaire documents and analyzes statistically sociocultural issues, attitudes, and acceptance of geothermal drilling.

The analysis of survey data used the multivariate statistical techniques Principal Component Analysis and Cluster Analysis. In particular, the analysis endeavors to establish social perceptions resulting in environmental/geothermal energy societal “tribes” and how they perceive the project. This task also formulates suggestions for designing “messy”/“clumsy” interventions and policies related to deep geothermal drilling that are more likely to be accepted by a large portion of society.

1.1 Environmental impact assessment

Previous work (Task 3.1) assessed the environmental implications of deep geothermal drilling, providing a solid basis for evaluating geothermal energy's benefits. The Report on Environmental Impacts (D3.1) addressed the qualitative and quantitative environmental impacts of the ORCHYD project. The impacts on the lithosphere, hydrosphere, atmosphere, and biosphere were thoroughly assessed to better understand the current environmental profile of deep geothermal drilling development. Direct impacts on land use, atmospheric emissions, water consumption, solid waste, and, depending on the site, specific threats to biodiversity have been identified. In contrast, indirect effects of geothermal development include soil erosion, surface runoff, and effects on tourism and resettlement.

In a holistic approach, the qualitative assessment was coupled with a quantitative approach which included a Life Cycle Assessment (LCA) study, which investigated the effect of Rate of Penetration (ROP) enhancement on a range of emission categories, material use, and energy consumption. Simplified Risk Analyses (RA) was conducted for induced seismic risk and noise levels were computed. The study was complemented with an Environmental Footprint Analysis (EFA). The results of these studies show in detail that the proposed drilling technique by ORCHYD will significantly reduce the environmental footprint of deep geothermal drilling operations. At the same time, noise and induced seismicity risks will be minimized, as well.

These results, if communicated appropriately to the public, will most likely positively change public perception of deep geothermal operations. Subsequently, it is of utmost importance to identify the hotspots of concern of the public towards deep geothermal drilling. The research undertaken here will help determine whether these concerns are genuine. Furthermore, the combination of results of D3.1 and D3.2 can set up a direction toward future developments in deep geothermal drilling techniques. Developments should be oriented towards implementing economically viable, environmentally friendly, and safe drilling techniques, which will contribute to the broader public acceptance and, ultimately, adopt geothermal energy as a key element of energy mixes.

1.2 Structure of report

Regarding the rest of the report, Section 2 presents the literature review of social acceptance, with an emphasis on findings and recommendations. Section 3 outlines the methodology of the work, with subsections discussing the structure and distribution of the online questionnaire. Section 4 presents the results of the statistical analyses of the pilot and the final questionnaire, with subsections detailing the extraction of principal components, the formulation of clusters of observations, and a discussion of a few important concerns. Finally, Section 5 presents the conclusions and the recommendations.

To avoid cluttering the main text, intermediate steps of the statistical analysis are presented in the appendixes.

2 Literature review of social acceptance

Several social science studies have provided insight into why consumers rationally oppose the adoption of a broad spectrum of more efficient technologies. Communities can shift from traditional to renewable resources such as geothermal energy, thanks to advances in new technologies and a desire for energy security. As a result of their involvement, they developed two perspectives on the community: acceptance and rejection (Syivarulli, 2020). The importance of social acceptance is often underestimated in discussions about technology transfer and the adoption of renewable energy (Mallett, 2007).

Development of trust with local people is becoming an unavoidable objective for renewable energy transitions, as Im et al. (2021) and Poortinga, Aoyagi and Pidgeon (2013) argue. The role of the public in energy transition concerns is strongly intertwined with the ability of the public to accelerate or prevent the development of new energy technologies (Demski et al., 2015). Incorporating the public's values broadens the authority's information base for energy transition decisions (Butler et al., 2015). Chavot et al. (2018) investigated how local governance may conflict with the state framework in the field of the energy transition and found information sharing and public engagement to be required for project social acceptance.

Public engagement and citizen participation have gained new traction in mainstream political discourse worldwide in recent years (Allansdottir, Pellizzone & Sciullo, 2019). It is critical to investigate the status of social acceptance prior to implementing a specific geothermal project. In addition to the investor, the decision to proceed with a project must be approved by a number of stakeholders (Wüstenhagen, Wolsink & Bürer, 2007).

Wüstenhagen and Bilharz (2006) define social acceptance as the intention to use technology and measure it through the willingness to pay. Acceptability is a concern for all actors involved in the decision-making process. When these actors include not only the surrounding residents and local civil society organizations but also foreign investors, large energy companies, and higher-level government officials, the situation quickly becomes complicated.

In general, social or public acceptance is defined as a positive attitude toward technology or measure that leads to supporting behavior when needed or requested, as well as counteracting resistance from others. The meaning of social acceptance has shifted from a market-oriented to a socio-political perspective (Vargas Payera, 2018). Social acceptance is essential in developing any energy project (Cataldi, 1999). It has been identified as one of the most potent

barriers to new technology implementation in the global renewable energy sector (Cataldi, 1999; Wüstenhagen, Wolsink & Bürer, 2007) and is commonly used in traditional energy policy thinking (von Hippel et al., 2011).

Resident participation may aid in avoiding controversies. Communication of environmental issues and energy technologies that shape public opinion and change policies allows different actors involved in developing a project to connect (Dowd et al. 2011). Finding consensus among key stakeholders such as public authorities, industry organizations, citizens, and associations is also a requirement for public acceptance (Schmidle-Bloch, Heintz & Moullet, 2019). Stakeholder cartography is extremely valuable when studying social acceptability since it aids in understanding similar or conflicting interests and interactions between them.

Geothermal energy enjoys less public acceptance than other renewable energy sources, such as wind and solar (Hosseini et al., 2018). Geothermal energy is one of the least understood renewable and clean energy sources by non-expert communities, making it more susceptible to community skepticism. Because of its subsurface nature, public perception of it can easily be negative, particularly in the absence or lack of communication and awareness campaigns, inconsistency with local policies, and a lack of alignment of the project's purpose (Barich et al., 2022).

The process character of social acceptance has been used to differentiate between the three significant acceptance dimensions: sociopolitical, community, and market (Wolsink, 2018). Socio-political acceptance is acceptance at the broadest, most general level and is related to the technology itself, public perception, key stakeholders, and policymakers. Acceptance of this type is linked to general public opinion as well as the attitudes of key stakeholders and policymakers (Toke, Breukers & Wolsing, 2008). Redefining market choice sets or effectively empowering citizens for renewable energy co-production is primarily a matter of socio-political acceptance (Wolsink, 2017).

Community acceptance refers to specific site decisions and is related to procedural justice, distributive justice, and trust. Community acceptance is also the setting for NIMBY (Not In My Back Yard) debates (Bell, Gray & Haggett, 2007). Batel (2020) defines NIMBY as a syndrome or phenomenon that summarizes the idea that people oppose specific technologies because they are to be built in their backyard. Thus, they are motivated solely by selfishness, ignorance, and irrationality. As a factor involved in the development of geothermal energy technology, community acceptance plays a critical role in supporting stakeholders in overcoming challenges and concerns (Syivarulli, 2020). Finally, market acceptance primarily concerns consumers, investors, and intra-firm relationships.

The common practice for enhancing social acceptance of geothermal projects includes engagement of local communities, prevention and mitigation of undesired effects, and creation of benefits for local communities (Karytsas et al., 2019). Social sustainability means that development must be aligned with society and local community views, values, and needs, as well as various forms of stakeholder and societal engagement activities and practices (Allansdottir & Pellizzone, 2019).

2.1 Significance of public acceptance of renewable energy technologies

Geothermal technologies and their impact on society, are particularly interesting because they address a wide range of issues, including environmental (i.e., water usage, drilling and exploitation risk, gas emissions), socioeconomic-political (i.e., procedural and distributive justice, public engagement in science, carbon lock-in debate, costs), and innovation-related (smart grids, prosumer role, new geothermal technologies), as Pellizzone et al. (2017) claim. How technology and its risks are perceived is a crucial factor in whether or not it is accepted by society (Dowd et al., 2011; Manzella et al., 2018).

During the 1980s, renewable energy (wind farm) studies focused on issues such as a lack of support among key stakeholders, policymaker reluctance to devote themselves to consistent and effective policies, and a lack of understanding of the roots of public attitudes toward wind power schemes, particularly the underrating of the critical importance of landscape issues in the attitude toward wind power schemes (Batel, 2020). The public became aware of environmental degradation, and policymakers began incorporating environmental concerns into models (Ribeiro, Ferreira & Araújo, 2011). Furthermore, concerns were raised about the social foundations of renewables in relation to the scale of the installations, as well as the options for ownership of installations and decentralized power supply (McDaniel, 1983; Wolsink, 1987). Nevertheless, the issue of social acceptance remained neglected mainly in the 1990s because of a high level of general public support for renewable energy technologies.

The respondents to a survey conducted by Ramírez et al. (2017), recognized that the most significant benefits of renewable energy development are reduced greenhouse gas emissions and increased energy independence through local production. Public opinion on different renewable energy sources is crucial for the design of future energy portfolios (Oluoch et al., 2020).

2.2 Social acceptance issues related to geothermal energy

Geothermal energy demands the resolution of social, political, and market issues (Soltani et al., 2021). The public, industry, stakeholders, and the media have a very close and interconnected relationship to enhance public acceptability, engagement, and awareness about geothermal energy. According to Nisbet (2009), the media significantly impacts public perceptions of emerging energy technology. Even people who are generally supportive of renewables do not support them without limitations, resulting in a disparity in approval between the general and the so-called local levels (Joe et al., 2016).

Numerous studies have demonstrated that geothermal energy does not have the same level of social acceptance as other renewable energy sources, such as solar and wind (Popovski, 2003). According to Sunil, Gupta, and Manish (2020), geothermal energy has a higher availability factor than solar energy, 2.2 times that of wind and 2.4 times that of biomass, underscoring the reliability of geothermal energy. Based on previous experience with wind and solar energy technologies, Cousse, Wüstenhagen, and Schneider (2020) and Jobin et al. (2019) argued that a good understanding of the public's emotive reactions to energy technologies is critical for anticipating indicators of public concern and, thus, reducing the risk of opposition. Because of the source's nature, fear adds to the lack of social acceptance of geothermal energy. Benefits are not immediately apparent in the early growth phases and appear to be balanced by detrimental environmental changes.

Attitudes regarding geothermal development generally shift as the project continues to the drilling stage and work on the plant begins. Ecosystems, human health, and the economy may all be negatively impacted by these actions. Environmental concerns may influence the public acceptability of geothermal energy. Early research has revealed that a lack of public awareness of the technology, inadequate media coverage, and concerns regarding potable water and perceptible seismicity during reservoir development and operation can influence public opinion (Dowd et al., 2011; Meller et al., 2018). Public opposition can significantly delay or even prevent the deployment of energy projects, particularly deep geothermal energy (Benighaus & Bleicher, 2019). Limited social acceptance has been linked to low levels of understanding and knowledge of the technologies and processes, including drilling operations, involved in Geothermal energy exploitation (Vargas Payera, 2018; Ibrohim, Prasetyo & Rekinagara, 2019). People have no set preferences for deep geothermal energy because it is still a relatively unknown technology (Blumer et al., 2018). In contrast to solar PV or wind, respondent preference for deep geothermal energy reduces dramatically when they are educated about the technology's possible implications (Volken, Xexakis & Trutnevyte, 2018). Environmental, economic, and political concerns are prominent in public debates concerning deep geothermal energy (Meller et al., 2018; Pelizzone et al., 2017).

Landscape changes and the alteration of natural features of cultural or religious significance caused by civil and industrial works, as well as changes in the use of public areas as a result of project activities, frequently elicit public outrage. Consequently, there are quite a few people considering geothermal energy to be costly, polluting, and potentially harmful to public health. Visual contact in the construction of drilling platforms for geothermal project development has been identified as an element that triggers public unease and anxiety (Vargas-Payera, Martínez-Reyes & Ejderyan, 2020). The creation of access roads through naturally preserved areas has also been highlighted as a socially criticized element of geothermal drilling operations.

Acceptance concerns of geothermal energy are predominantly documented in Europe (Benighaus & Bleicher, 2019; Dowd et al., 2011; Chavot et al., 2016; Pellizone et al., 2015) and on a smaller scale in Asia, as well. (Grigoli et al., 2018). Because of social opposition (mostly to odors), promising initiatives on the Greek islands of Milos and Nisyros were abandoned (Karytsas, Polyzou & Karytsas, 2019). In the USA, the AltaRock geothermal power project, located north of San Francisco, was similarly put down due to widespread opposition (Liu et al., 2018).

Several overviews have been published which discuss a wide range of risks associated with deep geothermal systems, such as the financial risk associated with the technology’s effective deployment, as well as more general difficulties relating to the location, scale, and impact of individual projects and their potentially associated consequences (Ryef & Ejderjan, 2021). The social acceptability of certain local residents concerned about environmental issues is one factor limiting the development of new geothermal projects (Manzella et al., 2018).

2.2.1 Induced seismicity

Although the likelihood of induced seismicity during the drilling phase of a geothermal project is very small (as discussed in D3.1), in discussions regarding the risks of deep geothermal systems, seismicity is frequently among the dominant topics (Knoblauch & Trutnevyte, 2018). Seismicity can be induced during both reservoir development and operation (Gischig, Wiemer

& Alcolea, 2014). Because geothermal power plants harvest geothermal heat by breaching the deep crustal layer, they may cause earthquakes (Zaunbrecher, Kluge & Ziefle, 2018), which has elicited negative public reactions (Liu et al., 2018; Manzella et al., 2018).

While noise is present in many emerging and established technologies, induced seismicity is a substantial and technology-specific obstacle to geothermal heat and power plants development (Meller et al., 2018; Spada, Sutra & Burgherr, 2021). This concept proposes locating projects in remote areas away from inhabited areas and infrastructure, where earthquake risks are low. Deep geothermal projects, on the other hand, work best when residual heat is utilized, which needs proximity to heat consumers and, thus, a more urban setting (Knoblauch, Trutnevytea & Stauffacher, 2019).

Seismic risk associated with deep geothermal projects has been at the forefront of public debate (Stauffacher et al., 2015; Pelizzone et al., 2017; Majer et al., 2007; Knoblauch, Trutnevytea & Stauffacher, 2019). Seismic incidents have brought the risk of induced seismicity to the attention of the public and operators (Mignan et al., 2017). Compared to deep geothermal projects, Trutnevyte and Wiemer (2017) found that the real risk and impact associated with shallow geothermal projects is substantially smaller.

The public perceives human-caused earthquakes to be worse than natural ones (McComas et al., 2016). Cousse, Trutnevyte, and Hahnel (2021) found that providing seismic risk information in a neutral versus a more negative, emotionally charged manner affected the desired results, spanning all of the different communication frames used to discuss geothermal energy projects. The findings reveal that information regarding the seismic risk of deep geothermal energy projects is crucial for public perception, especially if it is presented negatively and directed toward people who consider their knowledge of geothermal energy to be low. Knoblauch, Trutnevytea and Stauffacher (2019) have suggested that *"policies to reduce the risk of induced seismicity must be given the highest priority to enable an open dialogue"*.

Liu et al. (2018) cite a number of case studies of man-made seismicity related with deep geothermal applications in their study, including the hot dry rock tests at Fenton Hill in New Mexico (Pearson, 1981; Ferrazzini et al., 1990), Geysers in California (Majer and Peterson, 2007), and Cooper Basin (Zang et al., 2014). Edwards et al. (2015) and Trutnevyte and Wiemer (2017) investigated two deep geothermal pilot projects in the Swiss cities of Basel and St. Gallen that resulted in earthquakes, minor building damage and damage of 9 million USD (Knoblauch, Trutnevytea & Stauffacher, 2019). These occurrences, according to Ejderyan, Ruef, and Stauffacher (2019), marked a turning point in the media's debate of geothermal energy in terms of danger in Switzerland, and posed additional challenges in terms of public and political acceptance for an ongoing Swiss deep geothermal project in Haute-Sorne, Jura (Cousse, Trutnevyte & Hahnel (2021).

Because of public opposition generated by induced seismicity occurrences related with reservoir stimulation, the Basel deep geothermal project was abandoned (Majer et al., 2007). The findings of Cousse, Trutnevyte and Hahnel (2021) suggest that knowledge, even if provided negatively (e.g. costs and injuries associated with seismic risk), might positively influence personal attitudes about geothermal energy. This is especially true for individuals who consider their understanding of geothermal energy to be limited. Furthermore, it was shown that portraying seismic risk in a negative light – such as in the media or through oppositional party-led movements – has a negative impact on public perceptions of the

technology and may lead to a spillover of seismic risk perception from deep geothermal to less risky shallow geothermal projects. Although these incidents impacted geothermal growth in Switzerland, they did not result in abandonment (Ryef & Ejderjan, 2021). Public protest and opposition, on the other hand, can lead to the abandonment of deep geothermal energy projects (Knoblauch, Trutnevytea & Stauffacher, 2019). In Germany, induced seismic events linked with the Landau (M_w=2.7) deep geothermal energy project, triggered public outrage (Kunze & Hertel, 2017) and the establishment of citizen initiatives (Breede et al., 2013; Knoblauch, Trutnevytea & Stauffacher, 2019).

The Pohang earthquake (M_w=5.5) (Ellsworth et al., 2019) drew a lot of media attention because earthquakes do not happen very often in the Korean peninsula. Despite initially being considered as a natural disaster, the Korean government referred to the event as a "triggered earthquake" rather than a "caused earthquake" (Im et al., 2021). A triggered earthquake is an earthquake that was induced by anthropogenic activities, but occurred outside of the spatial area that could be attributable to human activities alone. As a result, extensive coverage in national and local newspapers may have influenced public perception of geothermal power plants. This led to a much more unfavorable impression of geothermal energy after the Pohang incident in the local than the national sample. The public preference for geothermal energy was negatively related to proximity to the epicenter of the earthquake.

Despite a favorable national atmosphere for renewable energy, local reactions are frequently much less favorable (Baek, Chung & Yun, 2021). Moore and Hackett (2016) also noticed that, in contrast to generally good public perceptions, the location of renewable energy installations has occasionally sparked local opposition. Following the Pohang earthquake in 2017, the previously positive media framing based on environment and technology shifted dramatically to a negative framing based on risk. This is attributed to the fact that Enhanced Geothermal System (EGS), which has allowed the utilization of geothermal resources in deeper geological layers (Spada, Sutra & Burgherr, 2021), may have triggered the earthquake, despite not being the primary cause.

2.2.2 Other concerns

Social concerns can be linked to other possible impacts of geothermal development such as impacts on air quality, noise, visual intrusion and water contamination.

The geothermal fluid content, as well as geothermal plants and natural manifestations, affect air quality in geothermal areas (Manzella et al., 2018). According to Ratio, Gabo-Ratio, and Fujimitsu (2020), the most significant environmental concern associated with geothermal development in the Philippines is air pollution. During drilling operations, a variety of other environmentally significant emissions are also liberated into the atmosphere, depending on site-specific conditions.

Noise is another issue of high importance, especially in cases where geothermal drilling operations take place in the vicinity of urban areas, due to public disturbance it can cause. However, this disturbance takes place for the limited amount of time that geothermal drilling operations are conducted and noise is considered a localized impact of geothermal development (Tarlock & Waller, 1977).

Visual impact mitigation is becoming increasingly crucial, and new plants are designed to blend in with the surrounding environment (Manzella et al., 2018). Landscape disturbances (such as land removal and the construction of access roads) caused by geothermal drilling (exploration,

production and restoration) have aesthetic and visual implications. When intense deep geothermal production needs a large number of wells, the construction of drilling sites and access infrastructures, particularly in wooded areas, can deface landscapes. However, the visual impact of drilling activities is anticipated to be minor and transient, as drilling towers are only present during the drilling phase (Finger & Blankenship, 2010).

If the proper plant construction and operating criteria are not followed, water quality, quantity, and subsurface circulation may suffer (Manzella et al., 2018). Issues related to hydrosphere include water consumption during drilling, surface and stormwater runoff, thermal and chemical pollution of surface waters and contamination of groundwater (however unlikely it may be).

2.3 Published literature on geothermal energy and public acceptance

This report attempts to analyze the (generally low) social acceptance of geothermal energy and identify potential solutions for changing the situation. Although geothermal energy is regarded as a promising renewable energy source, its development is obstructed by several obstacles, the most significant of which is social opposition (Bertani, 2016).

The literature on social acceptance of geothermal energy is still limited, but it is expanding globally (Pelizzone et al., 2017). Public attitudes toward the uses and development of geothermal energy are highly differentiated; in fact, attitudes change over time and vary by location. More and more incidents of local societal resistance have been noticed in recent years as the number of actual site selections for geothermal power, and direct geothermal consumption has grown (Reith et al., 2013).

Pelizzone et al. (2015) presented the findings of an assessment of public opinion on potential geothermal energy development in Sicily. The findings revealed that public awareness of this energy source could be higher. The issue is clouded in uncertainty, and the Sicilian public has expressed a general lack of trust in decision-making processes. The findings further demonstrate the need for additional societal dialogue, backed by a solid communication action strategy, as the first stage in public participation. In a follow up study, Pelizzone et al. (2017) researched resident engagement with geothermal energy harnessing in central Italy. The results showed general support for renewable energy, but knowledge and understanding of geothermal potential were meager. Lack of trust in politics and unsure public communication emerged as prominent themes where the common good and community development are sharply contrasted with corporate and private interests.

Dincer and Acar (2015) researched clean energy solutions to achieve greater sustainability, as well as opportunities and challenges from various perspectives, including social, economic, energetic, and environmental aspects. The goal was to identify the improvement potential for each option considered by ranking energy sources based on technical, economic, and environmental performance criteria. When non-air pollution criteria such as land use, water contamination, and waste issues were taken into account, the power generation ranking shifted, with geothermal performing best (7.23/10) and biomass performing worst (3.72/10). When heating and cooling modes are considered useful outputs, geothermal and biomass perform similarly (as 4.9/10) in terms of technical, environmental, and cost performance, while solar performs the worst (2/10). The survey concluded that geothermal energy is one of the most sustainable renewable energy options.

Because geothermal energy is a lesser-known alternative to solar energy, it is almost non-existent in Chile, despite the country's exceptional geological characteristics for geothermal energy development, according to Syivarulli (2020). The El Tatio Well incident in 2009 drew widespread media attention and resulted in unfavorable public perceptions of geothermal energy due to a 27-day substantial leak. Despite the fact that the Chilean Ministry of Environment stated that the geysers did not cause the incident's likely impacts, the El Tatio project was canceled due to the company's failure to meet environmental and safety regulations (Lahsen et al., 2015).

Vargas Payera's (2018) research, conducted near the Villarrica Volcano in Chile's Araucania region, illustrates this opposition. A risk communication approach was used, which included extensive semi-structured interviews with local stakeholders. A lack of understanding of the technology involved in geothermal energy production, as well as social barriers such as a scarcity of resources were established. It was concluded that participants lack understanding and negative attitudes toward geothermal energy for electricity generation. The study concluded that geothermal technology has low social acceptance in the Villarrica community, as well as a high-risk perception.

Following three distinct events, media interest in geothermal technologies peaked in Switzerland. The earthquakes in Basel in 2006 (M_w=3.4 induced during a well stimulation) (Mignan et al., 2015) and St. Gallen in 2013 (M_w=3.5) (Edwards et al., 2015), both of which were allegedly caused by geothermal exploitation activities, as well as the halting of the Triemli deep drilling geothermal project in Zurich in 2010 for technical and economic reasons. Media articles published in two major Swiss newspapers between 1997 and 2013, were examined by Stauffacher et al. (2015). The pro and con arguments for deep geothermal energy were grouped into four major categories: energy transition, risks, technology, and costs. The most common themes were energy transition and risks. The study was concluded by emphasizing the importance of transparency and public participation in the siting of future geothermal projects. There is a trade-off to be made when sitting deep geothermal energy projects, between lowering the danger of induced seismicity and optimizing the benefits of deep geothermal energy, such as price competitiveness and CO_2 savings (Knoblauch, Trutnevytea & Stauffacher, 2019).

The effect of informing the Swiss public about the seismic risk associated with deep geothermal projects on emotions, attitudes, and perceptions of risks and advantages for both deep and shallow geothermal projects was investigated by Cousse, Trutnevyte and Hahnel (2021). The study concluded that project developers and policymakers should emphasize the benefits of geothermal energy in terms of energy independence. Furthermore, they should help to reduce the perceived value of fossil fuels and nuclear energy as people become more aware of seismic risk and its consequences.

In 2013, an Internet-based public awareness and opinion survey of Québec residents by Malo et al. (2015) investigated their views on energy, focusing on their knowledge and attitudes toward deep geothermal energy. The main concerns of Québec's population linked to a deep geothermal energy project were groundwater pollution and soil contamination. It seems that a sort of NIMBY syndrome was a less important obstacle than the concerns linked to hydraulic fracturing. Potential obstacles toward the social acceptability of a deep geothermal energy project are of environmental nature.

The study by Barich et al. (2022) adds to a better understanding of social license in the geothermal sector by shedding light on the practices and problems that influence the acquisition and maintenance of Social License to Operate (SLO) in geothermal energy projects and initiatives. The overall purpose of a geothermal SLO as an ethical notion is to build trust and transparency bridges between the geothermal industry and communities, as part of an attempt to create mutual benefits and social capital. It was concluded that geothermal energy has the potential to offer significant value to the socioeconomic fabric as a domestic resource, especially in the context of the global energy transition.

Considering that geothermal energy technology is still relatively undeveloped in Australia (Syivarulli, 2020), the findings of a participatory action research methodology used to engage broad groups of Australian citizens were presented in a study by Dowd et al. (2011). The workshop method, which included the distribution of information and the facilitation of discourse, effectively raised public familiarity with technologies, including emerging geothermal technology, as evidenced by an increased self-rated understanding of geothermal technology. Participants raised concerns about geothermal technology, specifically water consumption and the potential for seismic activity due to drilling methods. Participants also requested more information about the technology, particularly from the industry.

Carr-Cornish and Romanach (2014) discovered a positive shift in perspective once Australian participants got information and understanding about the new technology, noting that the shift is noticeable even when worries about groundwater pollution or induced seismicity are expressed. The findings show that when a geothermal project is considered in the immediate area, the favorable opinion of the affected population reduces, resulting in the NIMBY phenomenon. As a consequence, the site of projects will be a key factor, and the criteria of acceptability will likely differ among community members. The findings also emphasize the significance of responding to public concerns about technology hazards and indicate the role of policymakers and the industry in engaging Australians before a large-scale demonstration.

Carr-Cornish, Muriuki and Romanach (2015) used existing research on factors that influence public acceptance to identify the advantages and hazards that have been documented and the social actors involved. Observing how a developing energy technology, such as geothermal energy technology in Australia, has been reported in the media is one approach to gathering insight into social acceptance. The most commonly stated geothermal technology risks were economic or scientific. The most frequently highlighted issues were economic feasibility and uncertainty regarding the technology, rather than potentially more contentious concerns such as seismicity, electricity costs, water, and noise pollution, which were identified in the literature.

A survey conducted by Ibrohim, Prasetyo, and Rekinagara (2019) sought to highlight the public's understanding of geothermal energy and how it influences their perceptions and preferences for its expansion in Indonesia. Most of the residents were farmers worried about the potential adverse effects of a geothermal project on Mt. Lawu, mostly related to water availability. Some people were willing to die to stop the development of geothermal energy. According to the survey, socialization caused negative impressions in society, which resulted in the rejection of geothermal projects. Because the community lacks a thorough understanding of the relationship between geothermal utilization and its direct and indirect benefits, they believe the program benefits only a few parties while ignoring the local community.

Much geothermal energy sociological research examines how society perceives the construction of a geothermal power plant through questionnaire surveys and focus groups (Chavot et al., 2018). Such a bilingual (French/English) Internet-based survey for an international panel (including France) was presented in a study by Ramírez et al. (2017). Geothermal energy was found to be the third most well-known renewable energy on the survey's list. Solar and wind energy have been identified as being more well-known and widely accepted than geothermal energy. Geothermal energy had a high level of acceptance, comparable to tidal energy and hydroelectricity. After reading a text explaining how deep geothermal energy can be used to generate electricity, most respondents supported this type of electricity production and the installation of a pilot project in their region. When stimulation was introduced as a technique that is occasionally used in deep geothermal energy, the level of support dropped significantly. However, the majority of respondents were still in favor of deep geothermal energy and a pilot project.

To describe the level of awareness and acceptance of deep geothermal energy at various stages of geothermal development, an online survey by Balzan-Alzate et al. (2021) was conducted among post-secondary students and professionals in two European (including France) and three American countries Even when hydraulic stimulation was taken into account, each country had a favorable attitude toward a geothermal project. Environmental concerns and community safety were determined to be the two most important issues that must be addressed in order to support a pilot geothermal project.

Chavot et al. (2019) researched opinions on deep geothermal energy in urban and rural Strasbourg with questionnaires. Residents were found to believe that deep geothermal energy could cause seismicity, ground deformation, noise, and various pollution issues.

Puppala et al. (2022) reviewed the literature and identified twenty-eight barriers to harnessing geothermal energy in India. An expert panel of researchers working in the field of geothermal energy in India responded to a questionnaire comprising all the identified barriers. They were then asked to assess each barrier's acceptability in the context of India. The resource barrier was recognized as the most crucial barrier category, while social barriers came in fifth, related to the fear of customer acceptability and a lack of understanding of the benefits and pitfalls of geothermal energy.

An exploratory study to identify and understand the issues that are likely to affect geothermal energy technologies and projects in Australia was conducted by Carr-Cornish and Romanach (2012). They used a mix of media analysis, online and face-to-face focus groups, and a questionnaire distributed during focus groups to investigate public attitudes toward geothermal energy. Participants were unable to distinguish between different types of geothermal resources and uses, but presenting them with science-based knowledge and group discussion increased their support for the technology. There were concerns about the engineering of geothermal systems and the potential for adverse consequences. It was agreed that the general public should be consulted before specific projects in their area are implemented.

Finally, a questionnaire survey by Liu et al. (2018) showed that although highly educated people have substantial sociopolitical support for geothermal energy production, geothermal energy is less well-known among the general public, especially in comparison to solar and wind energy. For consumers and government investors, however, market acceptance of

geothermal power and direct consumption (e.g. geothermal heating systems and residential hot water from geothermal sources) was high.

Many studies have developed recommendations aiming to lift the social barriers to accepting geothermal development in the literature. In their research Shoedarto et al. (2016) developed a list of actions to address the social barriers that prevent local communities from accepting geothermal development. These actions include educating the local community about the advantages of widespread local geothermal direct utilization through incorporating geothermal energy into daily life. Such beneficial actions also include the development of partnership schemes with the local community, the dissemination of accurate information in an understandable and culturally appropriate manner, as well as the education of community residents about the presence and benefits of geothermal energy.

According to Stauffacher et al. (2015), policymakers and project developers should pay special attention to how the media portrays the technology, so that any fears or concerns can be addressed early. Cousse, Trutnevyte and Hahnel (2021) advise policymakers that early communication is critical to avoid a drop in acceptance. The social acceptance of an energy technology is also influenced by public uncertainty and information gaps. Vargas Payera (2018) argued that encouraging active dialogue among stakeholders could provide fertile ground for conducting an empirical study of social attitudes toward geothermal energy.

2.4 Energy tribes

There is a diversity of attitudes towards the consequences arising from the policies intended to manage climate change and mitigate global warming. These have been underscored by a couple of research publications that wrote about “energy tribes”, but have received little attention over time.

Thomson (1984) wrote of the existence of three such groups in society: business as usual, middle of the road, and radical change now. Caputo (2009) wrote of the existence of four such ways of thinking in society: egalitarianism, individualism, fatalism and hierarchy. Membership in different energy tribes reflects overlapping sets of rationality, different sets of beliefs, and different cultural values. People in different energy tribes place different bounds on what is credible/incredible, possible/impossible, sensible/foolish and rational/irrational. As a result, they have different attitudes and beliefs, and accept different solutions.

Since policies can move forward only if embraced by a large majority for a long time, the existence of energy tribes means that only “messy” or “clumsy” policy solutions, combining the logic of different energy tribes, have a chance of working.

3 Methodology

3.1 Goal and research questions of survey

The empirical survey dealt with in this report aims to identify social attitudes toward geothermal energy drilling and how the project’s technological advancements may serve social demands. In particular, this survey seeks to identify the social perceptions that result in environmental/energy societal tribes, how they perceive the ORCHYD project, and how these tribes might adopt a more favorable stance towards geothermal energy.

3.2 Structure of questionnaire

The survey is composed of 65 question items, with many of these being items requiring respondents to declare their level of agreement on a 6-point Likert scale with respect to attitudes regarding the technological, environmental, material, energy, socioeconomic, cultural, institutional, and (geo)political aspects and impacts of geothermal energy and (deep) geothermal drilling. The questions were intended to be clear and straightforward so that technical terms or phrases would not influence the responses.

Section 1 of the questionnaire contains background information. Section 2 is based on the findings of deliverable D3.1 on the environmental impacts of geothermal energy and drilling. Sections 3 to 5 are designed based on the triangle of social acceptance, as proposed by Wüstenhagen, Wolsink, and Bürer (2007). Sections 2-5 include questions requiring respondents to rank on a 6-point Likert scale their attitude toward geothermal energy's technological, environmental, material, energy, socioeconomic, cultural, institutional, and (geo)political aspects and impacts.

The complete questionnaire is presented in Appendix E.

3.2.1 Section 1 (Background information)

The aim of Section 1 was to gather anonymous background and sociodemographic data such as gender, age, marital status, educational background, professional experience, annual income, country and city of residence, energy consumer type, familiarity with geothermal exploration and development.

These inquiries are centered on factors that may impact individual behavior regarding energy procurement. Key determinants include age, income, level of education, residence country, the population density of the surrounding area, and type of energy consumer.
Personal information and data obtained from questionnaires were managed in accordance with Deliverable 10.3 (D10.3) "H - Requirement No. 3."

3.2.2 Section 2 (Environmental concerns)

The section on environmental concerns was based on D3.1, which was included in the Environmental impact assessment (Task 3.1). The questions were also developed in response to the findings of an internal questionnaire designed to help finalize the importance of environmental issues to be addressed in the ORCHYD Environmental Assessment Report.

The assessment of environmental impacts was categorized in four distinct spheres of impact. Issues related to environmental impacts on lithosphere, including subsidence, seismicity, soil profile, groundwater, land use, visual intrusion and liquid and solid waste were extensively analyzed. Issues related to environmental impacts on hydrosphere including wastewater treatment and water quality and quantity for geothermal drilling operations were presented in detail. Greenhouse gas emissions, local air pollution, odors and noise issues were assessed as a part of the analysis of environmental impacts on the atmosphere. Lastly, environmental impacts on the biosphere including ecosystems, health and socioeconomic impacts, energy security and consumption and material use were presented.

The questionnaire also includes questions about the urgency of specific environmental concerns and their impact on the overall impact of the existing energy production model. Environmental concerns include air and noise pollution, aesthetic degradation, and the

degradation and/or depletion of water resources in the case of geothermal development in the respondent's area.

3.2.3 Section 3 (Sociopolitical issues)

Sociopolitical acceptance is the broadest and most general form of social acceptance. Both policy and technology require societal acceptability. This relates to the approval of effective policies by major stakeholders and policy actors at the most fundamental level of sociopolitical acceptance. The construction of frameworks that successfully encourage and enhance market and community acceptance is required under these policies. Such policies may include the creation of solid financial procurement systems that open up new investment opportunities and spatial planning systems that promote collaborative decision-making.

Section 3 contained questions about sociopolitical issues related to geothermal development. Initially, respondents were asked to rate the urgency of global issues such as terrorism, the economic and pandemic crises, poverty, and environmental concerns. The importance of environmental regulations in developing effective strategies for sustainable energy systems, as well as knowledge of recent initiatives to promote more sustainable energy generation and consumption were also questioned.

Respondents were asked to rank the importance of energy-related issues and select who should decide on geothermal exploration and drilling. Future impact and trust in energy sources, as well as the role of actors in the energy selection process, were also examined. Acceptance and support for a geothermal energy exploration project were investigated by rating conditions such as public safety, environmental protection, employment and community awareness, consultation, or compensation.

Two separate questions polled the significance of the media. Respondents were asked how frequently geothermal news appeared in their country's media. They were also asked to rank commonly used terms in geothermal energy debates such as economy, climate change, geothermal potentials, and national, energy, or ecological security. Finally, respondents were asked about using geothermal energy to generate electricity and heat in their country.

3.2.4 Section 4 (Community acceptance)

Community acceptance refers to local stakeholders including residents and local governments. On the NIMBY issue, some have argued that the difference between general acceptance and opposition to specific projects can be explained by the fact that people support renewable energy as long as it is not located in their own backyard, while others argue that this is at best an oversimplification of people's true motivations. According to Wolsink (2007), the typical pattern of local acceptability before, during, and after a project follows a U-curve, with high approval throughout the siting phase (typically still favorable on average), and then returning to a higher degree of acceptance once the project is up and running.

The first question about community acceptance focused on the respondent's knowledge of geothermal energy. Respondents were asked to rank geothermal energy exploration concerns about facility location, societal risks and benefits, environmental impacts, and public concerns. Insufficient service maturity, hidden/unknown costs, switching inconvenience, and issues of credibility, transparency, and trust were listed as factors that could deter respondents from switching to a geothermal-only energy supply.

The following questions asked respondents how concerned they were about geothermal drilling near their property and how influential or trusted selected factors would be if they were considering purchasing energy from deep geothermal sources in their area or switching energy suppliers. The level of concern about energy plants/installations in their area, such as fossil fuels, nuclear power, and RES, including geothermal energy, was also included in the questionnaire. Specific aspects of geothermal drilling that respondents might be concerned about (greenhouse gas emissions, landscape impacts, infrastructure impacts, induced (micro)seismicity, water aquifer-related risks, and legal transparency), were also included in the poll.

Respondents were asked to rank how receptive they would be to geothermal drilling in their area if monitoring offering safety assurance, electricity cost reductions, increased employment, control by public institutions, and compensation for local residents were true. Respondents were also asked to rank several geothermal drilling-related factors drawn from D3.1 in terms of their contribution to public concern about deep geothermal drilling in their region.

Four questions at the end of this section were dedicated to earthquakes, because seismicity was deemed the most important factor preventing people from accepting geothermal energy. The earthquake experience and how unpleasant it was, the characterization of the place of residence (seismic or not), and finally, how much a potential earthquake would affect their perspective on geothermal development in their area were the most important determinants. Finally, respondents were asked whether they would actively oppose geothermal drilling operations in their area.

3.2.5 Section 5 (Market acceptance)

Market acceptance refers to the process of an innovation being adopted by the market, regarding both consumers and investors. Intra-firm acceptability of renewable energy innovations is a related issue, and the market is linked to socio-political acceptance.

In Section 5, respondents were asked whether their country provides any public incentives or facilitating measures to help consumers transition to geothermal energy. They were also asked to describe the quantity of incentives or facilitating measures available in their country to assist customers in making the transition to geothermal energy.

Respondents were also asked to rank the importance of factors like economic benefits, social benefits, community awareness, and environmental benefits in switching to a geothermal-only energy provider. Finally, they were asked how the knowledge that geothermal energy is less expensive than conventional energy sources may affect their opinions towards geothermal drilling.

3.3 Survey distribution

The questionnaire development and distribution was planned in three stages: focus group, pilot survey, and final survey.

3.3.1 Focus group

During this first phase, the questionnaire was distributed to the UPRC team to clarify and test whether the survey included the findings of the first phase of Task 3.2's literature review.

The most significant findings from this phase related to the length and language of the questionnaire. The transition to the second phase was made after the findings were corrected.

3.3.2 Pilot survey

Before posting it online, the questionnaire was pilot-tested with a sample of 21 respondents in order to shorten, simplify, and improve its structure and readability, as well as boost its coherence and consistency.

During the pilot phase, the questionnaire, initially designed in English, was also translated into French to ensure the greatest possible participation by French-speaking respondents. Furthermore, the questionnaire was created in Google Forms and then copied to Microsoft Forms to provide access to respondents in the People's Republic of China, where Google is not available.

Following the improvements mentioned above, the questionnaire was made available to ORCHYD's partners in its final form (as included in Appendix E).

3.3.3 Final survey

The partners were tasked with disseminating the final questionnaire, preferably to diverse communities in their respective countries. The survey was administered to a diverse sampling framework of people in the five countries where the project's partners are located: Association pour la Recherche et le Developpement des Methodes et Processus Industriels (France), Imperial College London (United Kingdom), SINTEF AS (Norway), Drillstar Industries (France), University of Piraeus Research Center (Greece), and China University of Petroleum (East China) (China).

Some of the respondents were likely to have a background in engineering and/or geoscience subjects or to be familiar with those fields, which would facilitate comprehension of the survey.

3.4 Software tools

Several software tools were used for the graphical, descriptive, and inferential analysis of the pilot and final survey. Data storage and management was done in Microsoft Excel and Google Sheets. R was utilized for the analysis of the pilot questionnaire, while Minitab, Statgraphics, SPSS, and the gretl freeware econometric program (https://gretl.sourceforge.net/) were used for the analysis of the final (full) survey.

4 Results

4.1 Introduction

The results of the analysis of responses to the online questionnaire are presented in this section of the report.

Section 4.2 presents (in summary form) the analysis of the 21 responses to the pilot questionnaire, while Section 4.3 presents the analysis of the 100 responses to the final survey, which were collected in June and July 2022.

4.2 Analysis of pilot questionnaire

The pilot questionnaire was designed as a preliminary test for creating the final questionnaire. It further played a key role in the identification of vulnerabilities in the final version of the questionnaire. The full list of questions was modified a few times after discussion with other partners and based on the recommendations of an informal expert panel. The analysis of the

21 responses was carried out with R and Minitab and is omitted from this report for brevity (although it is available separately).

The pilot questionnaire analysis produced graphs with multimodality, symmetries, skew tendencies, and uniformities. Given the nature of the pilot questionnaire, it was critical to identify the issues where opinions concur and the presence of various clusters in others where opinions disagree.

Bimodality seems to be present in a series of graphs such as age, professional experience, familiarity with geothermal energy and others. Out of 21 respondents, 8 identified as females and 13 as men, with the majority being between the ages of 30 and 39 and having fewer than 3 years of professional experience. The majority of responses were from Greece, and the majority of respondents were householders who resided in densely populated areas. Most of the respondents appeared to be familiar with geothermal energy exploration or development; however, a smaller group appears to have little or no experience.

The influence of noise pollution on public perception of geothermal drilling was divided into two groups, one claiming a moderately high impact and the other claiming a moderately minor impact. The question of the urgency of climate change followed a similar trend. According to the responses, water issues were of great concern. Two groups with opposing viewpoints were present in responses on the urgency of poverty.

The necessity of reducing greenhouse gas emissions and developing renewable energy displayed a geometrically climbing slope toward the most significant rating. The relevance of energy accessibility was similar to related items; however, the importance of energy price stability was divided into two clusters, one extremely high and another moderately high. The importance of hydropower in the next few years was divided into two clusters: low and slightly high, with the majority of respondents agreeing that it would grow, displaying a similar distribution to the item on geothermal energy. Biomass had a nearly symmetric distribution between low and extremely high importance. Hydrogen had two response clusters, one smaller and one larger, the first stating that its relevance will be small and the latter that it will be significant.

The EU's importance in the energy selection process had a rather symmetric distribution shape around somewhat high values, while the role of national governments was deemed crucial. However, confidence in the EU had a larger variance, with two clusters positioned around slightly lower and higher. Still, trust in national governments had a lower variation, with two clusters positioned around slightly lower and higher as well. On the other side, respondents had extremely low to slightly low faith in print and broadcast media. The importance of energy independence and efficiency was quite high, as was the relevance of energy availability and price.

The majority of respondents placed a high value on the environmental implications of energy systems. The distribution of public safety and environmental protection for geothermal energy exploration was increasing geometrically. The importance of community awareness for geothermal energy development was characterized by a small cluster centered on slightly low and slightly high values. Furthermore, there was little hearing about geothermal energy and its potential in the national news.

Most respondents were optimistic about geothermal energy being used to create power and heat in their country. Most respondents were concerned about constructing fossil fuel and nuclear power stations near their homes. Wind and geothermal energy projects appeared to be the least worrisome, followed by solar energy projects. In the instance of geothermal energy project development using hydraulic stimulation, a small cluster of extremely negative opinions and a larger cluster of positive and very favorable opinions were present. Risks and advantages as well as public health and safety were highlighted as problems of moderate to high relevance for geothermal project development. The two significant causes of worry for geothermal energy production were induced seismicity and water/aquifer-related concerns. This can be attributed to the fact that most respondents (thought they) lived in earthquake-prone locations. According to most respondents, lower electricity costs might boost public acceptance of geothermal drilling. Finally, the majority of responders would not actively oppose geothermal drilling in their region.

4.3 Analysis of final questionnaire

The results of the analysis of the 100 responses to the final survey commences with the presentation of the variables that resulted from its many question items.

4.3.1 Survey variables

The complete list of variables of the final survey with basic descriptive measures is tabulated in Appendix A. The variables from the various sections of the questionnaire are presented into different tables for easier inspection. These tables contain a description of each variable (with the name used in figures and statistical analysis tables in CAPITAL LETTERS), the number of nonmissing cases (in the column entitled N), and certain descriptive measures appropriate for the variable type, e.g. the mean, the mode (i.e. the most frequent values), the standard deviation, as well as the minimum and maximum values for quantitative variables. The distribution and descriptive measures of each variable are discussed in the next section of this chapter.

As will be detailed in forthcoming section, to avoid further limiting the sample size, variables with missing cases are omitted for certain analyses. The discussion of the reliability or internal consistency of the questionnaire is discussed in Section 4.3.3 of this report.

4.3.2 Descriptive analysis

The graphical analysis of the variables of the final questionnaire is presented in Appendix B, which includes sections on background (demographic), environmental, sociopolitical, community, and market related concerns.

Based on the descriptive (Appendix A) and graphical (Appendix B) analysis of the variables, it is concluded that the data appear to be grouped into two or three clusters.

4.3.2.1 Highest and lower rankings

Having looked at the variables of the sample graphically and descriptively, attention now turns to some interesting rankings. Table 4.1 provides a listing of all ranking variables ordered by decreasing mean value (average).

Table 4.1. Rating variables sorted by decreasing mean value

	Variable description	*N*	*Mean*	*Standard deviation*
Rating≧5				
1	Importance of energy efficiency (1~6)	100	5.24	0.9224
2	Importance of energy availability (1~6)	100	5.1	0.8587
3	Importance of energy independence (1~6)	100	5.09	0.9857
4	Importance of environmental impacts of energy (1~6)	100	5.06	1.118
5	How do you feel about heating generated from geothermal	100	5.06	1.162
6	Environmental protection important for acceptance and support of geothermal projects (1~6)	100	5.03	1.087
7	Public safety important for acceptance and support of geothermal projects (1~6)	100	5.01	1.15
4.99≧Rating≧4.5				
8	How convincing would reliability of energy supply be if you were considering purchasing energy from deep geothermal (1~6)	100	4.99	1.049
9	How influential would economic benefits be in switching to geothermal energy provider (1~6)	100	4.99	1.078
10	Importance of environmental impacts in involving local communities in geothermal exploration (1~6)	100	4.98	1.101
11	How convincing would environmental benefits be if you were considering purchasing energy from deep geothermal (1~6)	100	4.95	1.209
12	Importance of development of renewable energy (1~6)	100	4.93	1.249
13	Total impact of energy production model on environment (1~6)	100	4.92	1.002
14	Importance of pollution reduction (1~6)	100	4.92	1.041
15	Importance of environmental regulations in promoting strategies for sustainable energy (1~6)	100	4.91	1.12
16	Urgency of water shortages (1~6)	100	4.89	1.23
17	Importance of development of renewable energy (1~6)	100	4.89	1.163
18	How convincing would economic benefits be if you were considering purchasing energy from deep geothermal (1~6)	100	4.89	1.205
19	National governments important in energy selection (1~6)	100	4.88	1.233
20	Concern about fossil fuel installations built in your area (1~6)	100	4.87	1.361
21	Importance of energy accessibility (1~6)	100	4.86	1.025
22	Urgency of climate change (1~6)	100	4.84	1.522

	Variable description	*N*	*Mean*	*Standard deviation*
23	Importance of risks and benefits to society in involving local communities in geothermal exploration (1~6)	100	4.82	1.095
24	How influential would environmental benefits be in switching to geothermal energy provider (1~6)	100	4.82	1.175
25	Importance of energy affordability (1~6)	100	4.81	1.012
26	Trust in academic/research/expert publications to help you decide to switch energy suppliers (1~6)	100	4.81	1.269
27	Urgency of food shortages and famine (1~6)	100	4.8	1.172
28	Importance of mitigation of greenhouse gas emissions (1~6)	100	4.8	1.295
29	Importance of diversification of energy supply (1~6)	100	4.8	1.198
30	Urgency of river and seawater pollution (1~6)	100	4.79	1.225
31	Importance of concerns about public health and safety in involving local communities in geothermal exploration (1~6)	100	4.79	1.225
32	Importance of energy price stability (1~6)	100	4.76	1.084
33	How receptive to geothermal drilling in your area would electricity cost reductions make you (1~6)	100	4.74	1.16
34	Significance of impact of nuclear on our way of life (1~6)	79	4.734	1.402
35	Urgency of air pollution (1~6)	100	4.72	1.326
36	Importance of energy conservation (1~6)	100	4.69	1.228
37	Do you understand geothermal	100	4.68	1.222
38	Does the lower cost of geothermal (compared to traditional energy) affect your attitude towards geothermal drilling	100	4.68	1.091
39	Concerned about environmental impacts regarding geothermal drilling near your property (1~6)	100	4.67	1.45
40	Urgency of temperature increase (1~6)	100	4.59	1.609
41	Contribution of groundwater contamination to public concern about deep geothermal drilling in your area (1~6)	100	4.59	1.248
42	Urgency of decline of biodiversity (1~6)	100	4.57	1.358
43	Degradation/depletion of water resources affect attitude towards geothermal in your area	100	4.55	1.184
44	EU important in energy selection (1~6)	100	4.55	1.359
45	Significance of impact of natural gas on our way of life (1~6)	79	4.544	1.249
46	Importance of concerns about facility location in involving local communities in geothermal exploration (1~6)	100	4.53	1.123
47	How receptive to geothermal drilling in your area would monitoring offering safety assurance make you (1~6)	100	4.53	1.235
48	How do you feel about electricity generated from geothermal	100	4.52	1.46

	Variable description	*N*	*Mean*	*Standard deviation*
49	Concerned about water aquifer risks of geothermal drilling (1~6)	100	4.52	1.41
50	Concerned about public health regarding geothermal drilling near your property (1~6)	100	4.5	1.58
4.49≧Rating≧4				
51	Urgency of waste disposal (1~6)	100	4.47	1.275
52	Scientists and researchers important in energy selection (1~6)	100	4.47	1.329
53	Urgency of extreme weather conditions (1~6)	100	4.44	1.472
54	Contribution of induced seismicity to public concern about deep geothermal drilling in your area (1~6)	100	4.43	1.373
55	Urgency of poverty (1~6)	100	4.42	1.257
56	Significance of impact of solar on our way of life (1~6)	100	4.42	1.35
57	Community awareness important for acceptance and support of geothermal project (1~6)	88	4.42	1.238
58	Contribution of water use to public concern about deep geothermal drilling in your area (1~6)	100	4.42	1.273
59	Concerned about safety regarding geothermal drilling near your property (1~6)	100	4.41	1.505
60	Significance of public acceptance of geothermal (1~6)	100	4.35	1.29
61	Significance of impact of hydropower on our way of life (1~6)	100	4.35	1.403
62	Urgency of soil pollution/contamination (1~6)	100	4.34	1.281
63	Community consultation important for acceptance and support of geothermal project (1~6)	100	4.34	1.216
64	How much would hidden/unknown costs deter you from switching to geothermal only (1~6)	100	4.34	1.273
65	Opinion about geothermal project with hydraulic stimulation	100	4.33	1.557
66	Urgency of exploitation of natural resources (1~6)	100	4.29	1.486
67	Contribution of soil contamination to public concern about deep geothermal drilling in your area (1~6)	100	4.28	1.296
68	Urgency of economic crises and unemployment (1~6)	100	4.27	1.024
69	Concern about nuclear installations built in your area (1~6)	100	4.26	1.703
70	Significance of impact of oil on our way of life (1~6)	79	4.253	1.255
71	Energy utility bill too high (1~6)	79	4.241	1.313
72	Concerned about depreciation of property values regarding geothermal drilling near your property (1~6)	100	4.24	1.372
73	Air pollution affects attitude towards geothermal development (1~6)	100	4.21	1.282

	Variable description	*N*	*Mean*	*Standard deviation*
74	Jobs/employment important for acceptance and support of geothermal project (1~6)	100	4.21	1.192
75	Local authorities important in energy selection (1~6)	100	4.2	1.497
76	Urgency of pandemic crises (1~6)	100	4.19	1.3
77	How receptive to geothermal drilling in your area would increased employment make you (1~6)	100	4.19	1.339
78	Significance of impact of geothermal on our way of life (1~6)	100	4.18	1.359
79	Concerned about transparency regarding geothermal drilling near your property (1~6)	100	4.16	1.412
80	How much would credibility, transparency, and trust deter you from switching to geothermal only (1~6)	100	4.13	1.346
81	How convincing would social benefits be if you were considering purchasing energy from deep geothermal (1~6)	100	4.13	1.376
82	How receptive to geothermal drilling in your area would control by public institutions make you (1~6)	100	4.1	1.176
83	Contribution of noise to public concern about deep geothermal drilling in your area (1~6)	100	4.1	1.322
84	Trust national (public) administration to help you decide to switch energy suppliers (1~6)	100	4.09	1.408
85	Community compensation important for acceptance and support of geothermal project (1~6)	100	4.08	1.277
86	Energy companies important in energy selection (1~6)	100	4.07	1.444
87	How much would insufficient service maturity deter you from switching to geothermal only (1~6)	100	4.07	1.35
88	How receptive to geothermal drilling in your area would compensations for locals make you (1~6)	100	4.07	1.265
89	Significance of impact of wind on our way of life (1~6)	100	4.06	1.448
90	Significance of impact of hydrogen on our way of life (1~6)	100	4.03	1.403
91	Contribution of visual impacts to public concern about deep geothermal drilling in your area (1~6)	100	4	1.318
92	Would induced seismicity alter your perspective on geothermal development in your area (1~6)	100	4	1.484
	3.99≧Rating≧3.5			
93	Concerned about induced seismicity of geothermal drilling (1~6)	100	3.98	1.531
94	How influential would social benefits be in switching to geothermal energy provider (1~6)	100	3.92	1.228
95	Trust regional/local administration to help you decide to switch energy suppliers (1~6)	100	3.9	1.21
96	Familiarity with geothermal exploration (1~6)	100	3.86	1.538
97	How often is climate change used in geothermal media debates in your country (1~6)	100	3.86	1.477

	Variable description	*N*	*Mean*	*Standard deviation*
98	Urgency of acid rain (1~6)	100	3.84	1.398
99	Urgency of terrorism (1~6)	100	3.84	1.354
100	How influential would community awareness be in switching to geothermal energy provider (1~6)	100	3.83	1.19
101	Environmental organizations important in energy selection (1~6)	100	3.76	1.372
102	Trust EU (1~6)	100	3.75	1.52
103	Trust friends and colleagues to help you decide to switch energy suppliers (1~6)	100	3.75	1.298
104	Concerned about legal transparency of geothermal drilling (1~6)	100	3.74	1.454
105	Significance of impact of biomass/biofuels on our way of life (1~6)	100	3.73	1.355
106	Trust in environmental associations to help you decide to switch energy suppliers (1~6)	100	3.68	1.413
107	Urgency of traffic congestion (1~6)	100	3.66	1.343
108	Media important in energy selection (1~6)	100	3.66	1.584
109	Trust national governments (1~6)	100	3.66	1.327
110	Trust regional/local governments (1~6)	100	3.64	1.15
111	How much would inconvenience of switching deter you from switching to geothermal only (1~6)	100	3.62	1.42
112	Concerned about aesthetic issues regarding geothermal drilling near your property (1~6)	100	3.62	1.503
113	Unpleasantness of experiencing an earthquake (1~6)	47	3.617	1.596
114	Concerned about landscape impacts of geothermal drilling (1~6)	100	3.57	1.506
115	Contribution of air pollution to public concern about deep geothermal drilling in your area (1~6)	100	3.55	1.5
116	Noise affects perception of geothermal development in community	100	3.54	1.388
117	Urgency of noise (1~6)	97	3.526	1.234
118	NGOs important in energy selection (1~6)	100	3.52	1.425
	3.49≧Rating≧3			
119	Grassroot movements important in energy selection (1~6)	100	3.47	1.547
120	Concerned about infrastructure impacts of geothermal drilling (1~6)	100	3.47	1.432
121	Aesthetics/visual affect attitude towards geothermal in your area	100	3.46	1.396
122	Concerned about greenhouse gas emissions of geothermal drilling (1~6)	100	3.37	1.739

	Variable description	*N*	*Mean*	*Standard deviation*
123	Significance of impact of coal on our way of life (1~6)	79	3.354	1.687
124	Individual citizens important in energy selection (1~6)	100	3.35	1.714
125	How often is energy security used in geothermal media debates in your country (1~6)	100	3.33	1.531
126	How often is the economy used in geothermal media debates in your country (1~6)	100	3.31	1.568
127	Concern about biomass installations built in your area (1~6)	100	3.3	1.605
128	Concern about wind installations built in your area (1~6)	100	3.26	1.727
129	How often is ecological security used in geothermal media debates in your country (1~6)	100	3.13	1.454
130	Trust energy suppliers to help you decide to switch energy suppliers (1~6)	100	3.12	1.365
131	Contribution of radioactive wastes to public concern about deep geothermal drilling in your area (1~6)	100	3.12	1.665
132	Trust NGOs (1~6)	100	3.1	1.367
133	Concern about hydropower installations built in your area (1~6)	100	3.01	1.567
2.99≧Rating				
134	Concern about geothermal installations built in your area (1~6)	100	2.97	1.453
135	Trust energy companies (1~6)	100	2.95	1.274
136	How often is geothermal potential used in geothermal media debates in your country (1~6)	100	2.89	1.399
137	How often is national security used in geothermal media debates in your country (1~6)	100	2.89	1.614
138	Trust print and broadcast media to help you decide to switch energy suppliers (1~6)	100	2.88	1.416
139	Trust Internet and social media to help you decide to switch energy suppliers (1~6)	100	2.73	1.362
140	Frequency of geothermal in the news (1~6)	100	2.67	1.378
141	Concern about solar panel (PVs) installations built in your area (1~6)	100	2.64	1.624
142	Trust media (1~6)	100	2.52	1.243
143	Quantity of available incentives to help transition to geothermal	100	2.35	1.431

The following may be observed for variables that had an average rating over 5:

- Energy efficiency (mean rating of 5.24 out of a maximum of 6), energy availability (5.1), and energy independence (5.09) had the highest rating, underscoring the importance of energy security as perceived by respondents.

- The environmental impacts of energy were highly rated (5.06) and environmental protection was considered very important (5.03) for the acceptance and support of geothermal projects.
- Geothermal energy was very well received as a source of heating (5.06).
- Finally, public safety was considered very important (5.01) for the acceptance and support of geothermal projects.

The following may be observed for variables that has an average rating lower than 3:

- The quantity of available incentives to help transition to geothermal was considered to be very poor, receiving the lowest average rating of all variables (mean value of 2.35 out of a maximum of 6).
- Some of these lowest ratings were related to lack of trust in the media: media were not trusted (2.52); and neither the Internet and social media (2.73) nor print and broadcast media (2.88) were trusted to help respondents decide to switch energy suppliers.
- Some of these lowest ratings were also related to insufficient coverage of geothermal in the news: the frequency of geothermal in the news was considered inadequate (2.67); neither national security nor the geothermal potential were mentioned often in geothermal media debates in the respondent's country (2.89 in both cases);
- Neither solar panel (2.64) nor geothermal installations (2.97) built in the respondent's area were not a cause of concern. Geothermal appears to be like solar panels, in that it does not motivate nearby residents to adopt a NIMBY attitude.

Highlights of other variables that had a high rating are provided below:

- Reliability (4.99), economic benefits (4.99 and 4.89), environmental impacts (4.98) and benefits (4.95 and 4.82), pollution reduction (4.92), environmental regulations (4.91), national governments (4.88), energy accessibility (4.86), climate change (4.84) and the mitigation of greenhouse gas emissions (4.8), societal risks and benefits (4.82), energy affordability (4.81), scientific publications (4.81), and the diversification of energy supply (4.8) were considered very important in the context of various questions.
- Public health and safety (4.79 and 4.5 when asked for public health alone), energy price stability (4.76), electricity cost reductions (4.74), understanding of geothermal (4.68), concern about environmental impacts (4.67), public concern about groundwater contamination (4.59), biodiversity (4.57), the role of the EU (4.55), concerns about facility location (4.53), monitoring of geothermal drilling (4.53), and water aquifer risks of geothermal drilling (4.52) were also quite important in the context of various questions.

Highlights of other variables that had a low rating are provided below:

- Concern about nearby hydropower installations (3.01), trust in NGOs (3.1), trust in energy suppliers (3.12), mention of ecological security in the news (3.13), concern about nearby wind installations (3.26), mention of economy in the news (3.31), mention of energy security in the news (3.33), concern about greenhouse gas emissions from geothermal drilling (3.37), aesthetics and visual issues (3.46), and geothermal infrastructure impacts (3.47) were considered to be of low importance or magnitude in the context of various questions.
- NGOs (3.52), noise (3.526 and 3.54), air pollution (3.55), landscape impacts (3.57), aesthetic issues (3.62), trust in national (3.66) and regional/local governments (3.64

and 3.9), media (3.66), traffic congestion (3.66), trust in environmental associations (3.68) or organizations (3.75), trust in EU (3.75), community awareness (3.83), familiarity with geothermal exploration (3.86), social benefits (3.92), and induced seismicity (3.98) were also considered to be of rather low importance (or magnitude) in the context of various questions.

A histogram of the average values of all ranking variables (143 in number) is drawn in Figure 4.1, showing a left skewed distribution with a few modes indicating possible clusters.

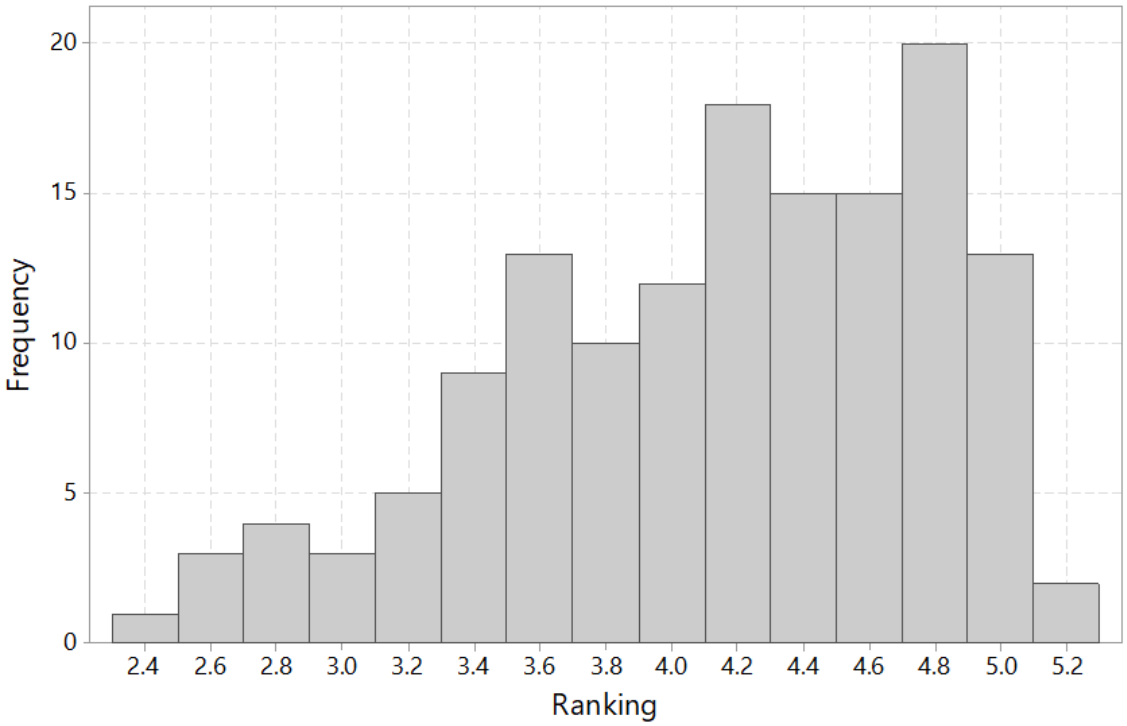

Figure 4.1. Histogram of average values of ranking variables

Figure 4.2 relates the average value with the standard deviation of each ranking variable (for all 143 ranking variables). A negative correlation is observed, with higher rankings characterized by smaller standard deviation values, possibly indicating a greater conviction of respondents.

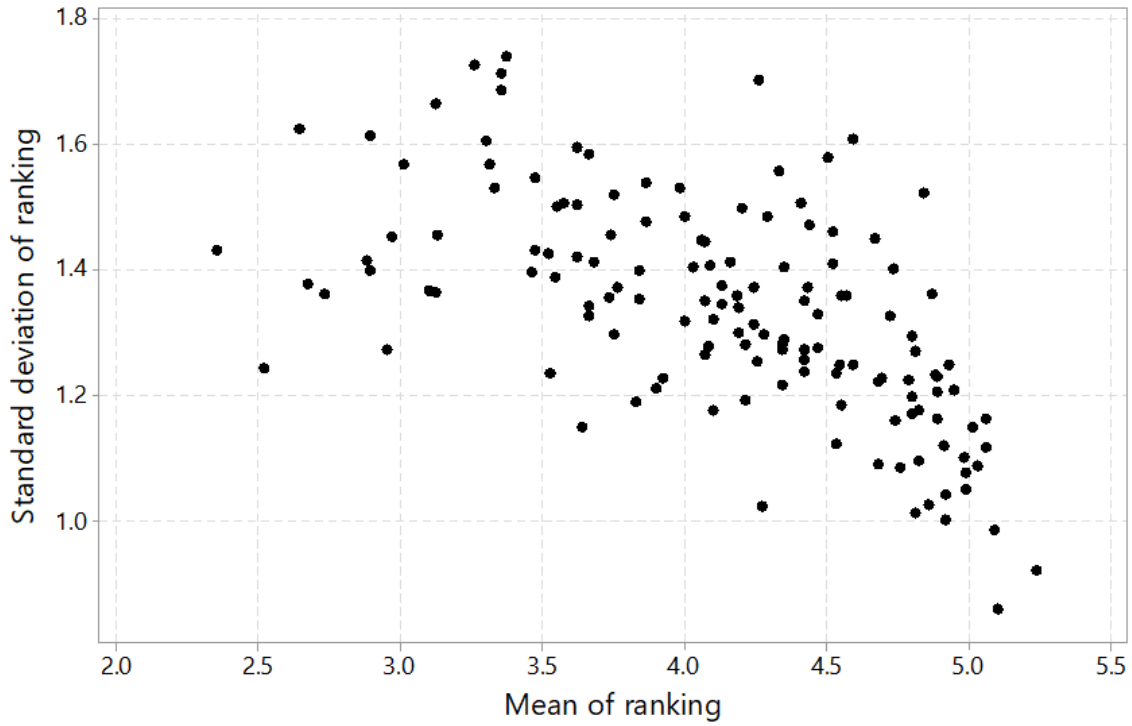

Figure 4.2. Standard deviation vs average values of ranking variables

4.3.2.2 Seismicity risk

The collective results from the questionnaire concerning perception of seismicity risk are collated with the actual seismicity risk in Table 4.2. The actual seismicity risk of each city/region is retrieved from the studies of Rajaram et al. (2010), Petersen et al. (2014), He et al. (2016), Allen et al. (2020) and La Greca and Margani (2018).

Table 4.2. Subjective and actual seismicity risk for cities

CITY	*Area prone to earth-quakes (%)*	*N*	*Actual risk*	*CITY*	*Area prone to earth-quakes (%)*	*N*	*Actual risk*
Antibes (France)	33	1	0.05	Meudon (France)	0	1	0
Athens (Greece)	90.1	11	0.4	Morlaas (France)	0	1	0.05
Bordeaux (France)	0	1	0.05	Mouans-Sartoux (France)	100	1	0.05
Bournos (France)	100	1	0.1	Oise (France)	0	1	0
Chabanière (France)	0	1	0.15	Orléans (France)	0	1	0
Chennai (India)	100	1	0.25	Orthez (France)	0	1	0.05
Clemson (USA)	100	1	0.1	Oslo (Norway)	0	1	0.1

CITY	*Area prone to earth-quakes (%)*	*N*	*Actual risk*	*CITY*	*Area prone to earth-quakes (%)*	*N*	*Actual risk*
Clermont Ferrand (France)	100	1	0.1	Paleo Faliro (Greece)	100	1	0.4
Courbevoie (France)	0	1	0	Paris (France)	20	10	0
Fontainebleau (France)	0	3	0	Pau (France)	80	5	0.05
Gjøvik (Norway)	0	1	0.05	Piraeus (Greece)	100	2	0.4
Gujarat (India)	0	1	0.35	Podgorica (Montenegro)	100	2	0.3
Heraklion (Greece)	100	1	0.5	Qingdao (China)	33	6	0.05
Houston (USA)	0	1	0	Rio (Greece)	100	1	0.4
Ioannina (Greece)	1	1	0.35	Shandong (China)	0	1	0.05
Ivano-Frankivsk (Ukraine)	0	1	0.05	Stavanger (Norway)	0	2	0.1
Jouy-en-josas (France)	0	2	0	Sydney (Australia)	100	1	0.05
Kaunas (Lithuania)	0	1	0	Tampere (Finland)	0	1	0
Kozani (Greece)	100	1	0.25	Thessaloniki (Greece)	100	2	0.3
Lacommande (France)	100	1	0.05	Thomery (France)	0	1	0
Linyi (China)	100	1	0.1	Tirane (Albania)	0	1	0.45
London (UK)	0	5	0	Tousson (France)	0	1	0
Lost (France)	100	1	0.05	Trondheim (Norway)	0	8	0.1
Lyon (France)	0	2	0.1	Villemoisson-sur-Orge (France)	0	1	0
Mauleon (France)	100	1	0.1	Warsaw (Poland)	0	1	0
Megara (Greece)	100	1	0.4	(missing)		2	

No systematic correlation was observed between the perceived risk and the actual seismicity risk. Perhaps some of the responses were influenced by the perceived risk of their entire country, as indicated by Figure 4.3.

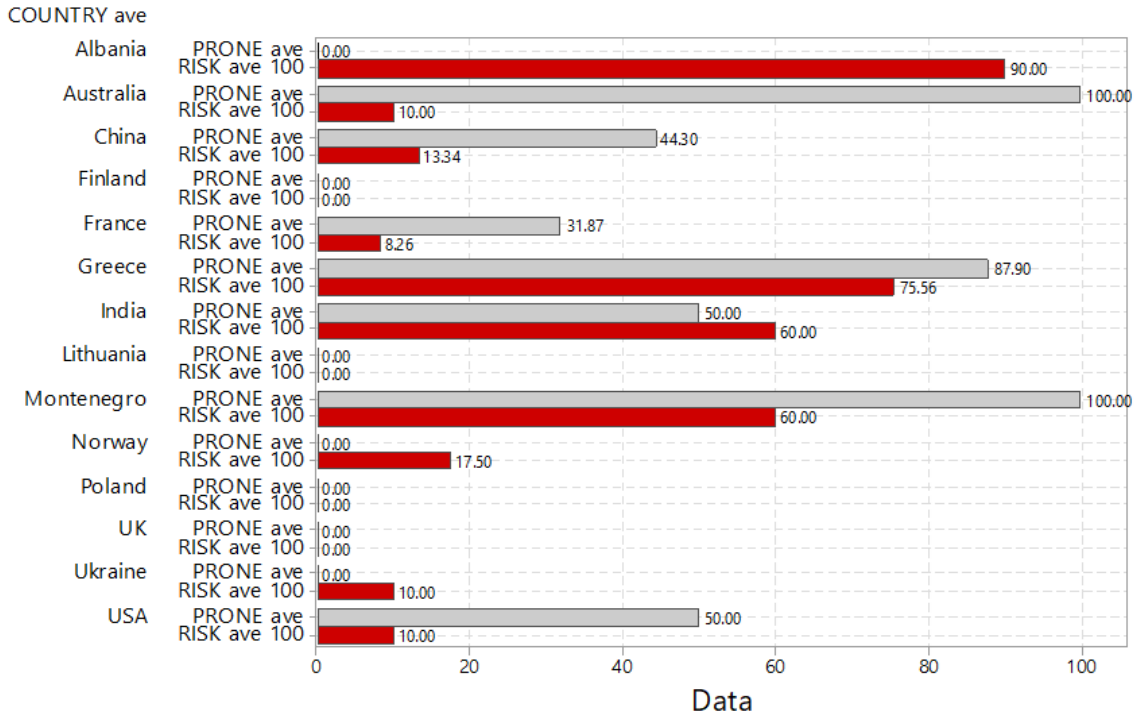

Figure 4.3. Average seismic risk prone response (gray bars) and average objective seismicity risk per country (red bars)

4.3.2.3 Qualitative comments

This section summarizes the respondents' thoughts and opinions on whether they had anything to observe or add to the questionnaire.

The total number of comments received from respondents was 50, as shown in Table 4.3, with 20 in Section 2 (Environmental concerns), 10 in Section 3 (Sociopolitical issues), 3 in Section 4 (community acceptance), and 3 in Section 5 (Market acceptance).

Table 4.3. Questionnaire comment quantification

Total questionnaire comments (sections 2-5)	50
Section 2 (Environmental concerns) comments	20
Section 3 (Sociopolitical issues) comments	10
Section 4 (Community acceptance) comments	3
Section 5 (Market acceptance) comments	3
Overall comments	13
Positive feedback	7
Negative feedback	8
General comments	12

Seismicity-related comments	5
Financial observations	4
Examples of countries	6
Environmental remarks	6

There were 13 overall comments and 12 general comments. Seven comments were positive, with the remaining 8 being negative. The majority of the negative comments concerned the length of the survey and the clarity of the questions. Five were about seismic remarks, 4 were financial observations, and 6 were about environmental remarks. Finally, 6 were comments on specific country examples.

Comments in Section 2 (Environmental concerns) recognized the effort to address the vast bulk of deep geothermal drilling's environmental concerns. However, comments about the clarity of the questions were made and have been considered. Seismicity comments indicated the widespread concern about seismicity effects, which was confirmed by the literature review in Tasks 3.1 and 3.2. More specific concerns about the drilling process and fracking requirements were also raised, emphasizing land destabilization. One of the respondents suggested looking for trace metal contamination (e.g. arsenic) in hydrothermal fluids. The importance of odorous gasses (such as hydrogen sulfide, H_2S) in the geothermal drilling process was also emphasized, using Reykjavík as an example. One of the comments questioned why traffic congestion was listed as an option in the question about environmental concerns (question 21) – traffic congestion was included because it is currently regarded as one of the major contributors to the problem of air pollution. The issue is most detectable in megacities.

Two comments in Section 3 (Sociopolitical issues) emphasized the importance of energy costs to public acceptance. Using the US as an example, the respondent posed the following distinct but related questions: "*who's going to pay* and *where are they going to put it"* as a factor that can delay or even prevent the progress of a geothermal project. Two additional comments highlighted the significance of communication and knowledge dissemination. This point was emphasized by a respondent from Montenegro, who noted a lack of knowledge regarding geothermal energy. Furthermore, the shale gas debate was cited as an example of the critical role of public engagement. The Rhine rift and the poor operational practices that resulted in building damage were used as a case that directly impacted public acceptance of geothermal drilling. Finally, one commenter noted that hydrogen is not a renewable source, and another expressed concern about the term ecological security as an answer option. It is noted that ecological security, which is concerned with the resilience of ecosystems in the face of climate change, was used as an option alongside other forms of security, such as energy and national security.

Section 4 (Community approval) includes three generic comments, one of which praised the questionnaire's comprehensive nature.

Finally, two comments in Section 5 (Market acceptance) were about geothermal energy's financial approach. One general comment was made about the instability of energy prices, which is subject to financial speculation. The other comment was about the question *"How does the fact that geothermal energy costs less than traditional energy sources affect your*

overall attitude toward geothermal drilling"? According to the respondent, the question should be rephrased as *"How does the fact that geothermal energy costs less than traditional energy sources affect your overall attitude toward geothermal drilling?"* because it implies that geothermal energy is less expensive than many other traditional energies on a global scale. The socioeconomic impacts consider how the hydro-percussive drilling advances developed by ORCHYD will improve the economic feasibility of deep geothermal drilling. According to the International Renewable Energy Agency (IRENA), renewable energy costs have been steadily declining over the years, owing to continuously improving technologies, economies of scale, competitive supply chains, and improved developer experience. The final comment argued that geothermal projects are decided on a regional or city scale and that individuals cannot choose between geothermal energy and other forms of renewable energy. The respondent did not mention his or her residential country or city.

Recapping, respondents rewarded the UPRC team for developing a comprehensive questionnaire on the social acceptance of deep geothermal drilling. Nevertheless, there were comments about the questionnaire's overall length, the technical nature, and the ambiguity of some questions. Despite knowing that the scope of the questionnaire was broad, UPRC could not leave out some questions that would greatly aid the research on the social acceptance of the ORCHYD project. According to one comment, the listed environmental concerns (section 2) could frighten people, lowering the social acceptance of deep geothermal drilling.

Question 15 of Section 1 asked for feedback on the type of energy respondents use to warm up. Figure B.13 in Appendix B showed that 39 respondents used electricity, 19 natural gas, 7 natural gas and electricity, and 6 oil. The rest used biomass, coal, geothermal, and wood at frequencies of 3 or less. This information will be considered in Task 3.3 (Energy security implications), which will broaden the scope of the previous tasks by focusing on the project's impact on energy security.

4.3.3 Internal consistency of the questionnaire

In order to confirm the reliability or internal consistency of the questions of an instrument (such as a questionnaire), Cronbach's alpha is used. Cronbach's alpha is calculated for all variables together and also when omitting a single variable at a time. It has been recommended that Cronbach's alpha be at least 0.7 for an instrument (e.g., a questionnaire) to be considered reliable.

In reliability testing, it is recommended that a sample contain several hundreds observations, while an older rule of thumb recommends a minimum of 10 observations per item (i.e. question). This would mean that, in the case of the final ORCHYD questionnaire, which contains 100 responses, testing more than 10 items (variables) would not be advisable. Furthermore, with many items (such as in the case of a long questionnaire like the ORCHYD one), Cronbach's alpha tends to increase even over 0.95 without this meaning that the questionnaire items are internally consistent; in fact, such high values of Cronbach's alpha oftentimes imply that the questionnaire and/or the scale levels could be shortened without losing reliability.

Although it is not recommended that Cronbach's alpha be used with the full questionnaire items, it may be used with the subset of multimodal variables that were used for extracting PCs. Excluding a few items that were found to be linearly dependent (and prevented calculations), Cronbach's alpha for the variables with multimodal histograms was found to be

0.863, with a 95% lower confidence bound of 0.823, indicating high reliability for this set of variables.

Cronbach's alpha may also be used with the quantitative variables of the five sections of the questionnaire, to test their internal consistency:

- Section 1 (Background data) items had a Cronbach's alpha of 0.53, indicating a mediocre internal consistency, which was rather expected given the heterogeneous information (mixing demographic and socioeconomic information with familiarity and opinions about geothermal) requested in this section.
- Section 2 (Environmental concerns) items had a Cronbach's alpha of 0.906, indicating excellent internal consistency.
- Section 3 (Sociopolitical issues) items had a Cronbach's alpha of 0.938, indicating excellent internal consistency.
- Section 4 (Community acceptance) items (excluding some that were found to be linearly dependent) had a Cronbach's alpha of 0.953, indicating excellent internal consistency.
- Finally, section 5 (Market acceptance) items had a Cronbach's alpha of 0.594, indicating a mediocre internal consistency, in part due to some heterogeneous items (e.g. mixing opinions on incentives with attitudes for economic, social, and environmental benefits).

Variables with many missing values were not used for the calculation of the Cronbach alpha values for the different sections of the questionnaire.

To provide some additional checking of the internal consistency of the questionnaire, the correlation of a couple of almost identically worded questions (that were placed in different sections of the questionnaire) as well as questions that were replicated with slightly different wording, e.g. *"near your property"* as opposed to *"in your area"*. will be examined.

Such variables include:

- Familiarity with geothermal exploration (FAMILIAR with GEOTHERMAL, mean ranking of 3.86) and understanding geothermal (UNDERSTAND GEOTH, mean ranking of 4.68)
- Importance of development of renewable energy, which had been asked twice (IMPORT DEVEL RENEW ENER_1, mean ranking of 4.89, and IMPORT DEVEL RENEW ENER_2, mean ranking of 4.93)

A t-test for independent samples between the two variables polling for the importance of development of renewable energy did not reject the null hypothesis of equal means ($t=-0.234$, p-value=0.8149).

Other variable correlations of interest in the context of internal consistency:

- Urgency of climate change (URGENT CLIMATE CHANGE, mean ranking of 4.84), importance of mitigation of greenhouse gas emissions (IMPORT GHG MITIGATION, mean ranking of 4.8), and concern about greenhouse gas emissions of geothermal drilling (CONCERN GHG EMISS of GEOTH, mean ranking of 3.37)

- EU important in energy selection (IMPORT SELECT EU, mean ranking of 4.55) and trust EU (TRUST EU, mean ranking of 3.75)
- Concern about induced seismicity of geothermal drilling (CONCERN INDUC SEISMIC of GEOTH, mean ranking of 3.98), contribution of induced seismicity to public concern about deep geothermal drilling in your area (INDUCED SEISM PUB CONCERN GEOTH, mean ranking of 4.43), and whether induced seismicity would alter the respondent's perspective on geothermal development in your area (INDUCED SEISMIC PERSPECT GEOTH, mean ranking of 4)

4.3.4 Principal Component Analysis

There are too few observations (100 cases) in the sample of responses for a meaningful analysis of all the variables (over 150). Therefore, Principal Component Analysis (PCA) was performed to extract a small number of Principal Components (PCs), which would subsequently be used for Cluster Analysis.

The purpose of PCA is to obtain a few linear combinations of the ranking variables, which account for most of the variability in the data. Two PCA approaches were attempted: (1) on selected variables with multimodal distributions, and (2) on subjectively selected groups of conceptually related variables. The first approach was superior and is presented here, while the second approach, which was inferior, is presented in Appendix C. Missing cases were excluded listwise in both cases.

4.3.4.1 Principal Component Analysis on multimodal ranking variables

Initially, variables are selected based on whether their distribution (as depicted in their histograms) indicates the presence of multiple clusters in the sample. Among those, only variables with complete cases will be used for PCA. Table 4.4 displays such variables along with the number of modes indicated by their histogram and the number of nonmissing cases.

Table 4.4. Variables with multimodal histograms
(amber highlight indicates variables with missing data)

Num.	*Question (full description)*	*Variable name*	*Modes*	*Non-missing cases*
1	How many years of professional experience do you have?	EXPERIENCE YEARS	2	100
2	What is your annual income?	INCOME	3	88
3	How familiar are you with geothermal energy exploration and development (including drilling)?	FAMILIAR with GEOTHERMAL	2	100
4	How urgent, in your opinion, are the following environmental concerns? Acid rain	URGENT ACID RAIN	2	100
5	How urgent, in your opinion, are the following environmental concerns? Waste disposal	URGENT WASTE DISPOSAL	2	100

Num.	*Question (full description)*	*Variable name*	*Modes*	*Non-missing cases*
6	How urgent, in your opinion, are the following environmental concerns? Temperature increase	URGENT TEMP INCREASE	2	100
7	How urgent, in your opinion, are the following environmental concerns? Extreme weather conditions	URGENT EXTREME WEATHER	2	100
8	How urgent, in your opinion, are the following environmental concerns? Traffic congestion	URGENT TRAFFIC CONGESTION	2	100
9	How much would noise pollution affect your perception of geothermal development in your community?	NOISE AFFECT PERCEPT GEOTH	2	100
10	In your opinion, how urgent are the following global issues? Climate change	URGENT CLIMATE CHANGE	2	100
11	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Coal	IMPACT COAL on WoL	2	79
12	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Oil	IMPACT OIL on WoL	2	79
13	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Natural gas	IMPACT NATURAL GAS on WoL	2	79
14	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Biomass/biofuels	IMPACT BIOMASS on WoL	2	100
15	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Nuclear	IMPACT NUCLEAR on WoL	2	79
16	How important do you consider the following actors in the energy selection process? Energy companies	IMPORT SELECT ENER COMPAN	2	100

Num.	*Question (full description)*	*Variable name*	*Modes*	*Non-missing cases*
17	How important do you consider the following actors in the energy selection process? Scientists and researchers	IMPORT SELECT SCIENT RESEARCH	2	100
18	How important do you consider the following actors in the energy selection process? Environmental organizations	IMPORT SELECT ENV ORGs	2	100
19	How important do you consider the following actors in the energy selection process? Grassroot movements	IMPORT SELECT GRASSROOT	2	100
20	How important do you consider the following actors in the energy selection process? Individual citizens	IMPORT SELECT CITIZENS	3	100
21	How much do you trust the following sources? European Union	TRUST EU	2	100
22	How frequently do you hear about geothermal energy in the news in your country?	FREQ GEOTH NEWS	2	100
23	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Geothermal potential	DEBATE GEOTH POTENTIAL	2	100
24	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Economy	DEBATE GEOTH ECON	2	100
25	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Climate change	DEBATE GEOTH CLIM CHANGE	2	100
26	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Ecological security	DEBATE GEOTH ECOL SECUR	2	100
27	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Energy security	DEBATE GEOTH ENER SECUR	2	100

Num.	*Question (full description)*	*Variable name*	*Modes*	*Non-missing cases*
28	What is your opinion on developing a pilot geothermal energy project in your country, if (underground) hydraulic stimulation is required?	OPINION GEOTH HYDR STIM	3	100
29	How much would the following deter you from switching to a geothermal-only energy supply? Inconvenience of switching	INCONVEN SWITCH DETER	2	100
30	How concerned would you be about the following issues regarding geothermal drilling near your property? Aesthetic issues	CONCERN AESTHET GEOTH DRILL	2 or 3	100
31	How concerned would you be about the following issues regarding geothermal drilling near your property? Public health	CONCERN PUBL HEALTH GEOTH DRILL	2	100
32	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Print and broadcast media	TRUST PR&BR MEDIA SWITCH ENERG	2	100
33	How concerned would you be if one of the following energy plants/installations were built in your area? Nuclear	CONCERN NUCLEAR if BUILT	2	100
34	How concerned would you be if one of the following energy plants/installations were built in your area? Hydropower	CONCERN HYDRO if BUILT	2	100
35	How concerned would you be if one of the following energy plants/installations were built in your area? Wind	CONCERN WIND if BUILT	2	100
36	How concerned would you be if one of the following energy plants/installations were built in your area? Solar panel (PVs)	CONCERN PVs if BUILT	2	100
37	How concerned would you be if one of the following energy plants/installations were built in your area? Biomass	CONCERN BIOMASS if BUILT	2	100
38	How concerned would you be about the following aspects of geothermal drilling? Greenhouse gas emissions	CONCERN GHG EMISS of GEOTH	3	100

Num.	*Question (full description)*	*Variable name*	*Modes*	*Non-missing cases*
39	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Groundwater contamination	GROUNDW CONTAM PUB CONCER GEOTH	2	100
40	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Radioactive wastes	RADIOACT WAST PUB CONCERN GEOTH	2	100
41	How might the prospect of induced seismicity alter your perspective on geothermal development in your area?	INDUCED SEISMIC PERSPECT GEOTH	2	100

Since 5 of the variables of Table 4.10 have missing data, only the remaining 36 variables were used for PCA. Based on Kaiser's (1960) criterion, 10 PCs with an eigenvalue greater than 1 were extracted, as shown in Table 4.5.

Table 4.5. Results of PCA on selected variables

PC number	*Eigenvalue*	*% of variance*	*Cumulative % of variance*
1	6.29686	17.491	17.491
2	4.36817	12.134	29.625
3	3.82618	10.628	40.253
4	2.21506	6.153	46.406
5	1.69499	4.708	51.115
6	1.58233	4.395	55.510
7	1.4008	3.891	59.401
8	1.34863	3.746	63.147
9	1.25062	3.474	66.621
10	1.09225	3.034	69.655

The Kaiser–Meyer–Olkin (KMO) statistic, a measure of sampling adequacy, indicates whether the correlations between variables can be explained by the other variables in the dataset" (Mooi & Sarsted, 2011). In the case of the questionnaire, Kaiser-Meyer-Olkin's measure of sampling adequacy (KMO statistic) was 0.6836, which is greater than the recommended value of 0.6, indicating that the extraction of PCs is likely to provide interesting information.

The Bartlett's test of sphericity may be used to test the null hypothesis that the correlation matrix is diagonal (i.e., all non-diagonal elements are zero) (Mooi & Sarsted, 2011), in the hope that the null hypothesis is rejected (since high correlations are needed for principal components analysis). In the case of the questionnaire, Bartlett's test for sphericity rendered a chi-square value of 1812.79 with 630 degrees of freedom, with a resulting significance of zero (p=0), thus rejecting the null hypothesis that the correlation matrix among the variables is an identity matrix (which would mean that the variables shared no common variance, in which case extracting PCs would be meaningless).

It is therefore concluded that the PCs extracted by this PCA are likely to reflect the variability of the original data accurately, and may be used for cluster analysis. The PC variable coefficients (weights) are not displayed because the PCs were not extracted for interpretation but rather to be used for cluster analysis.

4.3.4.2 Principal Component Analysis on groups of conceptually related ranking variables

As an alternative to the previous section, PCA will now be attempted on groups of conceptually related ranking variables, hoping to extract a few PCs from each group.

Given the limited sample size (100) and anticipating sample size considerations for Cluster Analysis (which are discussed in the next section), it was decided that no more than 6 to 7 such groups be created, so that a reasonable total number of PCs would be extracted.

In consultation with an ad hoc expert group (which included a member of ORCHYD's advisory board), it was decided to classify rankings into the six variable groups depicted in Figure 4.4: dissemination (15 variables), economic (15), environmental (27), geopolitical (21), NIMBY (27), and public acceptance (38).

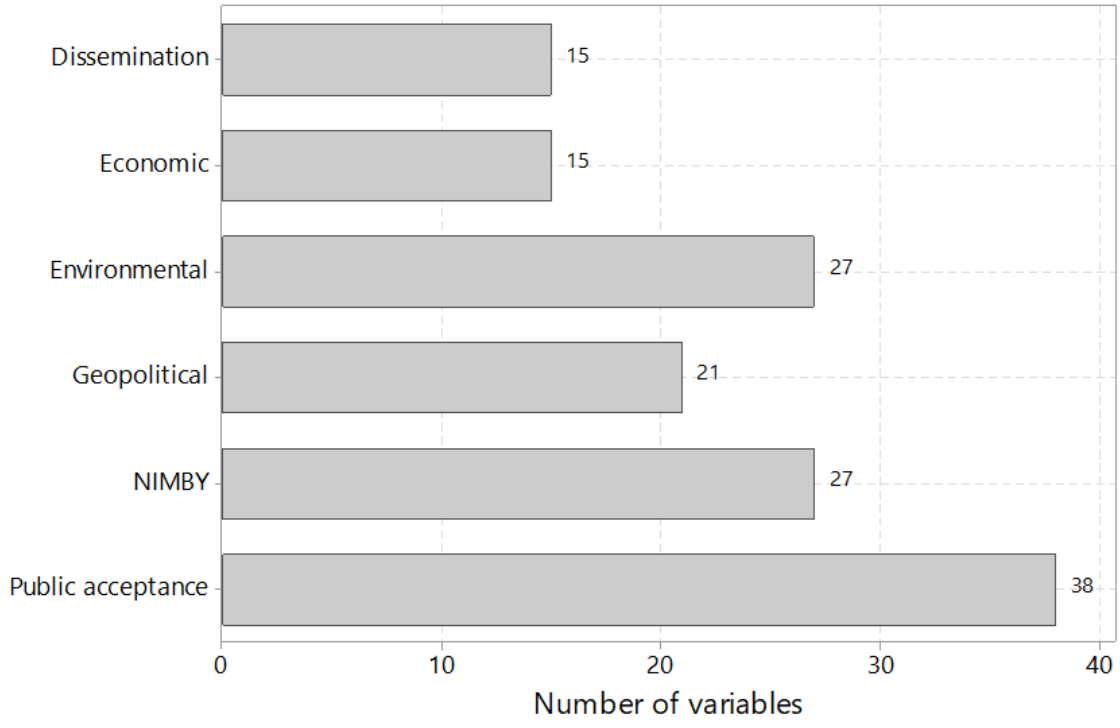

Figure 4.4. Groups of ranking variables

These groups contain comparable ranking variables, and while plausible, they are subjective and neither optimal nor ideal. Some remarks:

- The concept of dissemination refers to both the media and public perceptions of the media, which are distinct concepts.
- Dissemination contains the distinct concepts of exposure and trust.
- Conceptually, the environmental group should include NIMBY items, but doing so would create a very large group.

It would be possible to divide public acceptance into multiple groups, but this would increase the total number of groups (and thus the total number of PCs).

The extraction of PCs from these 6 groups of variables is shown in Appendix C. If the approach of extracting PCs from each variable group were adopted, a total of 38 PCs should be used for cluster analysis, which is derived by adding 4 PCs for dissemination, 4 PCs for economics, 6 PCs for the environment, 6 PCs for geopolitics, 8 PCs for NIMBY, and 10 PCs for public acceptance.

An estimate of the proportion of variability captured by these 38 PCs may be obtained by adding the variability captured within each group, weighted by the number of variables (with nonmissing values) within each group:

$$(15\times69.61 + 14\times60.151 + 26\times73.663 + 21\times68.772 + 27\times72.426 + 32\times74.966) \div (15+14+26+21+27+32) = 71.112\%$$

As will be iterated in the cluster analysis section, only 6 to 7 clustering variables are recommended for a sample size of 100 observations. Therefore, using all the 38 PCs that were extracted in this section cannot be done. Furthermore, about the same percentage of the total variance of the data (69.655%) as the one computer above (71.112%) was captured by only 10 PCs that were extracted from the 38 variables with multimodal histograms in the previous section.

Therefore, the previous method of extracting 10 PCs from multimodal variables is preferred.

4.3.5 Cluster analysis

The objective of this section is to identify any geothermal energy tribes present in the sample and, presumably, in the population. Their existence would enable more targeted and effective efforts to increase the public acceptance of geothermal energy.

On the issue of sample size, Formann (1984) as quoted by Mooi and Sarstedt (2011) recommends a sample of at least 2^m cases, where m equals the number of clustering variables. Although these are just recommendations, it follows that it would be good to not exceed 6 (2^6=64) to 7 (2^7=128) variables in order to cluster analyze the available 100 complete cases of ranking variables.

Using Ward's linkage method with the squared Euclidean as the preferred distance metric, should enable the creation of larger and more distinct clusters (Hair, Black, & Babin, 2009). Cluster analysis was run with these choices on the 10 PCs extracted from the variables (with multimodal histograms) that did not have any missing data.

Based on the Scree plot (not shown), two equally plausible solutions were obtained: one with two clusters, and a second one with three clusters. As explained below, the three cluster solution proved superior, so it is tabulated and discussed below. Details on the two cluster solution, which was not as clear-cut or straightforward as the three cluster solution, are presented in Appendix D.

The following tables, 4.6.a to 4.6.e, display the characteristics of the three clusters, organized by section of the questionnaire.

Overall, 88 out of 146 variables (60.3%) had a significant ANOVA F-test, supporting the presence of three clusters in the sample of responses. Attention now turns to summarizing the most prominent traits of each cluster after each table.

Table 4.6.a. Cluster size and centroids or frequencies of background information variables (3 cluster solution) for cluster analysis on PCs from selected multimodal variables (with ANOVA F test red if significant at 95% confidence level; cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
N	22 (22%)	59 (59%)	19 (19%)	
Male	13 (59.09%)	50 (84.75%)	9 (47.37%)	
Age (years)	40.636	41.56	39.053	0.27 (0.7675)
Country	Greece 7 (31.82%) France 6 (27.27%) UK 4 (18.18%) Norway 2 (9.09%) etc.	France 25 (42.37%) Greece 12 (20.34%) Norway 8 (13.56%) China 7 (11.86%) Montenegro 2 (3.39%) etc.	France 9 (47.37%) Greece 3 (15.79%) Norway 2 (10.53%) etc.	
Annual income (thousand euros)	43.333	46.111	50.0	0.11 (0.8979)
Marital status	Married/with partner 12 (54.55%) Single 9 (49.91%) etc.	Married/with partner 35 (59.32%) Single 20 (33.9%) etc.	Married/with partner 10 (52.63%) Single 5 (26.32%) etc.	
Children	0.905	1.034	1.111	0.17 (0.8436)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Education	University 8 (36.36%) Postgrad 5 (22.73%) PhD 5 (22.73%) etc.	PhD 20 (33.9%) University 16 (27.12%) Postdoc 12 (20.34%) Postgrad 10 (16.95%) etc.	University 7 (35.84%) Postdoc 4 (21.05%) Postgrad 3 (15.79%) PhD 3 (15.79%) etc.	
Experience (years)	14.546	16.02	13.553	0.36 (0.6968)
Professional	Researcher 8 (38.1%) Student 4 (19.05%) Faculty 3 (14.29%) Private employee 3 (14.29%) etc.	Researcher 27 (45.76%) Faculty 13 (22.03%) Private employee 11 (18.64%) Business executive 6 (10.17%) Student 6 (10.17%) etc.	Researcher 7 (36.84) Private employee 6 (31.58%) Faculty 4 (21.05%) Student 4 (21.05%) etc.	
Area characteri-zation	Other urban 9 (40.91%) Suburban 5 (22.73%) Megacity 5 (22.73%) Densely populated 2 (9.09%) etc.	Other urban 22 (37.29%) Megacity 14 (23.73%) Rural 9 (15.25%) Suburban 6 (10.17%) Densely populated 5 (8.47%) Moderately populated 2 (3.39%) etc.	Suburban 5 (26.32%) Other urban 5 (26.32%) Megacity 5 (26.32%) Rural 3 (15.79%) etc.	
Consumer type	Householder 13 (59.01%) Tenant 8 (36.36%) etc.	Householder 40 (67.8%) Tenant 15 (25.42%) etc.	Householder 13 (68.42%) Tenant 5 (26.32%) etc.	
Familiarity with geothermal	4.546	3.967	2.737	8.52 (0.0004)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Distance to geothermal exploration	Over 50 km 10 (50%) Don't know 6 (30%) 0-25 km 4 (20%)	Don't know 27 (47.37%) Over 50 km 12 (21.05%) 0-25 km 9 (15.79%) 25-50 km 8 (14.04%)	Don't know 16 (84.21%) Over 50 km 2 (10.53%) 0-25 km 1 (5.26%)	
Significance of public acceptance of geothermal	4.0	4.441	4.474	1.04 (0.3561)

Cluster 1 had the following notable (and statistically significant) characteristics regarding background information:

- Cluster 1 was of intermediate size with 22 respondents, compared to 59 in Cluster 2 and 19 in Cluster 3.
- Cluster 1 had an intermediate proportion of male respondents (59.09%) compared to the other two clusters (84.75% and 47.37% in Clusters 2 and 3 respectively).
- Cluster 1 respondents had the lowest average income (43.333 thousand euros, compared to 46.111 and 50 for Clusters 2 and 3 respectively), although the difference among the clusters was not statistically significant.
- 54.55% of respondents in Cluster 1 were married or living with a partner, while 49.91% were single.
- Cluster 1 respondents had a diverse set of educational profiles and professional qualifications.
- Cluster 1 respondents from other urban areas had the highest percentage (40.91%), followed by respondents from suburban areas and megacities (22.73% each).
- Cluster 1 had the highest percentage of tenants (36.36%).
- Cluster 1 respondents were the most familiar with geothermal (ranking of 4.546) compared to the other two Clusters (ratings of 3.967 and 2.737 respectively).

Cluster 2 had the following notable (and statistically significant) characteristics regarding background information:

- Cluster 2 was the biggest cluster, with 59 respondents, compared to 22 of Cluster 1 and 19 of Cluster 3.
- Cluster 2 had the biggest proportion of male respondents (84.75%) compared to Clusters 1 and 3 (59.09% and 47.37% respectively).
- Cluster 2 had the biggest percentage of respondents who were from China (11.86%) with another 20.34% from Greece and 42.37% from France.
- Contained the biggest percentage of respondents who were married or living with a partner (59.32%) and 33.9% who were single.

- Compared to the other two clusters, Cluster 2 had the highest percentage of respondents with a doctoral degree (33.9%). Also, most of its respondents were researchers (45.76%).
- 37.29% of Cluster 2 respondents were from another urban area, and 23.73% were from a megacity. Suburban areas had the lowest percentage of Cluster 2 respondents (10.17%).
- Compared to the other two clusters, Cluster 2 had the lowest percentage of tenants (25.42%).

Finally, Cluster 3 had the following notable (and statistically significant) characteristics regarding background information:

- Cluster 3 had the fewest respondents, with 19 participants (compared to 22 of Cluster 1 and 59 of Cluster 2).
- Cluster 3 had the lowest percentage of male respondents (47.37%) compared to Cluster 1 (59.09%) and Cluster 2 (84.75%).
- Cluster 3 comprised respondents with the youngest average age, 39.053 years, compared to 40.636 and 41.56 for Clusters 1 and 2, respectively.
- Cluster 3 had the highest proportion of responders from France (47.37%).
- The respondents in Cluster 3 had the greatest average income (50,000 euros), however the difference between clusters was not statistically significant.
- 52.63% of respondents in Cluster 3 were married or living with a partner, while 26.32% were single.
- Compared to the other two clusters, respondents had the least experience (13.553 years, although the difference was not statistically significant) and the highest proportion (21.05%) of postdoctoral studies. Additionally, fewer respondents were researchers (36.84%) compared to Cluster 1 (38.1%) and Cluster 2 (45.76%).
- Cluster 3 respondents had the same proportion of respondents from suburban areas, other urban areas, and megacities (26.32%).
- Cluster 3 respondents were least familiar with geothermal energy when compared to other clusters (2.737). These respondents assigned the greatest weight to public acceptance of geothermal (rating of 4.474), a figure close to Cluster 2's ranking (4.441).

Table 4.6.b. Cluster size and centroids or frequencies of environmental concerns variables (3 cluster solution) for cluster analysis on PCs from selected multimodal variables (with ANOVA F test red if significant at 95% confidence level; cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
N	22 (22%)	59 (59%)	19 (19%)	
Urgency of decline of biodiversity	3.773	4.712	5.053	5.83 (0.0040)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Urgency of river water pollution	4.227	4.966	4.895	3.13 (0.0482)
Urgency of air pollution	3.864	4.966	4.947	6.54 (0.0022)
Urgency of acid rain	3.0	4.203	3.684	6.80 (0.0017)
Urgency of soil contamination	3.591	4.559	4.526	5.24 (0.0069)
Urgency of waste disposal	3.773	4.593	4.895	4.99 (0.0086)
Urgency of temperature increase	3.591	4.814	5.053	6.18 (0.0030)
Urgency of extreme weather	3.5	4.576	5.105	7.56 (0.0009)
Urgency of exploitation of natural resources	3.045	4.644	4.632	12.11 (0.0000)
Urgency of traffic congestion	3.409	3.831	3.421	1.16 (0.3163)
Urgency of noise	3.05	3.81	3.159	4.13 (0.0192)
Total impact of energy production model on the environment	4.227	5.136	5.053	7.71 (0.0008)
Air pollution affects attitude towards geothermal	3.409	4.322	4.789	7.28 (0.0011)
Noise affects perception of geothermal	2.909	3.661	3.895	3.26 (0.0427)
Aesthetic degradation/visual intrusion affects attitude towards geothermal	2.955	3.746	3.158	3.27 (0.0423)
Degradation of water affects attitude towards geothermal	4.091	4.508	5.211	5.03 (0.0084)

Cluster 1 had the following notable (and statistically significant) characteristics regarding environmental concerns:

- The presence of three Clusters was prominent in the urgent decline of biodiversity, river water pollution, air pollution, acid rain and soil contamination, waste disposal, temperature increase, extreme weather, exploitation of natural resources, and noise. Respondents from Cluster 1 gave lower ratings (3.773, 4.227, 3.864, 3.0, 3.591, 3.773, 3.591, 3.5, 3.045, and 3.05, respectively) than respondents from Clusters 2 and 3.
- Cluster 1 respondents rated the total environmental impact of the energy production model lower (rating of 4.227) than Clusters 2 and 3 (ratings of 5.136 and 5.053 respectively).
- Air pollution had the least impact on the attitude of Cluster 1 respondents toward geothermal energy (rating of 3.409, compared to 4.322 and 4.789 for Clusters 2 and 3 respectively).
- Noise had the least impact on the perception of Cluster 1 respondents toward geothermal energy (rating of 3.895, compared to 3.661 and 3.895 for Clusters 2 and 3 respectively).
- Aesthetic degradation/visual intrusion had the least impact on the attitude of Cluster 1 respondents towards geothermal (rating of 2.955, compared to 3.745 and 3.158 for Clusters 2 and 3 respectively).
- Water degradation had the least impact on the attitude of Cluster 1 respondents towards geothermal (rating of 4.091, compared to 4.508 and 5.211 for Clusters 2 and 3 respectively).

Cluster 2 had the following notable (and statistically significant) characteristics regarding environmental concerns:

- Three Clusters are prominent in the urgent river water pollution, air pollution, acid rain and soil contamination, waste disposal, natural resource exploitation, and noise. Cluster 2 respondents gave the highest rankings (4.966, 4.966, 4.203, 4.559, 4.593, and 4.644 respectively) compared to Clusters 1 and 3.
- Cluster 2 respondents ranked the total environmental impact of the energy production model (5.136) higher than Cluster 1 (4.227) and especially Cluster 3 (5.053) respondents.
- Cluster 2 respondents ranked aesthetic degradation/visual intrusion (3.746) higher than Cluster 1 and Cluster 3 respondents (2.955 and 3.158 respectively).

Finally, Cluster 3 had the following notable (and statistically significant) characteristics regarding environmental concerns:

- Cluster 3 respondents rated the urgency of biodiversity decline, temperature increase, and extreme weather the highest (5.053, 5.053, and 5.105 respectively).
- Cluster 3 respondents ranked the total environmental impact of the energy production model (5.053) nearly as high as Cluster 2 respondents (5.136).

- Cluster 3 respondents believed that air pollution had a more significant impact on their attitude toward geothermal energy (4.789) than Clusters 1 and 2 respondents (3.409 and 4.322, respectively). Cluster 3 respondents also believed that noise affected their perception of geothermal (3.895) more than Cluster 1 and 2 respondents (2.909 and 3.661 respectively).
- Cluster 3 respondents rated water degradation as important in influencing their attitudes toward geothermal energy (5.211), more so than Cluster 1 and 2 respondents (4.091 and 4.508 respectively).

Table 4.6.c. Cluster size and centroids or frequencies of sociopolitical issues variables (3 cluster solution) for cluster analysis on PCs from selected multimodal variables (with ANOVA F test red if significant at 95% confidence level; cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
N	22 (22%)	59 (59%)	19 (19%)	
Urgency of climate change	3.909	5.051	5.263	5.95 (0.0036)
Urgency of water shortages	4.045	5.068	5.316	7.91 (0.0007)
Urgency of food shortages	3.909	5.017	5.158	9.70 (0.0001)
Urgency of pandemics	3.045	4.559	4.368	13.99 (0.0000)
Urgency of economic crises and unemployment	3.773	4.441	4.316	3.62 (0.0305)
Urgency of poverty	3.273	4.847	4.421	16.53 (0.0000)
Urgency of terrorism	3.682	3.881	3.895	0.19 (0.8272)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Who should decide on geothermal exploration	Nation 16 (72.73%) Region 11 (50%) Local communities 11 (50%) EU 7 (31.82%) Suppliers 7 (31.82%) Environmental groups 3 (13.64%) Producers 2 (9.09%) Citizens 2 (9.09%)	Nation 41 (69.49%) EU 31 (52.54%) Local communities 31 (52.54%) Region 28 (47.46%) Citizens 18 (30.51%) Environmental groups 17 (28.81%) Producers 13 (22.03%) Suppliers 7 (11.86%)	Nation 14 (73.68%) EU 10 (52.63%) Region 10 (52.63%) Environmental groups 4 (21.05%) Local communities 4 (21.05%) Citizens 3 (15.79%)Producers 1 (5.26%) Suppliers 1 (5.26%)	
Are you aware of any recent initiatives to promote more sustainable energy generation and consumption?	Uncertain/Not sure 14 (63.63%) Unaware 5 (22.73%) Aware 3 (13.64%)	Uncertain/Not sure 45 (76.27%) Unaware 12 (20.34%) Aware 2 (3.39%)	Uncertain/Not sure 15 (78.95%) Unaware 4 (21.05%)	
Importance of environmental regulations in developing effective strategies for sustainable energy	4.182	5.102	5.158	6.66 (0.0019)
Importance of pollution reduction in developing effective strategies for sustainable energy	3.955	5.085	5.526	18.03 (0.0000)
Importance of GHG mitigation	3.909	5.017	5.158	7.67 (0.0008)
Importance of energy conservation	3.955	4.932	4.789	5.63 (0.0048)
Importance of developing renewable energy (1)	4.045	5.068	5.316	9.03 (0.0003)
Importance of energy accessibility	4.045	5.085	5.105	10.64 (0.0001)
Importance of energy price stability	4.455	4.831	4.895	1.15 (0.3211)
Impact of coal on way of life	3.188	3.468	3.188	0.26 (0.7731)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Impact of oil on way of life	4	4.298	4.375	0.42 (0.6559)
Impact of natural gas on way of life	4.5	4.617	4.375	0.23 (0.7933)
Impact of solar on way of life	3.455	4.881	4.105	11.66 (0.0000)
Impact of wind on way of life	3.045	4.542	3.737	10.99 (0.0000)
Impact of hydro on way of life	3.864	4.542	4.316	1.92 (0.1524)
Impact of geothermal on way of life	3.5	4.61	3.632	8.34 (0.0005)
Impact of biomass on way of life	3.091	4.288	2.737	16.49 (0.0000)
Impact of hydrogen on way of life	3.773	4.339	3.368	4.16 (0.0184)
Impact of nuclear on way of life	5.188	4.681	4.438	1.24 (0.2965)
Importance of EU in energy selection	3.818	4.729	4.842	4.43 (0.0144)
Importance of national governments in energy selection	4.591	5.051	4.684	1.42 (0.2462)
Importance of local authorities in energy selection	3.273	4.627	3.947	7.84 (0.0007)
Importance of energy companies in energy selection	3.318	4.424	3.842	5.43 (0.0058)
Importance of scientists and researchers in energy selection	4.045	4.525	4.789	1.75 (0.1795)
Importance of media in energy selection	2.682	4.39	2.526	21.74 (0.0000)
Importance of NGOs in energy selection	2.545	4.169	2.632	21.03 (0.0000)
Importance of environmental organizations in energy selection	2.773	4.339	3.105	17.49 (0.0000)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Importance of grassroot organizations in energy selection	2.367	4.153	2.632	19.43 (0.0000)
Importance of individual citizens in energy selection	2.045	4.068	2.632	17.67 (0.0000)
Trust the EU	3.045	3.763	4.526	5.26 (0.0068)
Trust national governments	3.364	3.661	4	1.18 (0.3129)
Trust regional authorities	3.227	3.797	3.632	2.00 (0.1405)
Trust energy companies	2.545	3.102	2.947	1.54 (0.2188)
Trust NGOs	2.227	3.542	2.737	9.69 (0.0001)
Trust the media	1.909	2.949	1.895	10.17 (0.0001)
Importance of energy independence	5.091	5.034	5.263	0.38 (0.6822)
Importance of energy efficiency	5	5.288	5.368	1.01 (0.3683)
Importance of energy affordability	4.5	4.898	4.895	1.33 (0.2687)
Importance of energy availability	4.727	5.203	5.211	2.75 (0.0688)
Importance of diversification of energy supply	4.273	4.949	4.947	2.83 (0.0636)
Importance of developing renewable energy (2)	4.045	5.119	5.368	8.47 (0.0004)
Importance of environmental impacts of energy systems	4.091	5.322	5.368	13.24 (0.0000)
Public safety important for geothermal to be accepted and supported	4.318	5.203	5.21	5.57 (0.0051)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Environmental protection important for geothermal to be accepted and supported	4.227	5.288	5.158	9.07 (0.0002)
Jobs/employment important for geothermal to be accepted and supported	3.545	4.542	3.947	6.92 (0.0016)
Community awareness important for geothermal to be accepted and supported	3.684	4.804	4.111	7.28 (0.0012)
Community consultation important for geothermal to be accepted and supported	3.909	4.593	4.053	3.34 (0.0395)
Community compensation important for geothermal to be accepted and supported	3.364	4.424	3.842	6.60 (0.0020)
Frequency of hearing about geothermal in the news	2.136	3.034	2.158	5.47 (0.0056)
Frequency of hearing the term geothermal potential in energy debates in the news	2.591	3.102	2.579	1.67 (0.1936)
Frequency of hearing the term economy in energy debates in the news	2.864	3.424	3.474	1.15 (0.3197)
Frequency of hearing the term climate change in energy debates in the news	3.5	3.729	4.684	4.08 (0.0198)
Frequency of hearing the term ecological security in energy debates in the news	2.682	3.136	3.632	2.23 (0.1130)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Frequency of hearing the term energy security in energy debates in the news	2.818	3.458	3.526	1.61 (0.2052)
Frequency of hearing the term national security in energy debates in the news	2.136	3.068	3.211	3.28 (0.0420)
How do you feel about electricity generation from geothermal	4.045	4.746	4.368	2.01 (0.1394)
How do you feel about heat generation from geothermal	4.864	5.169	4.947	0.66 (0.5187)
Opinion on developing geothermal project if hydraulic stimulation is required	4.318	4.525	3.737	1.88 (0.1587)

Cluster 1 had the following notable (and statistically significant) characteristics regarding sociopolitical issues:

- Climate change, water and food shortages, pandemics, the economic crisis, and unemployment and poverty were rated as less urgent by Cluster 1 respondents (ratings of 3.909, 4.045, 3.045, 3.773, and 3.273, respectively).
- When asked who should make the decision on geothermal exploration, the nation (72.73%), region (50%), and local communities (50%) ranked first, second, and third, respectively. Compared to the other two clusters, the EU had the lowest percentage (31.82%).
- Fewer Cluster 1 respondents were uncertain or not sure about any recent initiatives to promote more sustainable energy generation and consumption (63.63% compared to 76.27% and 78.95% for Clusters 2 and 3 respectively).
- Cluster 1 respondents rated the importance of environmental regulations in developing effective, sustainable energy strategies lower (rating of 4.182) than Cluster 2 and 3 respondents (ratings of 5.102 and 5.158 respectively).
- Cluster 1 respondents also rated the importance of pollution reduction in developing effective, sustainable energy strategies (rating of 3.955) lower than Cluster 2 and 3 respondents (ratings of 5.085 and 5.526 respectively).
- Cluster 1 respondents rated GHG emissions as much less important (3.909) than Clusters 2 and 3 (5.017 and 5.158 respectively).
- Cluster 1 respondents rated energy conservation substantially lower (3.955) than Cluster 2 and 3 respondents (4.932 and 4.789 respectively).

- Respondents were asked about the necessity of producing renewable energy at two different points in the questionnaire. Cluster 1 respondents gave it the same rating in both situations (4.045), which was lower than Clusters 2 and 3.
- Cluster 1 respondents rated energy accessibility as being substantially less important (4.045) than Cluster 2 and 3 respondents (5.085 and 5.105 respectively).
- Cluster 1 respondents rated solar (3.455), wind (3.045), and geothermal (3.5) as having a lower impact on their way of life compared to the other two Clusters.
- Cluster 1 respondents gave lower ratings than Cluster 2 and 3 respondents to the importance of EU, local authorities, energy companies, NGOs, environmental organizations, grassroot organizations, and individual citizens in the energy selection process (3.818, 3.273, 3.318, 2.545, 2.773, 2.367, and 2.045, respectively).
- Cluster 1 respondents had less trust in the EU and NGOs (3.045 and 2.227, respectively) than Clusters 2 and 3 respondents.
- Cluster 1 respondents ranked the importance of the environmental impacts of energy systems significantly lower than Cluster 2 and 3 respondents ((4.091 compared to 5.322 and 5.368 respectively).
- Cluster 1 respondents rated the importance of environmental protection, jobs/employment, community awareness and consultation, as well as compensation in order for geothermal energy to be accepted (ratings of 4.227, 3.545, 3.684, 3.909, 3.364 respectively) as less important than Cluster 2 and 3 respondents.
- Cluster 1 respondents heard about geothermal (2.136), climate change (3.5), and national security (2.136) in energy debates in the news less frequently than Clusters 2 and 3.

Cluster 2 had the following notable (and statistically significant) characteristics regarding sociopolitical issues:

- Compared to Clusters 1 and 3, Cluster 2 respondents considered pandemics (4.559), economic crises and unemployment (4.441), and poverty (4.847) to be the most important.
- Cluster 2 respondents rated energy conservation as more important (4.932) than Cluster 1 (3.955) and Cluster 3 (4.789).
- When asked about the importance of generating renewable energy twice, Cluster 2 respondents gave it comparable values (5.068 and 5.119), placing it in the middle of the three clusters.
- Cluster 2 respondents rated solar, wind, geothermal, biomass, and hydrogen as having a greater impact on their way of life (4.881, 4.542, 4.61, 4.288, and 4.339, respectively) than Clusters 1 and Cluster 3 respondents.
- Cluster 2 respondents rated the importance of local authorities, energy companies, NGOs, environmental organizations, grassroot organizations, and individual citizens in the energy selection process (4.627, 4.424, 4.39, 4.169, 4.339, 4.153, 4.068 respectively) higher than Cluster 1 and Cluster 3 respondents.
- Cluster 2 respondents trusted the NGOs and media (3.542 and 2.949, respectively) more than Cluster 1 and Cluster 3 respondents.

- Cluster 2 and Cluster 3 respondents placed a similar higher value on the environmental impacts of energy systems (5.322 and 5.368 respectively) than Cluster 1 respondents (4.091).
- Cluster 2 respondents rated the importance of environmental protection, jobs/employment, community awareness, community consultation, and community compensation for geothermal energy to be accepted and supported (5.288, 4.542, 4.894, 4.593, 4.424, respectively) higher than Cluster 1 and Cluster 3 respondents.
- Cluster 2 respondents heard more about geothermal energy in energy debates in the news (3.034), but less about climate change (3.729) and national security (3.068) than Cluster 1 and Cluster 3 respondents.

Finally, Cluster 3 had the following notable (and statistically significant) characteristics regarding sociopolitical issues:

- Cluster 3 respondents rated climate change (5.263), water shortages (5.316), food shortages (5.158) and terrorism (3.895) the highest among the clusters.
- Cluster 3 respondents rated the importance of environmental regulations (5.158) and pollution reduction (5.526) in developing effective strategies for sustainable energy the highest among the clusters.
- Cluster 3 respondents rated the importance of GHG mitigation the highest among the clusters (5.158).
- As with previous clusters, when asked about the importance of generating renewable energy twice, Cluster 3 respondents gave it comparable values (5.316 and 5.318), which were the highest among the clusters.
- Cluster 3 respondents rated the importance of energy accessibility (5.105) highest among the clusters.
- Cluster 3 respondents rated the impacts of biomass (2.737) and hydrogen (3.368) on the way of life lowest among the clusters.
- Cluster 3 respondents considered the role of the EU (4.842) and scientists and researchers (4.789) in the energy selection process as more important compared to the other two clusters. In contrast, media was considered as the least important (2.526) in comparison to the other two clusters.
- Cluster 3 respondents trusted the EU (4.526) the most and the media (1.895) the least compared to the other two clusters.
- Cluster 3 respondents ranked the importance of environmental impacts of energy systems (5.368) the highest among the three clusters.
- In energy debates in the news, Cluster 3 respondents heard about geothermal potential (2.579) the least frequently, whereas climate change (4.684) and national security (3.211) were heard the most frequently among the three clusters.

Table 4.6.d. Cluster size and centroids or frequencies of community acceptance variables (3 cluster solution) for cluster analysis on PCs from selected multimodal variables (with ANOVA F test red if significant at 95% confidence level; cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
N	22 (22%)	59 (59%)	19 (19%)	
Understand geothermal and how it works	5.045	4.78	3.947	4.97 (0.0089)
Facility location important in involving local communities in geothermal exploration	4.273	4.661	4.421	1.07 (0.3473)
Risks and benefits to society important in involving local communities in geothermal exploration	4.364	4.966	4.895	2.56 (0.0828)
Environmental impacts important in involving local communities in geothermal exploration	4.318	5.102	5.368	6.09 (0.0032)
Public health and safety important in involving local communities in geothermal exploration	3.909	4.983	5.211	8.71 (0.0003)
Insufficiently service maturity deters from switching to geothermal-only energy supply	3.364	4.254	4.316	4.12 (0.0192)
Hidden/ unknown costs deter from switching to geothermal-only energy supply	3.909	4.475	4.421	1.65 (0.1974)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Inconvenience of switching deters from switching to geothermal-only energy supply	2.909	4.102	2.947	9.75 (0.0001)
Credibility, transparency and trust deter from switching to geothermal-only energy supply	3.545	4.322	4.211	2.81 (0.0652)
Concerned about environmental impacts of geothermal drilling near property	4	4.712	5.316	4.57 (0.0127)
Concerned about aesthetics of geothermal drilling near property	3.136	3.881	3.368	2.36 (0.0997)
Concerned about safety of geothermal drilling near property	3.636	4.542	4.895	4.40 (0.0148)
Concerned about public health issues due to geothermal drilling near property	3.864	4.475	5.316	4.65 (0.0118)
Concerned about transparency of geothermal drilling near property	3.364	4.407	4.316	4.87 (0.0097)
Concerned about depreciation of property values due to geothermal drilling near property	3.318	4.492	4.526	7.17 (0.0012)
Reliability of energy supply convincing in purchasing energy from deep geothermal	4.864	5.068	4.895	0.4 (0.6747)
Economic benefits convincing in purchasing energy from deep geothermal	4.364	5.085	4.895	2.98 (0.0553)
Social benefits convincing in purchasing energy from deep geothermal	3.318	4.475	4	6.40 (0.0025)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Environmental benefits convincing in purchasing energy from deep geothermal	4.227	5.153	5.158	5.50 (0.0055)
Trust national/public administration to help decide about switching energy supplier	3.318	4.237	4.526	4.90 (0.0094)
Trust regional/local administration to help decide about switching energy supplier	3.409	4.068	3.947	2.46 (0.0906)
Trust print/broadcast media to help decide about switching energy supplier	1.909	3.424	2.316	13.9 (0.0000)
Trust Internet/social media to help decide about switching energy supplier	1.909	3.203	2.211	10.69 (0.0001)
Trust energy suppliers to help decide about switching energy supplier	2.773	3.305	2.947	1.42 (0.2473)
Trust environmental associations to help decide about switching energy supplier	2.5	4.119	3.684	13.07 (0.0000)
Trust research journals and expert publications to help decide about switching energy supplier	4.091	4.966	5.158	5.08 (0.0080)
Trust friends and colleagues to help decide about switching energy supplier	3.136	3.932	3.895	3.31 (0.0408)
Concerned if fossil fuel installations were built in the near area	4.318	4.983	5.158	2.51 (0.0863)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Concerned if nuclear energy installations were built in the near area	3.455	4.78	3.579	7.62 (0.0008)
Concerned if hydropower installations were built in the near area	3.045	3.186	2.421	1.75 (0.1795)
Concerned if wind installations were built in the near area	3.773	3.237	2.737	1.88 (0.1582)
Concerned if PVs were built in the near area	3.318	2.61	1.947	3.87 (0.0242)
Concerned if geothermal installations were built in the near area	2.818	2.966	3.158	0.28 (0.7600)
Concerned if biomass installations were built in the near area	3.591	3.305	2.947	0.82 (0.4446)
Concerned about GHG emissions of geothermal	2.182	3.508	4.316	9.54 (0.0002)
Concerned about landscape impacts of geothermal	2.909	3.763	3.737	2.82 (0.0646)
Concerned about infrastructure impacts of geothermal	2.955	3.678	3.421	2.11 (0.1273)
Concerned about induced seismicity of geothermal	3.5	4.085	4.211	1.45 (0.2400)
Concerned about water aquifer risks of geothermal	3.909	4.508	5.263	5.09 (0.0079)
Concerned about legal transparency of geothermal	2.682	4.203	3.526	10.82 (0.0001)
Receptive to geothermal if monitoring offered safety assurance	4.045	4.695	4.579	2.29 (0.1063)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Receptive to geothermal if electricity cost reductions	4.273	4.983	4.526	3.58 (0.0316)
Receptive to geothermal if increase in employment	3.636	4.475	3.947	3.72 (0.0277)
Receptive to geothermal if controlled by public institutions	3.909	4.186	4.053	0.46 (0.6331)
Receptive to geothermal if compensation for local residents	3.636	4.288	3.895	2.42 (0.0944)
Groundwater contamination contributes to public concern about deep geothermal drilling in the area	3.864	4.627	5.316	7.94 (0.0006)
Soil contamination contributes to public concern about deep geothermal drilling in the area	3.455	4.322	5.105	9.84 (0.0001)
Radioactive wastes contribute to public concern about deep geothermal drilling in the area	1.909	3.271	4.053	10.83 (0.0001)
Induced seismicity contributes to public concern about deep geothermal drilling in the area	3.818	4.475	5	4.10 (0.0196)
Air pollution contributes to public concern about deep geothermal drilling in the area	2.5	3.661	4.421	10.42 (0.0001)
Water use contributes to public concern about deep geothermal drilling in the area	3.864	4.458	4.947	3.99 (0.0217)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Visual impacts contribute to public concern about deep geothermal drilling in the area	3.409	4.136	4.263	3.02 (0.0534)
Noise contributes to public concern about deep geothermal drilling in the area	3.273	4.339	4.316	6.09 (0.0032)
Ever experienced an earthquake in the area	Yes 9 (40.41%)	Yes 30 (50.85%)	Yes 7 (36.84%)	
Earthquake unpleasant	3.3	3.793	3.375	0.45 (0.6374)
Area prone to earthquakes	Yes 9 (40.91%)	Yes 26 (44.07%)	Yes 8 (42.11%)	
Induced seismicity alters perspective towards geothermal	4.273	3.915	3.947	0.47 (0.6236)
Actively oppose geothermal drilling in the area	Yes 0 (0%)	Yes 5 (8.47%)	Yes 3 (15.79%)	

Cluster 1 had the following notable (and statistically significant) characteristics regarding community acceptance:

- Cluster 1 respondents rated their understanding of geothermal and how it works significantly higher (rating of 5.045) than Cluster 2 and 3 respondents (ratings of 4.78 and 3.947 respectively).
- Cluster 1 respondents rated the importance of environmental impacts (4.318) and public health and safety (3.909) in involving local communities in geothermal exploration lower than Clusters 2 and 3 respondents.
- Cluster 1 respondents rated insufficient service maturity as a factor in deterring switching to a geothermal-only energy supply (3.384) lower than Cluster 2 (4.254) and Cluster 3 (4.316) respondents.
- Cluster 1 respondents ranked the inconvenience of switching as a factor deterring them from switching to a geothermal-only energy supply (2.909) lower than Cluster 2 (4.102) and Cluster 3 (2.947) respondents.
- Cluster 1 respondents were less concerned about environmental impacts, safety, public health, transparency, and depreciation of property values due to geothermal drilling near the property (4, 3.636, 3.864, and 3.318, respectively) than Cluster 2 and Cluster 3 respondents.

- Cluster 1 respondents ranked social (3.318) and environmental (4.227) benefits as less convincing in purchasing energy from deep geothermal than Cluster 2 and Cluster 3 respondents.
- Compared to Clusters 2 and 3, Cluster 1 respondents had less trust in national/public administration (3.318), print/broadcast media (1.909), internet/social media (1.909), environmental associations (2.5), research journals and expert publications (4.091), and friends and colleagues (3.136) to help them decide whether to switch energy suppliers.
- Cluster 1 respondents were less concerned about nuclear energy installations built nearby (3.455), GHG emissions of geothermal (2.182), water aquifer risks of geothermal (3.909), and the legal transparency of geothermal than Cluster 2 and 3 respondents. On the other hand, they are more concerned about solar panels (PVs) built nearby (3.318).
- Compared to Cluster 2 and 3 respondents, Cluster 1 respondents were less receptive to geothermal energy if electricity costs fell (4.273) or employment rose (3.636).
- Cluster 1 respondents ranked groundwater and soil contamination (rankings of 3.864 and 3.455 respectively), radioactive wastes (1.909), induced seismicity (3.818), air pollution (2.5), water use (3.864), and noise (3.273) as contributing to public concern about deep geothermal drilling in their area, less than Cluster 2 and 3 respondents.
- A smaller percentage of Cluster 1 respondents experienced an earthquake (40.41%) than Cluster 2 (50.85%) and Cluster 3 (36.84%) respondents.

Cluster 2 had the following notable (and statistically significant) characteristics regarding community acceptance:

- Cluster 2 respondents placed a greater value (4,102) on the inconvenience of switching as a factor deterring people from switching to a geothermal-only energy supply than Cluster 1 and Cluster 3 respondents (2.909 and 2.947 respectively).
- Cluster 2 respondents were the most concerned about transparency of geothermal drilling near their property (4.407) compared to respondents in Cluster 1 and Cluster 3 (3.364 and 4.316 respectively).
- Cluster 2 respondents ranked social benefits (4.475) higher than Clusters 1 and 3, and their position on environmental benefits (5.153) was close to that of Cluster 3’s highest score (5.158).
- Regarding switching energy suppliers, Cluster 2 respondents trusted print/broadcast media (ranking of 3.424), Internet/social media (3.424), environmental associations (4.119) and friends and colleagues (3.932) more than Cluster 1 and 3 respondents.
- Cluster 2 respondents were more concerned about nuclear energy installations built nearby (4.78) than those in Clusters 2 and 3.
- Cluster 2 respondents were the most concerned about the legal transparency of geothermal (4.203), but also the most amenable to geothermal if electricity cost reductions (4.983) and employment growth (4.475) materialized.

- Cluster 2 respondents ranked the contribution of noise to public concern about geothermal drilling in their area (4.339) higher than respondents from Cluster 1 (3.273) and Cluster 3 (4.316).
- Half of the Cluster 2 respondents (50.85%) had experienced an earthquake. This was the highest percentage of respondents compared to Cluster 1 (40.41%) and Cluster 3 (36.84%). Cluster 2 also had the highest percentage of areas considered to be earthquake-prone (44.07%).

Finally, Cluster 3 had the following notable (and statistically significant) characteristics regarding community acceptance:

- Cluster 3 respondents rated understanding geothermal and how it works significantly lower (3.947) than Cluster 1 (5.045) and Cluster 2 (4.78).
- Cluster 3 respondents rated environmental impacts (5.368) and public health and safety (5.211) in involving local communities in geothermal exploration higher than Clusters 1 and 2.
- Cluster 3 respondents rated insufficient service maturity as a deterring factor in switching to a geothermal-only energy supply (4.316) higher than Cluster 1 (3.364) and Cluster (4.254) respondents.
- Compared to Clusters 1 and 2, Cluster 3 respondents appeared more concerned (ratings of 5.316, 4.895, 5.316, and 4.526, respectively) about environmental impacts, safety, health issues, and depreciation of property values due to geothermal drilling near the property.
- Cluster 3 respondents rated environmental benefits as a more convincing factor in purchasing energy from deep geothermal (5.158) compared to the respondents of Clusters 1 and 2 (4.227 and 5.153 respectively).
- Cluster 3 respondents trusted national and public administration as a factor in deciding about switching energy suppliers (4.526) more than Cluster 1 and 2 respondents (3.318 and 4.237 respectively).
- Cluster 3 respondents trusted research journals and expert publications to help them decide about switching energy suppliers (rating of 5.158) more than Cluster 1 and 2 respondents (ratings of 4.091 and 4.966 respectively.
- Compared to Cluster 1 and 2, Cluster 3 respondents were the most concerned about fossil fuel installations built nearby (5.158).
- Cluster 3 respondents were the least concerned about PVs being built nearby (rating of 1.947, compared to 3.318 and 2.61 for Clusters 1 and 2 respectively).
- Cluster 3 respondents were the most concerned about GHG emissions of geothermal (rating of 4.316, compared to 2.182 and 3.508 for Clusters 1 and 2 respectively).
- Cluster 3 respondents were the most concerned about water aquifer risks of geothermal (rating of 5.263 compared to 3.909 and 4.508 for Clusters 1 and 2 respectively).
- Cluster 3 respondents thought that groundwater contamination (5.317), soil contamination (5.105), radioactive wastes (4.053), induced seismicity (5), air pollution

(4.421), and water use (4.947) contributed more to public concern about deep geothermal drilling in their area than the respondents of Clusters 1 and 3.

- Cluster 3 respondents experienced earthquakes at the lowest rate (36.84%) when compared to Cluster 1 (40.41%) and Cluster 2 (50.85%). A higher proportion of Cluster 3 respondents believed that their area was earthquake-prone (42.11%).

Table 4.6.e. Cluster size and centroids or frequencies of market acceptance variables (3 cluster solution) for cluster analysis on PCs from selected multimodal variables (with ANOVA F test red if significant at 95% confidence level; cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
N	22 (22%)	59 (59%)	19 (19%)	
Offer of public incentives or facilitating measures to help transition to geothermal	Not aware 15 (68.18%) None 4 (18.18%) Not sure 2 (9.09%) I know a few 1 (4.55%)	Not aware 30 (50.85%) Not sure 18 (30.51%) I know a few 6 (10.17%) None 5 (8.47%)	Not aware 11 (57.89%) Not sure 5 (26.32%) I know a few 2 (10.53%) None 1 (5.26%) etc.	
Quantity of incentives or facilitating measures to help transition to geothermal	2.091	2.492	2.211	0.74 (0.4820)
Economic benefits influential for switching to geothermal only energy provider	4.682	5.068	5.105	1.17 (0.3160)
Social benefits influential for switching to geothermal only energy provider	3.409	4.153	3.789	3.20 (0.0449)
Community awareness influential for switching to geothermal only energy provider	3.5	4.034	3.579	2.19 (0.1177)
Environmental benefits influential for switching to geothermal only energy provider	4.409	4.847	5.211	2.48 (0.0889)

Variable (short description)	*Cluster 1*	*Cluster 2*	*Cluster 3*	*ANOVA F (p-value)*
Lower geothermal energy costs affect overall attitude toward geothermal drilling	4.773	4.763	4.316	1.32 (0.2727)

Cluster 1 had the following notable (and statistically significant) characteristics regarding market acceptance:

- More Cluster 1 respondents were unaware (68.18%) of public incentives or facilitating measures to help transition to geothermal energy (compared to 50.85% and 57.89% for Clusters 2 and 3 respectively).
- Finally, Cluster 1 respondents ranked the influence of social benefits on the decision to switch to a geothermal-only energy provider (3.409) lower than Cluster 2 (4.153) and Cluster 3 (3.789) respondents.

Cluster 2 had the following notable (and statistically significant) characteristics regarding market acceptance:

- Cluster 2 respondents were the least likely to be aware of public incentives or facilitating measures to help in the transition to geothermal energy (50.85%), but had the highest percentage of respondents who were not sure (30.51% vs. 9.09% for Cluster 1 and 26.32% for Cluster 3).
- Cluster 2 respondents valued the influence of social benefits on the decision to switch to a geothermal-only energy provider (4.153) more than Cluster 1 (3.409) and Cluster 3 (3.789) respondents.

Finally, Cluster 3 had the following notable (and statistically significant) characteristics regarding market acceptance:

- There were minor differences in the proportion of Cluster 3 respondents that were unaware of public incentives or facilitating measures to help transition to geothermal energy at the intermediate percentage (57.89% compared to 68.18% for Cluster 1 and 50.85% for Cluster 2).

The three-cluster approach is favored to the two-cluster solution due to the greater number of variables with a statistically significant difference among cluster centroids (50 versus 88 respectively), allowing for a more meaningful differentiation between the clusters.

The characteristics of the three clusters are outlined in the following table.

Table 4.7. Cluster characterization

Cluster 1 *"lower income, most familiar with geothermal, skeptical, distrustful"*	Cluster 2 *"concerned, trustful, community oriented"*	Cluster 3 *"upper income, least familiar with geothermal, focused concern, science-minded"*
● Intermediate size (22 respondents) ● Lowest average income ● Respondents mostly from other urban and suburban areas ● Most familiar with geothermal; best understanding of geothermal and how it works ● Least concerned about urgency of GHG emissions, environmental issues, environmental impacts of geothermal, and environmental regulations ● Preferring national and regional authorities to the EU ● Consistent (via 2 questions) lowest rating of the necessity to produce renewable energy ● Considering solar, wind and geothermal to be the least impactful on the way of life ● Least concerned about economic and community issues ● Least exposed to geothermal in the news ● Least trustful of various authorities (media etc.), with research journals and expert publications being relative more trusted ● No active opposition to geothermal drilling	● Largest (59 respondents) ● Most male respondents ● Most concerned about environmental issues and aesthetics ● Most concerned about socioeconomic, institutional, and community issues ● Preferring national, EU and local authorities to producers and suppliers ● Consistent (via 2 questions) intermediate rating regarding the necessity of producing renewable energy ● Considering solar, wind, geothermal, and biomass to be the most impactful on the way of life ● Considering the role of scientists and researchers in energy selection less important ● Underestimating the importance of energy independence ● Most concerned about nearby nuclear energy installations ● Least concerned about induced seismicity changing people's perspective about geothermal energy ● Most trustful of the media, NGOs, environmental associations, colleagues, and friends	● Smallest (19 respondents) ● Most female respondents ● Highest average income ● Least familiar with geothermal ● Highest concern for climate change effects and biodiversity, moderate concern about other environmental issues ● Preferring national, EU and regional authorities to producers and suppliers ● Consistent (via 2 questions) highest rating regarding the necessity of producing renewable energy, and considering oil most impactful on the way of life ● Considering scientists and researchers in energy selection very important ● Trusting the EU and national governments, but not the media ● Most concerned about nearby geothermal installations ● Most concerned about groundwater/soil contamination, water use, air pollution, noise, and geothermal induced seismicity ● Prioritize academic/research/expert publications ● Highest active opposition to geothermal drilling

In the conclusions section of this deliverable, the character of the three clusters is considered while developing recommendations for the project's benefit.

4.4 Discussion

This section focuses on certain issues of interest.

4.4.1 NIMBY attitudes

An analysis of the different clusters' NIMBY (not in my backyard) and PIMBY (please in my backyard) attitudes may help in the acceptance of geothermal energy by the general public.

Cluster 1 respondents appeared to be the least worried about the environmental consequences of geothermal drilling or other energy sources near their property. Furthermore, they valued the social acceptance of geothermal energy the lowest among the three clusters. An example is the worry about GHG emissions from geothermal drilling, which is the lowest of the three groups. It is worth noting that Cluster 1 respondents thought that they were the most familiar with geothermal energy and understood better how it works. Furthermore, they had the least faith in environmental organizations. However, worry was higher in the case of wind or PV installations than in the other two Clusters. There were noCluster 1 respondents who would actively oppose geothermal drilling activities in their region. It may be argued that Cluster 1 respondents adopted a rather dispassionate stance concerning geothermal drilling activities. The reactionary attitude characterizing Cluster 1, considering their low trust in organizations and media and their low esteem of environmental issues, is probably countered by their better impression of academic researchers and experts.

Cluster 2 respondents placed a greater emphasis on technological, commercial, social, and economic aspects associated with the development of geothermal energy. In most environmental concern items, they assigned the highest responses among the three clusters. They were also the most concerned about the impacts of energy systems on the environment and attributed high importance to organizations and institutions in the energy selection process. However, given that they appear to be the most receptive cluster towards geothermal energy development in their area and given specific incentives and benefits, one could argue that their attitude could change. Their responses suggest that a well-established legal and social framework would also change their opinions about geothermal drilling. Cluster 2 respondents are therefore quite responsive to geothermal energy, and any NIMBYism existing in the cluster might be mitigated with the proper public approach plan.

Cluster 3 was the only Cluster where females comprised the majority of respondents (52.63%) and believed that they had the lowest understanding of how geothermal energy works. They considered public acceptance of geothermal energy the most significant among the three clusters and they prioritized environmental, public health, legal, and safety considerations. They trusted the EU and valued the importance of energy independence, efficiency, and availability. Cluster 3 respondents had the most negative sentiments toward geothermal installation expansion in their region and hydraulic stimulation for geothermal drilling. On the contrary, they were not very concerned about wind, PVs, and hydroelectric plants in their region. Given that these three renewable energy sources are among the most prevalent in the EU, it is reasonable to conclude that Cluster 3 respondents could be easily persuaded by EU-planned ads touting the advantages of geothermal energy. Cluster 3 respondents were also very concerned about induced seismicity and water aquifer issues related to geothermal energy development in their area. Finally, Cluster 3 contained the largest number of respondents (15.79%) who would actively oppose geothermal drilling in their area. This shows a more pervasive NIMBY mentality in Cluster 3, which might be addressed if European-level incentives and a public education campaign were established.

4.4.2 Skeptical attitudes

Trust items may flag skeptical, somewhat reactionary individuals, those who feel that perhaps they have been left behind. The following table lists variables that may characterize such respondents, ranked in increasing overall mean ranking. As previously, the cells of this table are color coded, with a green highlight indicating the highest value and a yellow highlight indicating the lower value of the respective characteristic.

Table 4.8. Variables characterizing skeptical respondents
(cells with a green highlight indicate the highest value while cells with a yellow highlight indicate the lowest value of the centroid or other measure of the respective variable)

Variable description	*Size (N) or overall mean*	*Size (N) or Cluster 1 centroid*	*Size (N) or Cluster 2 centroid*	*Size (N) or Cluster 3 centroid*	*ANOVA F (p-value)*
N	100	22 (22%)	59 (59%)	19 (19%)	
Trust media (1~6)	2.52	1.909	2.949	1.895	10.17 (0.0001)
Trust Internet and social media to help you decide to switch energy suppliers (1~6)	2.73	1.909	3.203	2.211	10.69 (0.0001)
Trust print and broadcast media to help you decide to switch energy suppliers (1~6)	2.88	1.909	3.424	2.316	13.9 (0.0000)
Trust energy companies (1~6)	2.95	2.545	3.102	2.947	1.54 (0.2188)
Trust energy suppliers to help you decide to switch energy suppliers (1~6)	3.12	2.773	3.305	2.947	1.42 (0.2473)
Trust regional/local governments (1~6)	3.64	3.227	3.797	3.632	2.00 (0.1405)
Trust national governments (1~6)	3.66	3.364	3.661	4	1.18 (0.3129)
Trust environmental associations to help you decide to switch energy suppliers (1~6)	3.68	2.5	4.119	3.684	13.07 (0.0000)
Trust EU (1~6)	3.75	3.045	3.763	4.526	5.26 (0.0068)
Trust regional/local administration to help you decide to switch energy suppliers (1~6)	3.90	3.409	4.068	3.947	2.46 (0.0906)

Variable description	*Size (N) or overall mean*	*Size (N) or Cluster 1 centroid*	*Size (N) or Cluster 2 centroid*	*Size (N) or Cluster 3 centroid*	*ANOVA F (p-value)*
Trust national (public) administration to help you decide to switch energy suppliers (1~6)	4.09	3.318	4.237	4.526	4.90 (0.0094)
How much would credibility, transparency, and trust deter you from switching to geothermal only (1~6)	4.13	3.545	4.322	4.211	2.81 (0.0652)
Trust academic/research/ expert publications to help you decide to switch energy suppliers (1~6)	4.81	4.091	4.966	5.158	5.08 (0.0080)

The following may be observed:

- Respondents with the lowest rankings in almost all categories were in Cluster 1, which may be considered to contain most skeptical respondents.
- A skeptical attitude is perhaps flagged by a negative impression of the media, followed by a reduced trust in various energy authorities and actors (e.g. energy companies, the EU, national governments, and regional authorities).
- Interestingly, these skeptical respondents still had a relatively high impression of academic researchers and experts.

4.4.3 Energy tribes

Some perspectives on the presence of energy tribes and the development of "messy" or "clumsy" policy solutions are now presented in light of the findings of the statistical analysis of responses.

Core ecologists perceive the social setting in an egalitarian way (Caputo, 2009). These people are concerned about the environmental impacts of energy systems. Respondents from Cluster 2 and, to a lesser extent, Cluster 3 are likely to fall into this category. The policies that will be designed to persuade people in this group about the benefits of geothermal energy should emphasize its environmental advantages over fossil fuels. The ORCHYD project, which significantly reduces the environmental footprint of geothermal drilling operations, should be promoted and communicated to the general public, preferably by the EU, national governments, and scientists and researchers, who appear to be the best channels for such dissemination to the core ecologists group.

Environmental management in a hierarchical social setting requires certified experts to ensure that nature is stable and the world is controllable. This translates into governments enacting scientifically based environmental, energy, and economic policies. Given the high level of trust in researchers and scientists that respondents in all three clusters have, it is vital that well-documented environmental studies be disseminated and promoted. This underscores the need of implementing energy schemes such as deep geothermal energy, as well as the need for

cutting-edge research in areas such as deep geothermal drilling. Such solutions increase economic viability and efficiency while also addressing typical geothermal environmental, health, and safety issues such as induced seismicity, noise, and water aquifer contamination. Any policy designed for this group of people must be accompanied by comprehensive scientific documentation on the risks and benefits of deep geothermal energy.

Those who conform to the individualistic social setting have a worldview centered on a more market-ideology oriented lifestyle that accepts unfairness as a natural aspect of existence (Caputo, 2009). Such individuals may be found among the respondents of Cluster 2 and, to a lesser extent, Cluster 1. These people are unlikely to oppose any development since they feel institutional engagement with markets is an important societal requirement. They would prefer to be neutral or even advocate for such initiatives, as long as they were convinced of their economic and environmental benefits. The economic and social benefits of a geothermal project in their location should be stressed to promote societal acceptance among this group of people. The economic and environmental benefits provided by cutting-edge geothermal drilling technology (as in the case of ORCHYD) may offer this set of people a perception of geothermal energy as a competitive service with commercial worth.

Finally, individuals who embrace a fatalistic social context feel that there is no hope for positive change since man is fickle and untrustworthy (Caputo, 2009). This group is most likely found in Cluster 1, which is distinguished by both a reactive and a dispassionate posture. Given that Cluster 1 people would not vigorously resist geothermal development in their area, there is little need to establish a novel policy to reach them. This group's relatively high trust in academics and scientists, on the other hand, sets the way for a far-reaching campaign based on (mostly open-access) scientific sources promoting the environmental and economic benefits of geothermal energy.

4.4.4 Further considerations

The respondents' high educational level indicates that those with less education were less likely to respond to the questionnaire. There seems to be no relationship between familiarity with geothermal and significance of public acceptance of geothermal energy. Respondents considered public acceptance to be important for geothermal, but they were not personally concerned. Furthermore, although most respondents were unaware of any incentives, they did not believe that the quantity of incentives or facilitating measures would aid in the transition to geothermal.

Respondent comments at the end of Section 2 (Environmental concerns) acknowledged the effort to address the vast majority of deep geothermal drilling's environmental concerns. However, one respondent raised concern that the highlighted environmental problems might discourage people from accepting deep geothermal drilling, or at the very least influence their responses to the remainder of the poll. Seismicity comments revealed widespread concern about seismicity effects, which was confirmed by the extensive literature review in Environmental Impact Assessment (Task 3.1) and Social Impact Assessment (Task 3.2). Many respondents resided in a megacity (Paris, London, Beijing, and Chennai), which may have contributed to their concern about traffic congestion.

Respondent comments on sociopolitical issues (Section 3) emphasized the importance of energy costs to public acceptance, as well as the importance of communication and knowledge dissemination. There were no comments on section 4 (community acceptance). Finally, there

were comments about geothermal energy's financial approach in Section 5 (Market acceptance). One of them was concerned with the volatility of energy prices, which are subject to financial speculation. The fact that geothermal projects are decided on a regional or city scale and that individuals cannot choose between geothermal energy and other forms of renewable energy was added as a comment.

5 Conclusions and recommendations

Recapping the work carried out in this report, including the findings of the statistical analysis and the effort to establish social perception groupings, the following conclusions are reached as to the nature of the three clusters:

- Cluster 1, which accounted for 22% of all responses, consisted of respondents with the lowest incomes who were most familiar with geothermal yet were skeptical and distrustful. These respondents were least concerned with environmental issues, were least supportive of developing renewable energy, and supported national and regional authorities over the EU. These respondents also believed that geothermal would be among the energy forms that would have the least impact on our way of life. Despite having minimal trust in many authorities, including the media, these respondents trusted research and expert sources more. Finally, there was little willingness among these respondents to oppose geothermal drilling.
- Cluster 2 was the group of respondents that were concerned, less trusting, and more community oriented, accounting for 59% of all replies. Environmental, socioeconomic, institutional, and community issues were of particular concern to these respondents. In contrast to Cluster 1, these respondents believed that geothermal would be among the energy forms that would have the most impact on our way of life. National, European, and local government authorities were preferred by these respondents over producers and suppliers. Interestingly, these respondents undervalued the significance of scientists and researchers, underestimated the significance of energy independence, and discounted the influence of induced seismicity. Finally, these respondents trusted the media, NGOs, environmental organizations, colleagues, and friends the most.
- Cluster 3, which accounted for 19% of all replies, consisted of respondents with the highest income, were less familiar with geothermal, exhibited focused concern, and were more science-minded. These respondents were the most concerned about climate change and favored national, European and regional authorities to producers and suppliers. Also, these respondents considered oil to be the most impactful on our way of life and regarded very highly the importance of producing renewable energy. These respondents also considered scientists and researchers very important, valued academic/research/expert publications, and trusted the EU and national governments, but not the media. Finally, these respondents were the most concerned about groundwater/soil contamination, water use, air pollution, noise, and geothermal induced seismicity, and were the most actively opposed to geothermal drilling.

The following broad conclusions may also be drawn (irrespective of clusters):

- A safe strategy for promoting geothermal energy is to emphasize its role in improving energy efficiency, energy availability, and energy independence.

- Because the public is concerned about the environmental impacts of energy systems, promoting innovative technologies, such as those developed by ORCHYD, as a means of mitigating them, is a good strategy.
- It is essential to capitalize on how well geothermal energy is accepted as a source of heating.
- Although its news coverage is mediocre, there are more effective ways to promote geothermal energy.
- Economic incentives could act as a significant component of public acceptance, especially during the energy crisis that has followed the situation in Ukraine and the continuous rise of inflation levels.

Table 5.1. concludes this report by providing a list of specific recommendations aimed at increasing the public acceptance of geothermal energy.

Table 5.1. List of literature and empirical considerations and recommendations for increased public acceptance of geothermal exploration

Recommendations from the research literature
1. Promote the geothermal education of local communities (as well as public schools and universities).
2. Development geothermal partnership schemes with local communities (like the Energy Communities initiatives of the EU).
3. Disseminate accurate information in an understandable and culturally appropriate manner. In particular, promote comprehensively documented environmental reports and favor open access sources.
4. Promote early communication to avert a decline in acceptance and encourage active engagement among stakeholders.
5. Contextualize local energy siting politics within a broader national policy framework.
Recommendations from empirical findings
1. Some people will be more receptive to geothermal energy, even with hydraulic stimulation. Seek them out and help them take on the role of geothermal energy champion.
2. Some people are more familiar with geothermal energy and worry less about geothermal activities in their region. Seek them and recruit them as NIMBY warriors.
3. Some people know little of geothermal energy and worry the most about geothermal activities in their region. Nonetheless, these people agree on the need to develop renewable energy, and consider the role of scientists and researchers very important. Therefore, scientists, researchers and experts should be involved in approaching them.
4. On geothermal issues, almost everyone trusts their national governments more than any other institution or organization. Also, national government policies and communication campaigns are most likely to influence public understanding of geothermal energy. Therefore, prioritize the role of the national government in fostering geothermal exploration.

5. Nearly everyone trusts scientists and researchers, but distrusts NGOs, environmental groups, and grassroots movements. In particular, dissemination activities involving academics and scientists are likely to have a more significant influence on public perceptions than activism and other types of communication used by NGOs, environmental groups, and grassroots movements. Therefore, involve scientists, researchers and experts, and avoid involving parties perceived negatively in promoting geothermal energy.
6. Nearly everyone values energy independence, efficiency, affordability, availability, and source diversification. It is recommended that these ideas be used to drive the promotion of the (general) concept of geothermal energy.
7. Nearly everyone values environmental protection, community awareness and consultation, public health, and economic gains. It is recommended that these concepts be used to spearhead the (specific) concept of geothermal exploration.
8. In communities with established weak knowledge of geothermal energy and comprehension of how it works, dissemination activities should draw on their faith in the European Union and scientists and researchers.
9. Dissemination activities among reactionary communities should draw dispassionately on scientific and research sources papers. Therefore, utilize news developments, polls, and surveys to identify such populations, and adopt such sources to calm their anxieties and persuade them of the merits of geothermal energy and the importance of geothermal exploration.
10. Although there are better ways to promote geothermal energy, help increase its presence in the media in order to communicate novel drilling technologies to the public – more knowledge is likely to lead to more acceptance.
11. Leverage economic incentives as a major component of public acceptance, particularly after the conflict in Ukraine (2022).

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APPENDIX A: Variables of final survey

All in all, the final questionnaire contained a total of 164 quantitative and qualitative variables, excluding the optional open-ended comments requested at the conclusion of each section. These variables are now listed, along with selected descriptive information, starting with Table A.1, which contains the variables of the background (demographic) Section 1 of the questionnaire. The names of the variables that are used in graphs (mostly in capital letters) are shown in parentheses.

Table A.1. Variables of Section 1 (Background information) of the questionnaire (table cells are color coded in green or amber to indicate related question items)

	Question (and variable) description	*N*	*Values*
1	What is your gender? (GENDER)	100	72 male, 28 female
2	What is your age? (classes, AGE)	100	mean≅40.88 mode≅35 st. dev.≅13.07 min≅24 max≅65
3	What is your marital status? (MARITAL STATUS)	100	57 married/with partner, 34 single, etc.
4	Number of children (CHILDREN)	97	46 no children, 14 one, 28 two, 8 three, etc.
5	What is your educational background? (EDUCATION)	100	31 university, 28 doctoral, 18 postgraduate, 18 post doctoral, 3 vocational, 2 secondary
6	Which of the following professional classifications best describes you? (PROFESSIONAL)	99	27 researcher, 13 private employee, 12 university faculty, 11 student, 5 state employee, etc.
7	How many years of professional experience do you have? (EXPERIENCE YEARS)	100	mean=15.23 mode=2.5 st.dev.=11.68 min=0 max=42.5
8	What is your annual income? (classes of thousand euros, INCOME)	88	mean≅46 mode≅35 st.dev.≅40 min=0 max≅over 100
9	Which country do you currently reside in? (COUNTRY)	98	40 France, 22 Greece, 12 Norway, 9 China, 5 UK, etc.
10	Which city do you currently reside in? (CITY)	98	11 Athens, 10 Paris, 8 Trondheim, 6 Qingdao, 5 London, 5 Pau, etc.

	Question (and variable) description	*N*	*Values*
11	How would you characterize the area in which you reside? (DENSITY)	100	36 other urban area, 24 megacity (i.e. over 10 million inhabitants), 16 suburban, 12 rural, 8 densely populated, etc.
12	Which of the following energy consumer types describe your current situation? (CONSUMER)	100	60 householder, 26 tenant/leaseholder, etc.
13	Which is the energy source you use for heating? (ENERGY SOURCE)	79	39 electricity, 19 natural gas, 7 electricity and natural gas, 6 oil; etc.
14	Do you think your energy utility bill is too high? (1~6, ELEC BILL TOO HIGH)	79	mean=4.241 mode=5 st. dev.=1.313
15	Please select the options that apply to your current situation from the list below (regarding household members) (AT LEAST ONE HOUSEHOLD MEMBER)	61	29 under the age of 12, 23 over the age of 60, 8 unemployed, etc.
16	How familiar are you with geothermal energy exploration and development (including drilling)? (1~6, FAMILIAR with GEOTHERMAL)	100	mean=3.86 mode=5 st. dev.=1.538
17	What is the distance between your residence and the closest known to you geothermal exploration activities (e.g. drilling)? (DISTANCE to GEOTHERMAL)	96	49 don't know/not sure, 24 over 50 km, 14 up to 25 km, 8 from 25 to 50 km, etc.
18	What is the significance of public acceptance of geothermal energy development, in your opinion? (1~6, SIGNIF of PUBL ACCEPT of GEOTH)	100	mean=4.35 mode=5 st. dev.=1.29

Next comes Table A.2 that lists the variables of the environmental Section 2 of the questionnaire. To facilitate inspection, items that belong to the same question are color-coded.

Table A.2. Variables of Section 2 (Environmental concerns) of the questionnaire

	Question (and variable) description	*N*	*Values*
19	How urgent, in your opinion, are the following environmental concerns? Decline of biodiversity (1~6, URGENT DECL BIODIVERS)	100	mean=4.57 mode=6 st. dev.=1.358
20	How urgent, in your opinion, are the following environmental concerns? River and seawater pollution (1~6, URGENT RIVER WATER POLLUTION)	100	mean=4.79 mode=5 st. dev.=1.225
21	How urgent, in your opinion, are the following environmental concerns? Air pollution (1~6, URGENT AIR POLLUTION)	100	mean=4.72 mode=5 st.dev.=1.326

	Question (and variable) description	*N*	*Values*
22	How urgent, in your opinion, are the following environmental concerns? Acid rain (1~6, URGENT ACID RAIN)	100	mean=3.84 mode=4 st. dev.=1.398
23	How urgent, in your opinion, are the following environmental concerns? Soil pollution/contamination (1~6, URGENT SOIL CONTAMINATION)	100	mean=4.34 median=5 st. dev.=1.281
24	How urgent, in your opinion, are the following environmental concerns? Waste disposal (1~6, URGENT WASTE DISPOSAL)	100	mean=4.47 mode=5 st. dev.=1.275
25	How urgent, in your opinion, are the following environmental concerns? Temperature increase (1~6, URGENT TEMP INCREASE)	100	mean=4.59 mode=6 st. dev.=1.609
26	How urgent, in your opinion, are the following environmental concerns? Extreme weather conditions (1~6, URGENT EXTREME WEATHER)	100	mean=4.44 mode=6 st. dev.=1.472
27	How urgent, in your opinion, are the following environmental concerns? Exploitation of natural resources (1~6, URGENT EXPLOIT NATURAL RESOURCE)	100	mean=4.29 modes=5, 6 st. dev.=1.486
28	How urgent, in your opinion, are the following environmental concerns? Traffic congestion (1~6, URGENT TRAFFIC CONGESTION)	100	mean=3.66 mode=4 st. dev.=1.343
29	How urgent, in your opinion, are the following environmental concerns? Noise (1~6, URGENT NOISE)	97	mean=3.526 mode=4 st. dev.=1.234
30	In your opinion, how important is the total impact of the existing energy production model on the aforementioned environmental issues? (1~6, TOT ENV IMP of ENERGY PROD MOD)	100	mean=4.92 mode=5 st. dev.=1.002
31	How much would air pollution affect your attitude toward geothermal development in your area? (1~6, AIR POLL AFFECT ATTITUDE GEOTH)	100	mean=4.21 mode=5 st. dev.=1.282
32	How much would noise pollution affect your perception of geothermal development in your community? (1~6, NOISE AFFECT PERCEPT GEOTH)	100	mean=3.54 modes=3, 5 st. dev.=1.388

	Question (and variable) description	*N*	*Values*
33	How much would aesthetic degradation and visual intrusion affect your attitude toward geothermal development in your area? (1~6, VISUAL AFFECT ATTITUDE GEOTH)	100	mean=3.46 mode=3, 4 st. dev.=1.396
34	How much would degradation and/or depletion of water resources affect your attitude towards geothermal development in your area? (1~6, DEGR WATER AFFECT ATTITUD GEOTH)	100	mean=4.55 mode=5 st. dev.=1.184

Table A.3 lists the variables of the sociopolitical Section 3 of the questionnaire.

Table A.3. Variables of Section 3 (Sociopolitical issues) of the questionnaire

	Question (and variable) description	*N*	*Values*
35	In your opinion, how urgent are the following global issues? Climate change (1~6, URGENT CLIMATE CHANGE)	100	mean=4.84 mode=6 st. dev.=1.522
36	In your opinion, how urgent are the following global issues? Water shortages (1~6, URGENT WATER SHORTAGES)	100	mean=4.89 mode=5 st. dev.=1.23
37	In your opinion, how urgent are the following global issues? Food shortages and famine (1~6, URGENT FOOD SHORTAGES)	100	mean=4.8 mode=5 st. dev.=1.172
38	In your opinion, how urgent are the following global issues? Pandemic crises and their impacts (1~6, URGENT PANDEMICS)	100	mean=4.19 mode=4 st. dev.=1.3
39	In your opinion, how urgent are the following global issues? Economic crises and unemployment (1~6, URGENT ECON CRISES UNEMPL)	100	mean=4.27 mode=4 st. dev.=1.024
40	In your opinion, how urgent are the following global issues? Poverty (1~6, URGENT POVERTY)	100	mean=4.42 mode=5 st. dev.=1.257
41	In your opinion, how urgent are the following global issues? Terrorism (1~6, URGENT TERRORISM)	100	mean=3.84 mode=4 st. dev.=1.354
42	Who (i.e. which authorities), in your opinion, should ultimately decide on geothermal exploration and drilling? (DECISION MAKERS)	100	71 national, 49 regional, 48 EU, 46 local, 24 environmental groups, 23 citizen, 16 producer, 15 supplier, 6 other

	Question (and variable) description	*N*	*Values*
43	Are you aware of any recent initiatives to promote more sustainable energy generation and consumption? (AWARE of INITIATIVES)	100	54 aware of a few but uncertain, 21 unaware, 20 there are a couple but unsure, 5 aware
44	How important do you think environmental regulations are in developing effective strategies for sustainable energy systems? (1~6, IMPORT ENV REGUL for SUST ENER)	100	mean=4.91 mode=5 st. dev.=1.12
45	How important do you think the following are? Pollution reduction (1~6, IMPORT POLLUT REDUCT)	100	mean=4.92 mode=5 st. dev.=1.041
46	How important do you think the following are? Mitigation of greenhouse gas emissions (1~6, IMPORT GHG MITIGATION)	100	mean=4.8 mode=6 st. dev.=1.295
47	How important do you think the following are? Energy conservation (1~6, IMPORT ENERGY CONSERVATION)	100	mean=4.69 mode=6 st. dev.=1.228
48	How important do you think the following are? Development of renewable energy (1~6, IMPORT DEVEL RENEW ENER_1)	100	mean=4.89 mode=6 st. dev.=1.163
49	How important do you think the following are? Energy accessibility (1~6, IMPORT ENERGY ACCESSIBILITY)	100	mean=4.86 mode=5 st. dev.=1.025
50	How important do you think the following are? Energy price stability (1~6, IMPORT ENERGY PRICE STABILITY)	100	mean=4.76 mode=6 st. dev.=1.084
51	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Coal (1~6, IMPACT COAL on WoL)	79	mean=3.354 mode=2 st. dev.=1.687
52	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Oil (1~6, IMPACT OIL on WoL)	79	mean=4.253 mode=4 st. dev.=1.255
53	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Natural gas (1~6, IMPACT NATURAL GAS on WoL)	79	mean=4.544 modes=4, 6 st. dev.=1.249
54	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Solar (1~6, IMPACT SOLAR on WoL)	100	mean=4.42 mode=5 st. dev.=1.35

	Question (and variable) description	*N*	*Values*
55	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Wind (1~6, IMPACT WIND on WoL)	100	mean=4.06 mode=5 st. dev.=1.448
56	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Hydropower (1~6, IMPACT HYDRO on WoL)	100	mean=4.35 mode=5 st. dev.=1.403
57	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Geothermal (1~6, IMPACT GEOTHERM on WoL)	100	mean=4.18 mode=4 st. dev.=1.359
58	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Biomass/biofuels (1~6, IMPACT BIOMASS on WoL)	100	mean=3.73 mode=4 st. dev.=1.355
59	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Hydrogen (1~6, IMPACT HYDROGEN on WoL)	100	mean=4.03 mode=5 st. dev.=1.403
60	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Nuclear (1~6, IMPACT NUCLEAR on WoL)	79	mean=4.734 mode=5 st. dev.=1.402
61	How important do you consider the following actors in the energy selection process? European Union (1~6, IMPORT SELECT EU)	100	mean=4.55 mode=5 st. dev.=1.359
62	How important do you consider the following actors in the energy selection process? National governments (1~6, IMPORT SELECT NATION GOV)	100	mean=4.88 mode=6 st. dev.=1.233
63	How important do you consider the following actors in the energy selection process? Local authorities (1~6, IMPORT SELECT LOCAL AUTH)	100	mean=4.2 mode=5 st. dev.=1.497
64	How important do you consider the following actors in the energy selection process? Energy companies (1~6, IMPORT SELECT ENER COMPAN)	100	mean=4.07 mode=5 st. dev.=1.444

	Question (and variable) description	*N*	*Values*
65	How important do you consider the following actors in the energy selection process? Scientists and researchers (1~6, IMPORT SELECT SCIENT RESEARCH)	100	mean=4.47 mode=5 st. dev.=1.329
66	How important do you consider the following actors in the energy selection process? Media (1~6, IMPORT SELECT MEDIA)	100	mean=3.66 mode=4 st. dev.=1.584
67	How important do you consider the following actors in the energy selection process? Non-Governmental Organizations (NGOs) (1~6, IMPORT SELECT NGOs)	100	mean=3.52 mode=5 st. dev.=1.425
68	How important do you consider the following actors in the energy selection process? Environmental organizations (1~6, IMPORT SELECT ENV ORGs)	100	mean=3.76 mode=5 st. dev.=1.372
69	How important do you consider the following actors in the energy selection process? Grassroot movements (1~6, IMPORT SELECT GRASSROOT)	100	mean=3.47 mode=3 st. dev.=1.547
70	How important do you consider the following actors in the energy selection process? Individual citizens (1~6, IMPORT SELECT CITIZENS)	100	mean=3.35 mode=3 st. dev.=1.714
71	How much do you trust the following sources? European Union (1~6, TRUST EU)	100	mean=3.75 mode=5 st. dev.=1.52
72	How much do you trust the following sources? National governments (1~6, TRUST NATIONAL GOV)	100	mean=3.66 mode=5 st. dev.=1.327
73	How much do you trust the following sources? Regional/local governments (1~6, TRUST REGIONAL)	100	mean=3.64 mode=4 st. dev.=1.15
74	How much do you trust the following sources? Energy companies (1~6, TRUST ENERGY COMP)	100	mean=2.95 mode=3 st. dev.=1.274
75	How much do you trust the following sources? Non-Governmental Organizations (NGOs) (1~6, TRUST NGOs)	100	mean=3.1 modes=3, 4 st. dev.=1.367
76	How much do you trust the following sources? Print/broadcast and online media (1~6, TRUST MEDIA)	100	mean=2.52 mode=2 st. dev.=1.243

	Question (and variable) description	*N*	*Values*
77	How important are the following issues to you? Energy independence (1~6, IMPORT ENERGY INDEPEND)	100	mean=5.09 mode=6 st. dev.=0.9857
78	How important are the following issues to you? Energy efficiency (1~6, IMPORT ENERGY EFFIC)	100	mean=5.24 mode=6 st. dev.=0.9224
79	How important are the following issues to you? Energy affordability (1~6, IMPORT ENERGY AFFORD)	100	mean=4.81 mode=5 st. dev.=1.012
80	How important are the following issues to you? Energy availability (1~6, IMPORT ENERGY AVAIL)	100	mean=5.1 mode=5 st. dev.=0.8587
81	How important are the following issues to you? Diversification of the energy supply (1~6, IMPORT DIVERS ENER SUPPL)	100	mean=4.8 mode=5 st. dev.=1.198
82	How important are the following issues to you? Development of renewable energy (1~6, IMPORT DEVEL RENEW ENER_2)	100	mean=4.93 mode=6 st. dev.=1.249
83	How important are the following issues to you? Environmental impacts of energy systems (1~6, IMPORT ENV IMPACTS ENER SYST)	100	mean=5.06 mode=6 st. dev.=1.118
84	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Public safety (1~6, IMPORT GEOTH PUBLIC SAFE)	100	mean=5.01 mode=6 st. dev.=1.15
85	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Environmental protection (1~6, IMPORT GEOTH ENV PROTECT)	100	mean=5.03 mode=5 st. dev.=1.087
86	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Jobs/employment (1~6, IMPORT GEOTH JOBS)	100	mean=4.21 mode=4 st. dev.=1.192
87	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community awareness (1~6, IMPORT GEOTH COMMUN AWARE)	88	mean=4.42 mode=5 st. dev.=1.238
88	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community consultation (1~6, IMPORT GEOTH COMMUN CONSULT)	100	mean=4.34 mode=5 st. dev.=1.216

	Question (and variable) description	*N*	*Values*
89	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community compensation (1~6, IMPORT GEOTH COMMUN COMPENS)	100	mean=4.08 mode=5 st. dev.=1.277
90	How frequently do you hear about geothermal energy in the news in your country? (1~6, FREQ GEOTH NEWS)	100	mean=2.67 mode=2 st. dev.=1.378
91	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Geothermal potential (1~6, DEBATE GEOTH POTENTIAL)	100	mean=2.89 mode=2 st. dev.=1.399
92	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Economy (1~6, DEBATE GEOTH ECON)	100	mean=3.31 mode=2 st. dev.=1.568
93	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Climate change (1~6, DEBATE GEOTH CLIM CHANGE)	100	mean=3.86 mode=5 st. dev.=1.477
94	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Ecological security (1~6, DEBATE GEOTH ECOL SECUR)	100	mean=3.13 mode=2 st. dev.=1.454
95	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Energy security (1~6, DEBATE GEOTH ENER SECUR)	100	mean=3.33 mode=2 st. dev.=1.531
96	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? National security (1~6, DEBATE GEOTH NATION SECUR)	100	mean=2.89 mode=1 st. dev.=1.614
97	How do you feel about geothermal energy being used to generate electricity in your country? (1~6, FEEL GEOTH ELECTR)	100	mean=4.52 mode=6 st. dev.=1.46
98	How do you feel about geothermal energy being used to generate heating in your country? (1~6, FEEL GEOTH HEAT)	100	mean=5.06 mode=6 st. dev.=1.162
99	What is your opinion on developing a pilot geothermal energy project in your country, if (underground) hydraulic stimulation is required? (1~6, OPINION GEOTH HYDR STIM)	100	mean=4.33 mode=6 st. dev.=1.557

The community acceptance related variables of Section 4 of the questionnaire are listed in Table A.4.

Table A.4. Variables of Section 4 (Community acceptance) of the questionnaire (table cells are color coded in green or amber to indicate related question items)

	Question (and variable) description	*N*	*Values*
100	Do you understand what geothermal energy is and how it works? (1~6, UNDERSTAND GEOTH)	100	mean=4.68 mode=5 st. dev.=1.222
101	How important are the following in involving local communities in geothermal energy exploration? Concerns about facility location (1~6, IMP LOCAL COMM FACIL LOCAT)	100	mean=4.53 mode=5 st. dev.=1.123
102	How important are the following in involving local communities in geothermal energy exploration? Risks and benefits to society (1~6, IMP LOCAL COMM RISK BENEF SOC)	100	mean=4.82 mode=6 st. dev.=1.095
103	How important are the following in involving local communities in geothermal energy exploration? Environmental impacts (1~6, IMP LOCAL COMM ENV IMP)	100	mean=4.98 mode=6 st. dev.=1.101
104	How important are the following in involving local communities in geothermal energy exploration? Concerns about public health and safety (1~6, IMP LOCAL COMM PUBL HEALTH SAFE)	100	mean=4.79 mode=5 st. dev.=1.225
105	How much would the following deter you from switching to a geothermal-only energy supply? Insufficient service maturity (1~6, INSUFF SERV MATUR DETER)	100	mean=4.07 mode=5 st. dev.=1.35
106	How much would the following deter you from switching to a geothermal-only energy supply? Hidden/unknown costs (1~6, HIDDEN COSTS DETER)	100	mean=4.34 mode=5 st. dev.=1.273
107	How much would the following deter you from switching to a geothermal-only energy supply? Inconvenience of switching (1~6, INCONVEN SWITCH DETER)	100	mean=3.62 mode=4 st. dev.=1.42
108	How much would the following deter you from switching to a geothermal-only energy supply? Issues of credibility, transparency, and trust (1~6, CREDIB TRANSPAR TRUST DETER)	100	mean=4.13 mode=5 st. dev.=1.346

	Question (and variable) description	*N*	*Values*
109	How concerned would you be about the following issues regarding geothermal drilling near your property? Environmental impacts (1~6, CONCERN ENV IMPACTS GEOTH DRILL)	100	mean=4.67 mode=6 st. dev.=1.45
110	How concerned would you be about the following issues regarding geothermal drilling near your property? Aesthetic issues (1~6, CONCERN AESTHET GEOTH DRILL)	100	mean=3.62 modes=3, 5 st. dev.=1.503
111	How concerned would you be about the following issues regarding geothermal drilling near your property? Safety (1~6, CONCERN SAFETY GEOTH DRILL)	100	mean=4.41 mode=6 st. dev.=1.505
112	How concerned would you be about the following issues regarding geothermal drilling near your property? Public health (1~6, CONCERN PUBL HEALTH GEOTH DRILL)	100	mean=4.5 mode=6 st. dev.=1.58
113	How concerned would you be about the following issues regarding geothermal drilling near your property? Transparency (1~6, CONCERN TRANSPAR GEOTH DRILL)	100	mean=4.16 mode=5 st. dev.=1.412
114	How concerned would you be about the following issues regarding geothermal drilling near your property? Depreciation of property values (1~6, CONCERN DEPREC PROP GEOTH DRILL)	100	mean=4.24 mode=5 st. dev.=1.372
115	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Reliability of energy supply (1~6, RELIAB CONVINC PURCH GEOTH)	100	mean=4.99 mode=5 st. dev.=1.049
116	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Economic benefits (1~6, ECON BENEF CONVINC PURCH GEOTH)	100	mean=4.89 mode=5 st. dev.=1.205
117	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Social benefits (1~6, SOC BENEF CONVINC PURCH GEOTH)	100	mean=4.13 mode=5 st. dev.=1.376

	Question (and variable) description	*N*	*Values*
118	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Environmental benefits (1~6, ENV BENEFIT CONVINC PURCH GEOTH)	100	mean=4.95 mode=6 st. dev.=1.209
119	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? National public administration (1~6, TRUST NAT PUB ADM SWITCH ENERG)	100	mean=4.09 mode=4 st. dev.=1.408
120	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Regional/local administration (1~6, TRUST REG LOC ADM SWITCH ENERG)	100	mean=3.9 mode=4 st. dev.=1.21
121	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Print and broadcast media (1~6, TRUST PR&BR MEDIA SWITCH ENERG)	100	mean=2.88 mode=4 st. dev.=1.416
122	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Internet and social media (1~6, TRUST INTERN&SOC SWITCH ENERG)	100	mean=2.73 mode=2 st. dev.=1.362
123	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Energy suppliers (1~6, TRUST ENERG SUPPL SWITCH ENERG)	100	mean=3.12 mode=3 st. dev.=1.365
124	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Environmental associations (1~6, TRUST ENV ASSOC SWITCH ENERG)	100	mean=3.68 mode=4 st. dev.=1.413
125	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Academic/research journals and expert publications (1~6, TRUST JOURN&PUBL SWITCH ENERG)	100	mean=4.81 mode=6 st. dev.=1.269

	Question (and variable) description	*N*	*Values*
126	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Friends and colleagues (1~6, TRUST FRIEND&COLL SWITCH ENERG)	100	mean=3.75 mode=4 st. dev.=1.298
127	How concerned would you be if one of the following energy plants/installations were built in your area? Fossil fuel (1~6, CONCERN FOSSIL FUEL if BUILT)	100	mean=4.87 mode=6 st. dev.=1.361
128	How concerned would you be if one of the following energy plants/installations were built in your area? Nuclear (1~6, CONCERN NUCLEAR if BUILT)	100	mean=4.26 mode=6 st. dev.=1.703
129	How concerned would you be if one of the following energy plants/installations were built in your area? Hydropower (1~6, CONCERN HYDRO if BUILT)	100	mean=3.01 mode=2 st. dev.=1.567
130	How concerned would you be if one of the following energy plants/installations were built in your area? Wind (1~6, CONCERN WIND if BUILT)	100	mean=3.26 mode=1 st. dev.=1.727
131	How concerned would you be if one of the following energy plants/installations were built in your area? Solar panel (PVs) (1~6, CONCERN PVs if BUILT)	100	mean=2.64 mode=1 st. dev.=1.624
132	How concerned would you be if one of the following energy plants/installations were built in your area? Geothermal (1~6, CONCERN GEOTH if BUILT)	100	mean=2.97 mode=2 st. dev.=1.453
133	How concerned would you be if one of the following energy plants/installations were built in your area? Biomass (1~6, CONCERN BIOMASS if BUILT)	100	mean=3.3 mode=2 st. dev.=1.605
134	How concerned would you be about the following aspects of geothermal drilling? Greenhouse gas emissions (1~6, CONCERN GHG EMISS of GEOTH)	100	mean=3.37 mode=2 st. dev.=1.739
135	How concerned would you be about the following aspects of geothermal drilling? Landscape impacts (1~6, CONCERN LANDSC IMPACTS of GEOTH)	100	mean=3.57 mode=3 st. dev.=1.506
136	How concerned would you be about the following aspects of geothermal drilling? Infrastructure impacts (1~6, CONCERN INFRAS IMPACTS of GEOTH)	100	mean=3.47 mode=4 st. dev.=1.432

	Question (and variable) description	*N*	*Values*
137	How concerned would you be about the following aspects of geothermal drilling? Induced (micro)seismicity (1~6, CONCERN INDUC SEISMIC of GEOTH)	100	mean=3.98 mode=5 st. dev.=1.531
138	How concerned would you be about the following aspects of geothermal drilling? Water aquifer-related risks (1~6, CONCERN WATER ACQUIF of GEOTH)	100	mean=4.52 mode=5 st. dev.=1.41
139	How concerned would you be about the following aspects of geothermal drilling? Legal transparency (1~6, CONCERN LEGAL TRANSPAR of GEOTH)	100	mean=3.74 mode=3 st. dev.=1.454
140	How receptive would you be to geothermal drilling in your area if the following were true? Monitoring offering safety assurance (1~6, RECEPT GEOTH if MONITORING)	100	mean=4.53 mode=5 st. dev.=1.235
141	How receptive would you be to geothermal drilling in your area if the following were true? Electricity cost reductions (1~6, RECEPT GEOTH if ELEC COST REDUC)	100	mean=4.74 mode=5 st. dev.=1.16
142	How receptive would you be to geothermal drilling in your area if the following were true? Increase in employment (1~6, RECEPT GEOTH if INCR EMPLOYM)	100	mean=4.19 mode=5 st. dev.=1.339
143	How receptive would you be to geothermal drilling in your area if the following were true? Control by public institutions (1~6, RECEPT GEOTH if PUBL INSTITUT)	100	mean=4.1 mode=4 st. dev.=1.176
144	How receptive would you be to geothermal drilling in your area if the following were true? Compensation for local residents (1~6, RECEPT GEOTH if COMPENS LOC RES)	100	mean=4.07 mode=4 st. dev.=1.265
145	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Groundwater contamination (1~6, GROUNDW CONTAM PUB CONCER GEOTH)	100	mean=4.59 mode=5 st. dev.=1.248
146	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Soil contamination (1~6, SOIL CONTAM PUBL CONCERN GEOTH)	100	mean=4.28 mode=5 st. dev.=1.296

	Question (and variable) description	*N*	*Values*
147	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Radioactive wastes (1~6, RADIOACT WAST PUB CONCERN GEOTH)	100	mean=3.12 mode=1 st. dev.=1.665
148	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Induced (micro)seismicity (1~6, INDUCED SEISM PUB CONCERN GEOTH)	100	mean=4.43 mode=5 st. dev.=1.373
149	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Air pollution (1~6, AIR POLLUT PUBL CONCERN GEOTH)	100	mean=3.55 mode=4 st. dev.=1.5
150	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Water use (1~6, WATER USE PUBL CONCERN GEOTH)	100	mean=4.42 mode=5 st. dev.=1.273
151	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Visual impacts (1~6, VISUAL IMPACT PUB CONCERN GEOTH)	100	mean=4 mode=4 st. dev.=1.318
152	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Noise (1~6, NOISE PUBLIC CONCERN GEOTH)	100	mean=4.1 mode=5 st. dev.=1.322
153	Have you ever experienced an earthquake in the area of your residence? (EVER EXPERIENCED EARTHQUAKE)	100	51 no, 46 yes, 3 don’t remember
154	If you have experienced an earthquake, how unpleasant was your experience? (1~6, EARTHQUAKE UNPLEASANT)	47	mean=3.617 modes=4, 5 st. dev.=1.596
155	Is your area prone to natural earthquakes? (AREA PRONE to EARTHQUAKES)	100	48 no, 43 yes, 9 not sure
156	How might the prospect of induced seismicity alter your perspective on geothermal development in your area? (1~6, INDUCED SEISMIC PERSPECT GEOTH)	100	mean=4 mode=4 st. dev.=1.484
157	Would you actively oppose geothermal drilling operations in your area? (ACTIVELY OPPOSE GEOTH)	100	61 no, 24 not sure, 8 yes, 7 prefer not to answer

Finally, market acceptance variables of Section 5 of the questionnaire are listed in Table A.5.

Table A.5. Variables of Section 5 (Market acceptance) of the questionnaire

	Question (and variable) description	*N*	*Values*
158	Is your country offering any public incentives or facilitating measures to assist consumers in making the transition to geothermal energy? (PUBLIC INCENTIVES for GEOTH)	100	50 not aware of any, 17 there are some but not sure, 10 there are no incentives, 9 there are a few that I know in broad terms, 7 there are some and I am trying to learn more, etc.
159	How would you characterize the quantity of incentives or facilitating measures available in your country to help customers transition to geothermal energy? (QUANTITY of INCENTIVs for GEOTH)	100	mean=2.35 mode=1 st. dev.=1.431
160	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Economic benefits (1~6, ECON BENEFIT INFLUENT for GEOTH)	100	mean=4.99 mode=6 st. dev.=1.078
161	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Social benefits (1~6, SOC BENEFIT INFLUENT for GEOTH)	100	mean=3.92 mode=4 st. dev.=1.228
162	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Community awareness (1~6, COMM AWAREN INFLUENT for GEOTH)	100	mean=3.83 mode=3 st. dev.=1.19
163	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Environmental benefits (1~6, ENV BENEFIT INFLUENT for GEOTH)	100	mean=4.82 mode=6 st. dev.=1.175
164	How does the fact that geothermal energy costs less than traditional energy sources affect your overall attitude toward geothermal drilling? (1~6, LOW GEOTH COST AFFECT ATTITUD)	100	mean=4.68 mode=5 st. dev.=1.091

APPENDIX B: Graphical analysis of final survey

The graphs arising from the questionnaire variables are given and evaluated in the following sections. The vertical axis depicts the number of replies (designated as count or frequency), while the horizontal axis depicts the variable associated with each question.

B.1. Background (demographic) variables (Section 1)

Figure B.1 shows that 72 of the 100 responses were by men.

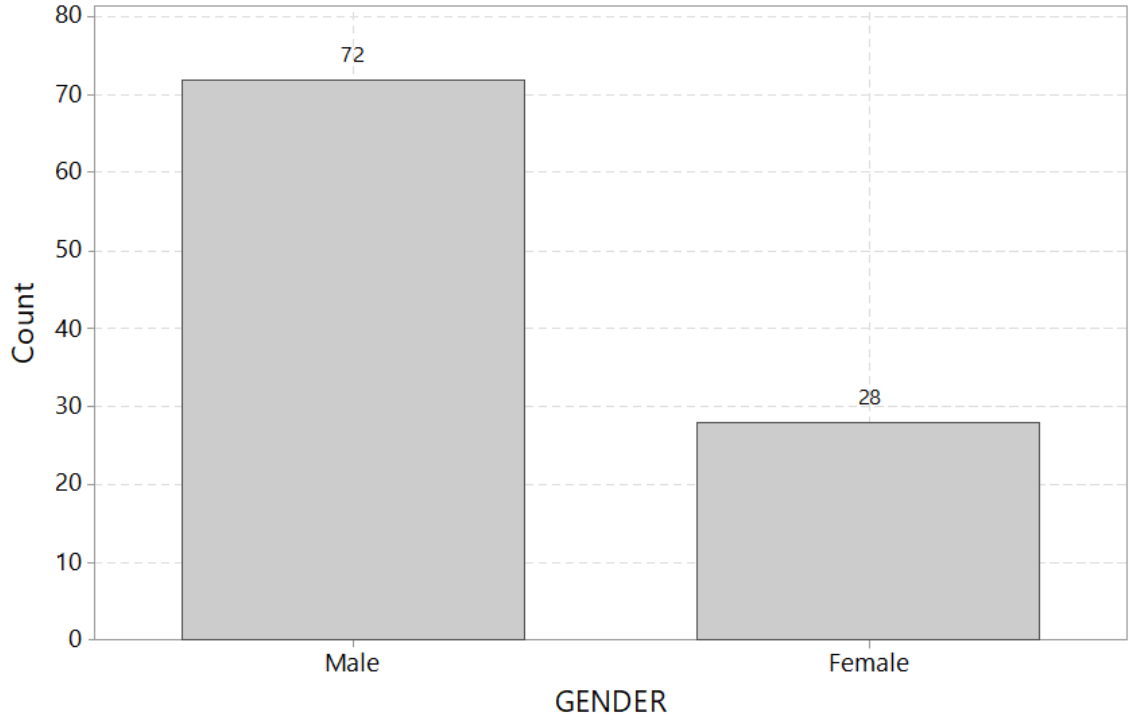

Figure B.1. Gender

Figure B.2 shows that the 30-39 age bracket gave the most responses (31 out of 100), followed by the 18-29 and 40-49 age brackets (22 responses each). 14 responses were from the 50-59 age bracket, and 11 from the 60 to 69 age bracket.

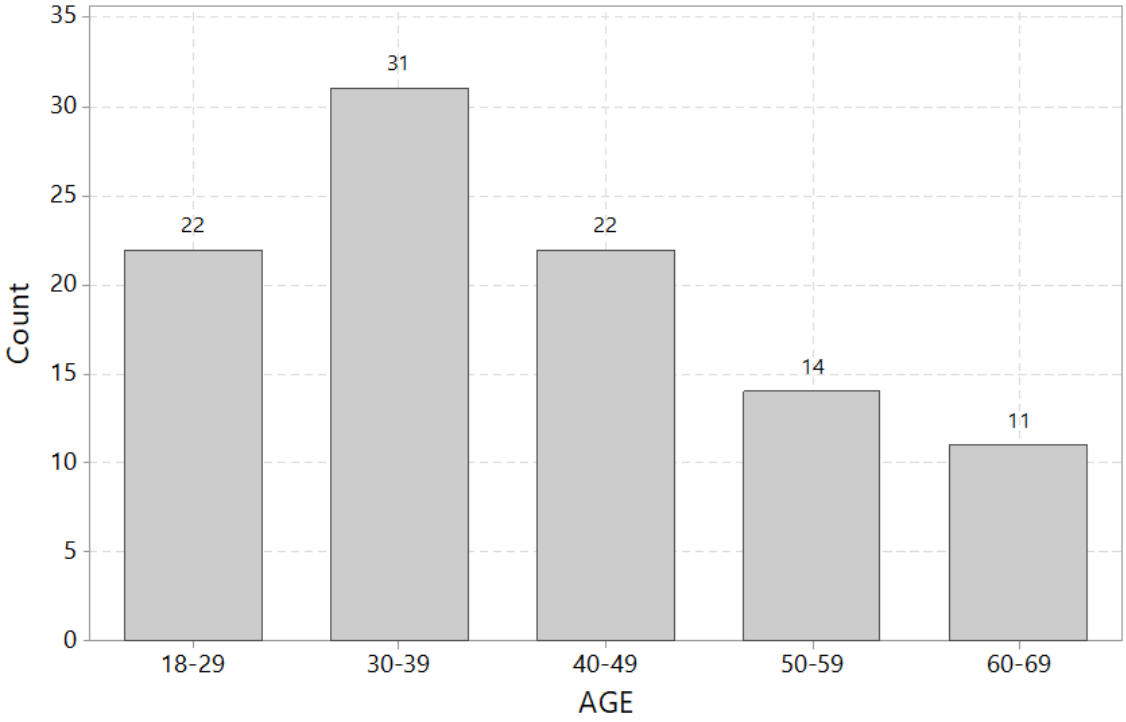

Figure B.2. Age classes

Figure B.3 shows that 57 out of 100 responses were by people married or with a partner, followed by 34 responses from single people.

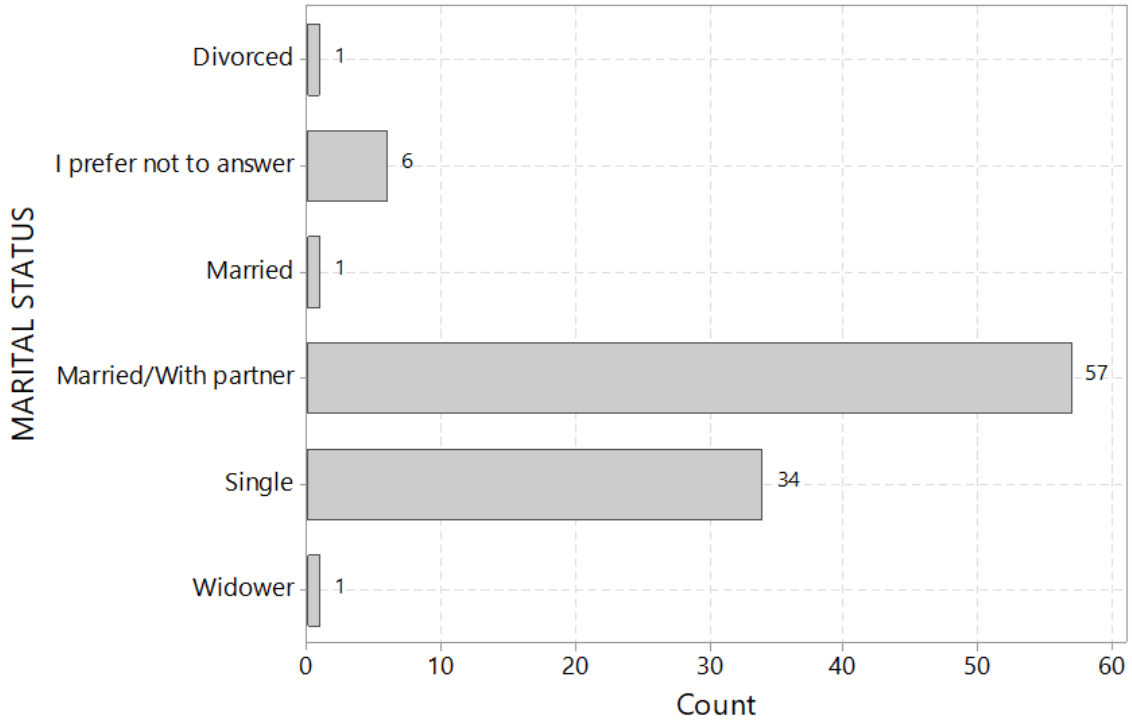

Figure B.3. Marital status values

As shown by Figure B.4, most respondents were quite educated. Of the 100 responses, 31 had a university degree, 28 had a doctoral degree, and 18 each had a postgraduate degree or were involved in post doctoral studies.

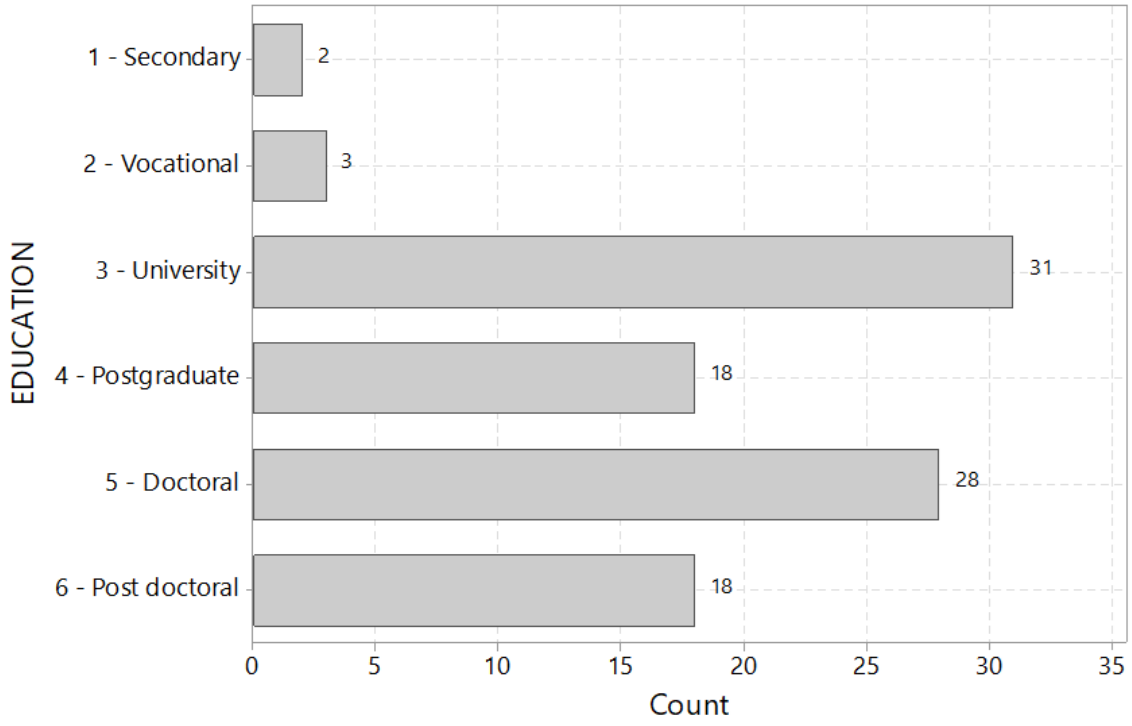

Figure B.4. Degree of education

Turning to professional classification shown in Figure B.5, 27 respondents were researchers, 13 private employees, 12 university faculty, 11 students, and 5 state employees. Other categories (including more than one classifications) had a frequency of 4 or less.

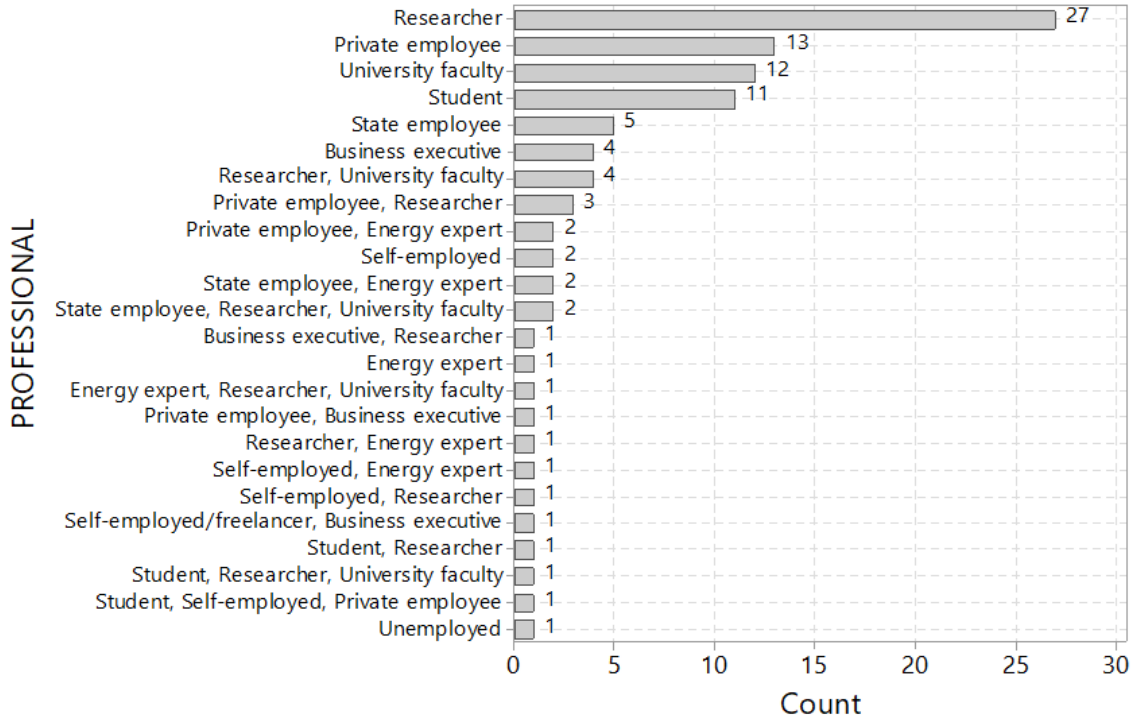

Figure B.5. Professional classification

Figure B.6 shows professional experience years calculated as class medians, e.g. 2.5 years was the median of the zero to 5 years of experience. It is shown that 21 researchers had an average of 2.5 years of experience, followed by 15 with 12.5 years of experience, 14 with 7.5 years of experience, 12 with 17.5 years of experience, and 11 with 22.5 years of experience. There were a total of 22 respondents with over 25 years of experience, and 5 without any experience at all.

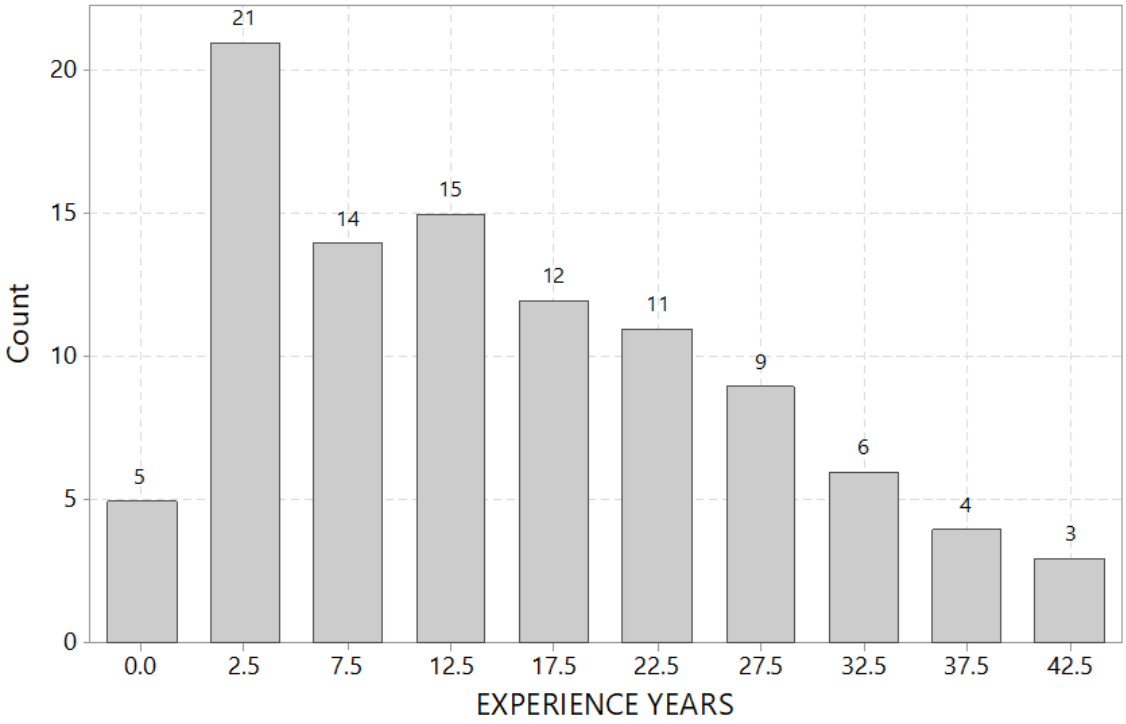

Figure B.6. Experience years (showing class centers)

Figure B.7 shows the income brackets, and it may be seen that 13 respondents declared an income between 30 and 40 thousand euros, 12 between 40 and 50 thousand euros, 11 between 20 and 30 thousand euros, 10 under 10 thousand euros, 9 between 60 to 70 thousand euros, and several other classes with smaller frequencies.

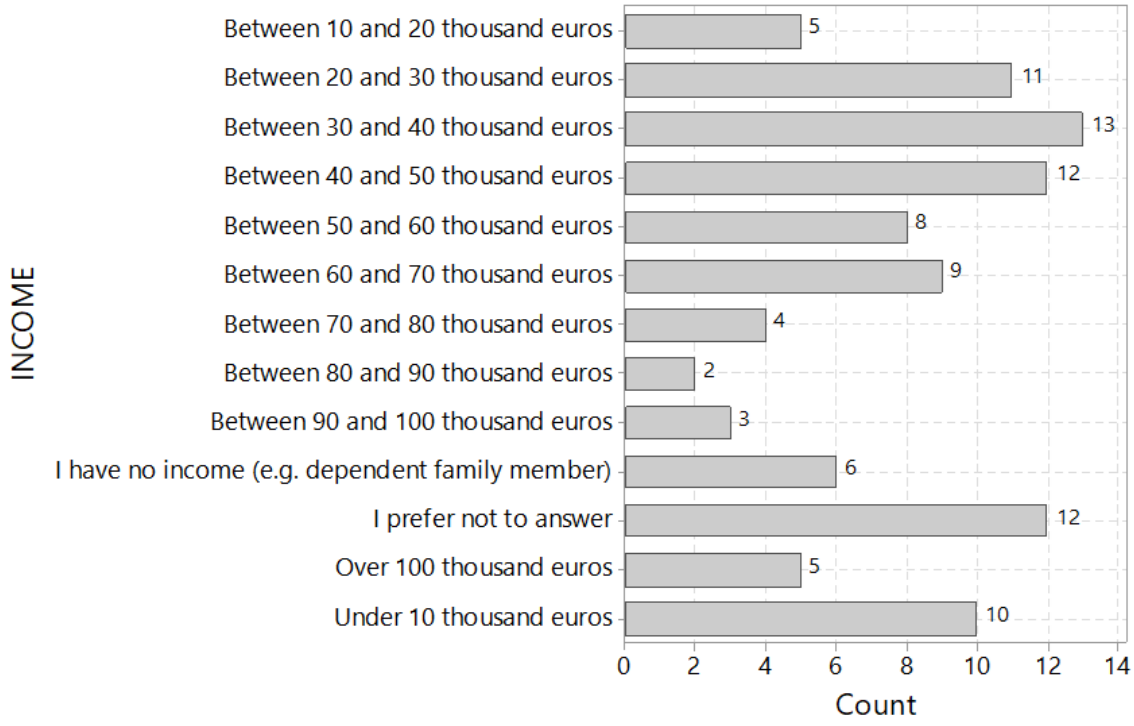

Figure B.7. Income classes

To estimate an approximate upper limit for the upper class that was over 100 thousand euros, Figure B.8 may be consulted.

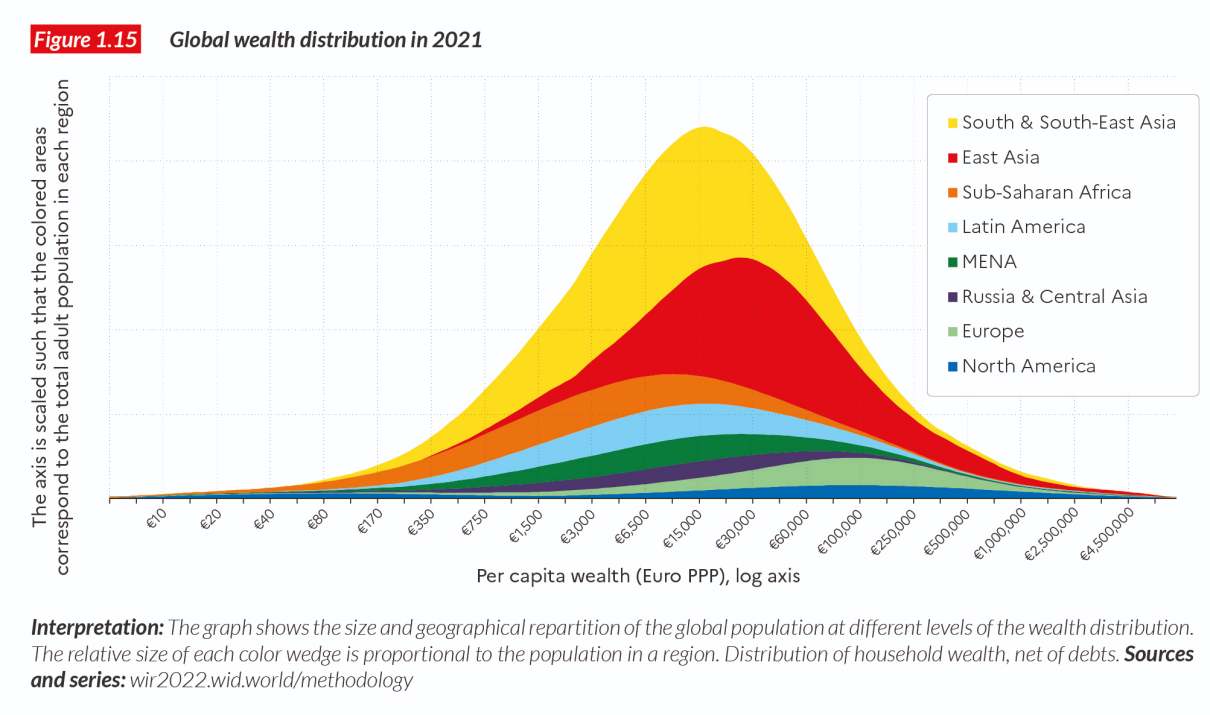

Figure B.8. Assessing the upper value of income (https://wir2022.wid.world/chapter-1/)

Figure B.9 shows that most responses were from France (40 out of a total of 100), Greece (22), Norway (12), China (9), the UK (5), and several other countries in smaller quantities.

It is reminded that responses from China were collected via the Microsoft Forms version of the questionnaire, while from all other countries via the Google Forms version. The English test of both versions was identical, but the Chinese version did not include French.

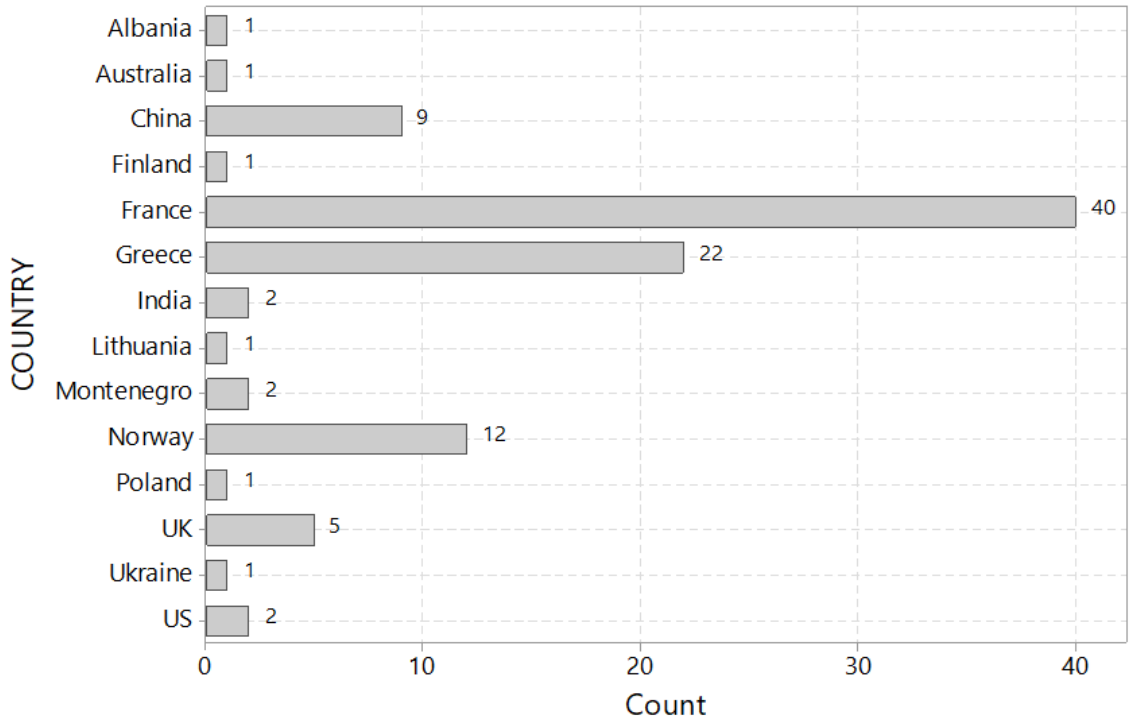

Figure B.9. Country of residence

The city of residence is shown in Table A.1. The biggest number of responses was from Athens (11), Paris (10), Trondheim (8), Qingdao (6), London and Pau (5 each), and many other cities in smaller numbers.

Table A.1. City of residence (N=100)

Index	*CITY*	*Count*	*Index*	*CITY*	*Count*
1	Antibes (France)	1	27	Meudon (France)	1
2	Athens (Greece)	11	28	Morlaas (France)	1
3	Bordeaux (France)	1	29	Mouans-Sartoux (France)	1
4	Bournos (France)	1	30	Oise (France)	1
5	Chabanière (France)	1	31	Orléans (France)	1
6	Chennai (India)	1	32	Orthez (France)	1
7	Clemson (USA)	1	33	Oslo (Norway)	1

Index	*CITY*	*Count*	*Index*	*CITY*	*Count*
8	Clermont Ferrand (France)	1	34	Paleo Faliro (Greece)	1
9	Courbevoie (France)	1	35	Paris (France)	10
10	Fontainebleau (France)	3	36	Pau (France)	5
11	Gjøvik (Norway)	1	37	Piraeus (Greece)	2
12	Gujarat (India)	1	38	Podgorica (Montenegro)	2
13	Heraklion (Greece)	1	39	Qingdao (China)	6
14	Houston (USA)	1	40	Rio (Greece)	1
15	Ioannina (Greece)	1	41	Shandong (China)	1
16	Ivano-Frankivsk (Ukraine)	1	42	Stavanger (Norway)	2
17	Jouy-en-josas (France)	2	43	Sydney (Australia)	1
18	Kaunas (Lithuania)	1	44	Tampere (Finland)	1
19	Kozani (Greece)	1	45	Thessaloniki (Greece)	2
20	Lacommande (France)	1	46	Thomery (France)	1
21	Linyi (China)	1	47	Tirane (Albania)	1
22	London (UK)	5	48	Tousson (France)	1
23	Lost (France)	1	49	Trondheim (Norway)	8
24	Lyon (France)	2	50	Villemoisson-sur-Orge (France)	1
25	Mauleon (France)	1	51	Warsaw (Poland)	1
26	Megara (Greece)	1	52	(missing)	2

The average income per country, calculated using 175 thousand euros as an upper limit (based on Figure B.8, as explained previously), is shown in Figure B.10. Apart from Australia (that gave only one response in the highest bracket), the highest income values came from Norway (69 thousand euros), the US (60 thousand euros), France (about 56 thousand euros), the US (53 thousand euros), Greece (about 31 thousand euros), Lithuania and Ukraine (25 thousand euros each), and China (about 23 thousand euros). Other countries gave average income values equal to 10 thousand euros or less.

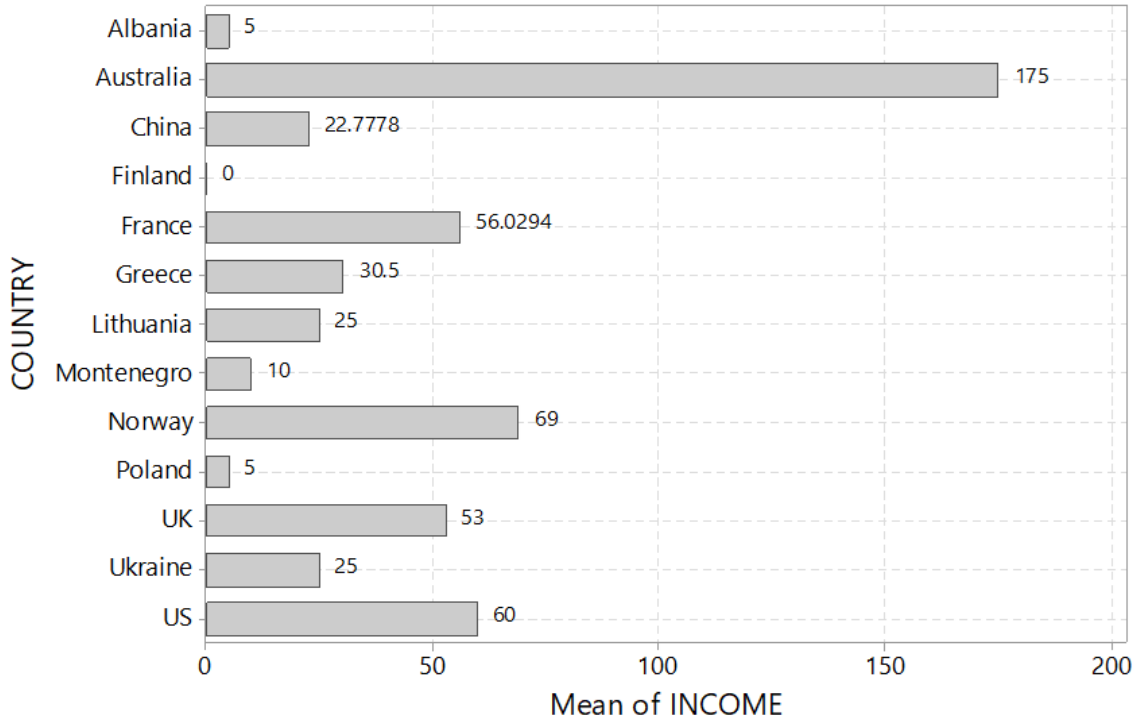

Figure B.10. Mean income per country

Figure B.11 shows that 36 respondents lived in another urban area, 24 in a megacity (i.e. a city with more than 10 million inhabitants, 16 in a suburban area, 12 in a rural area, 8 in a densely populated area, 3 in an area with moderate population density, and one in a sparsely populated area. All in all, about 70% of respondents lived in an urban area.

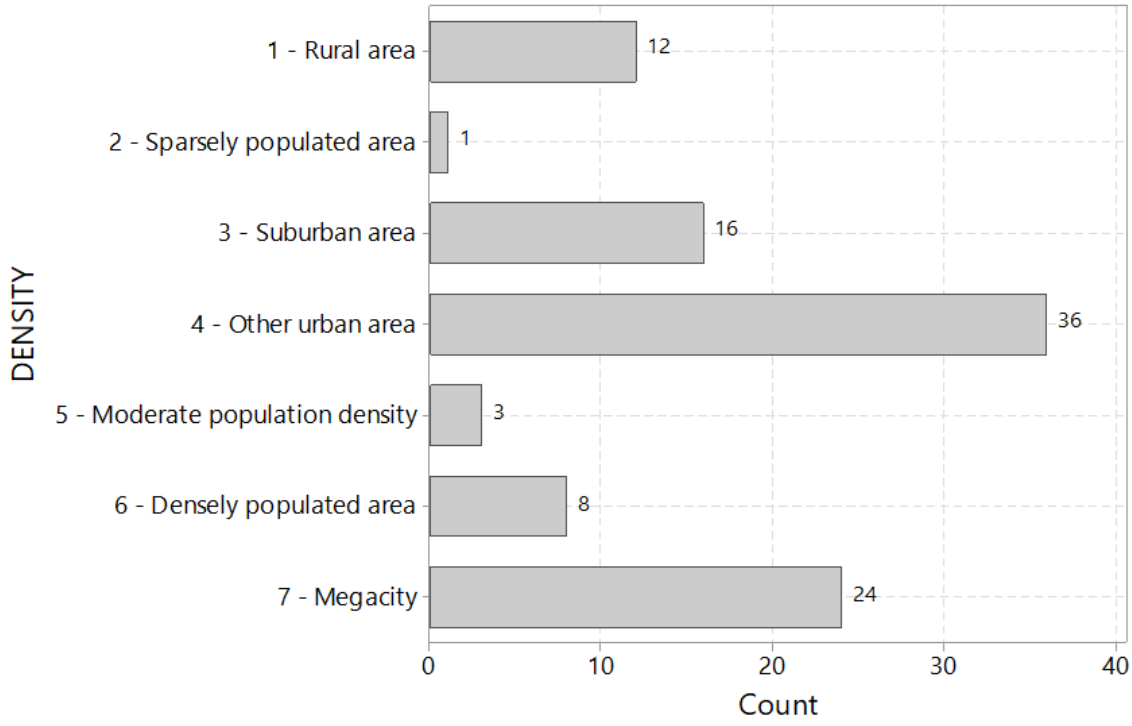

Figure B.11. Characterization of population density

Figure B.12 shows that 60 respondents were householders, 26 tenants/leaseholders, and 3 or less each belonged into various other categories.

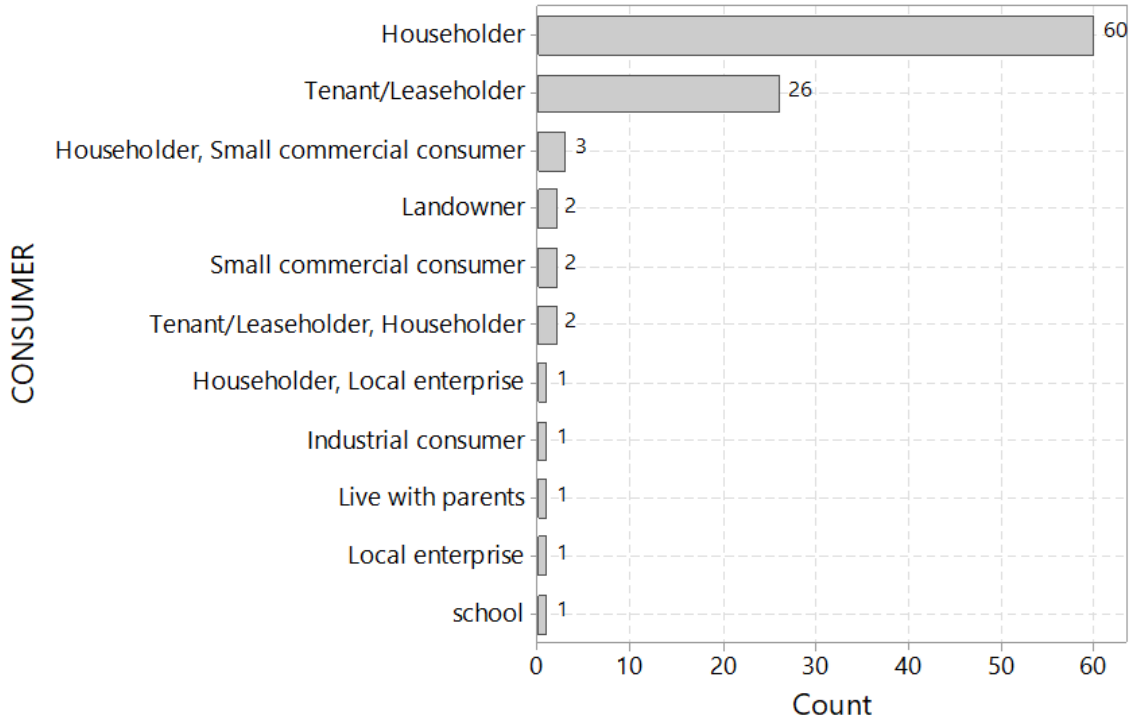

Figure B.12. Consumer type

As to the energy source, Figure B.13 shows that 39 respondents used electricity, 19 natural gas, 7 natural gas and electricity, and 6 oil. The remainder used biomass, coal, geothermal, and wood at frequencies of 3 or less.

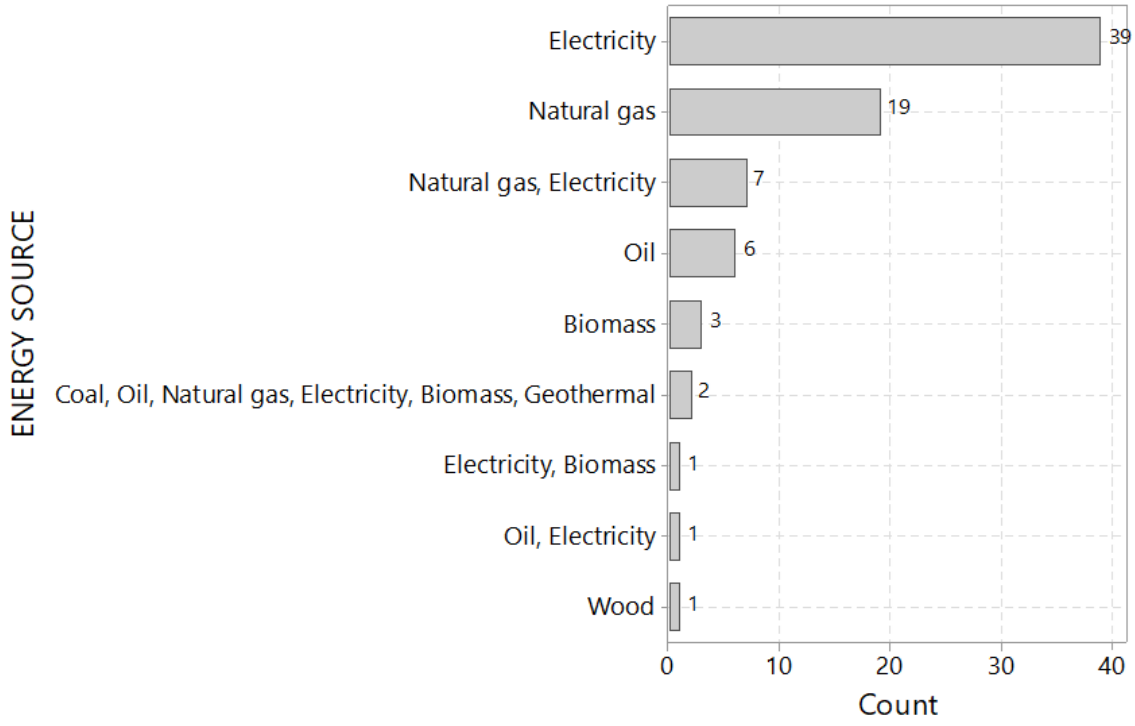

Figure B.13. Energy source

Turning to the first ranking question, Figure B.14 shows that most respondents felt that their electricity bill was high or very high.

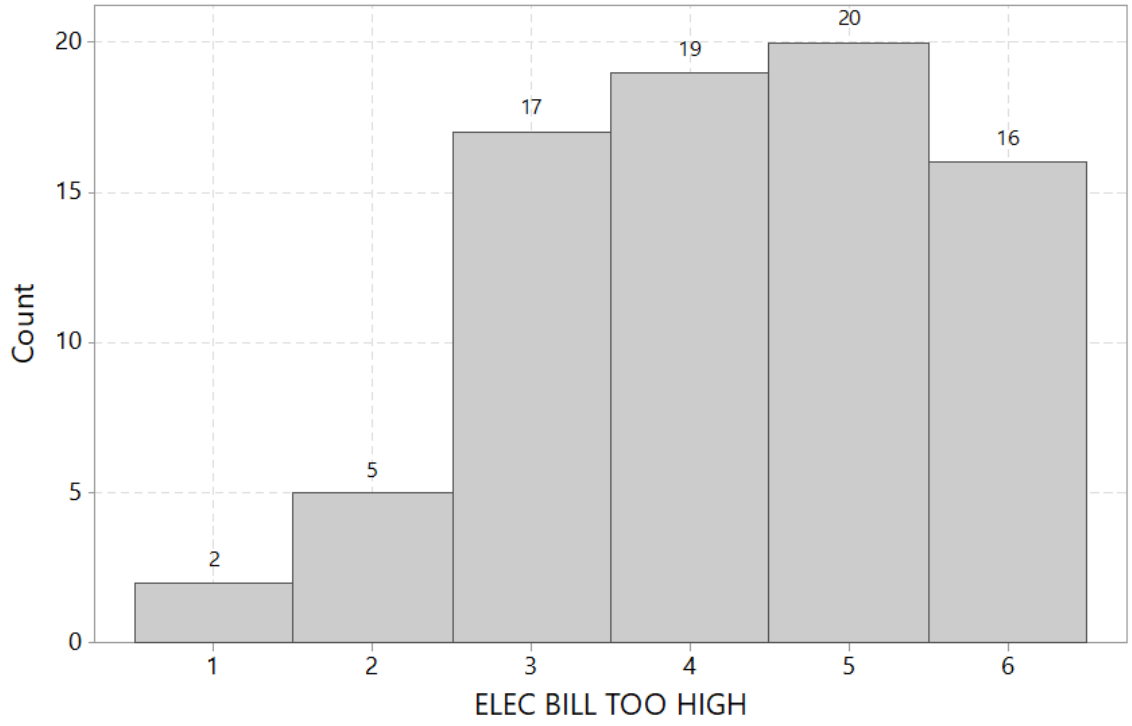

Figure B.14. Do you think your energy utility bill is too high?

Breaking the responses to the previous question on a per country basis, Figure B.15 shows that most respondents from European countries felt that their electricity bill was very high. Interestingly, respondents from China provided the lowest ratings to that question.

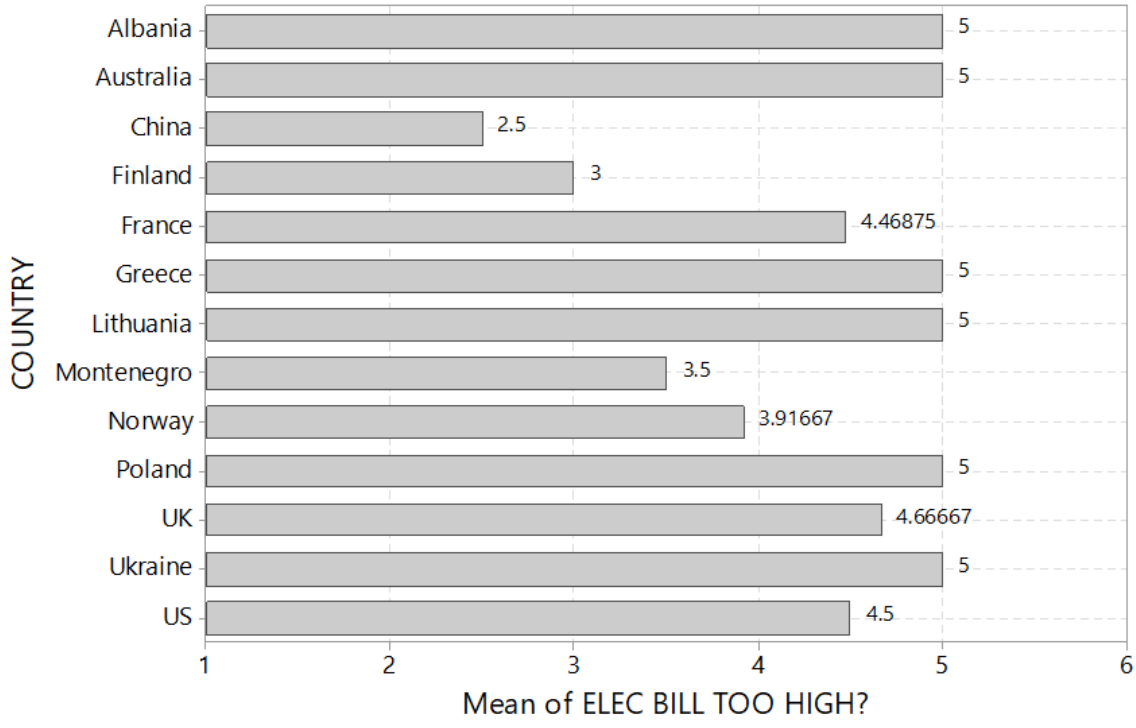

Figure B.15. Mean of “Do you think your energy utility bill is too high?” per country

Figure B.16 shows that 29 respondent families had at least one member under 12 years old, 23 had at least one member over 60 years old, 7 had at least one unemployed member, and one family had both an unemployed member and one over 60.

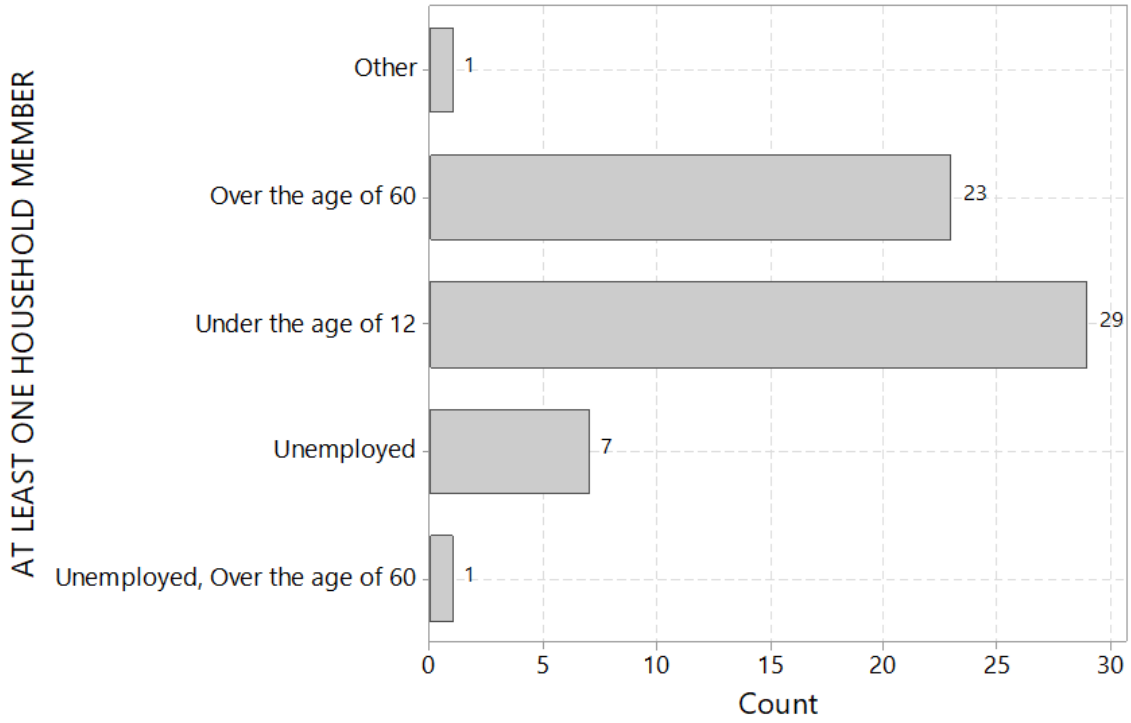

Figure B.16. Characterization of at least one household member

Figure B.17 shows that while many respondents felt they were familiar with geothermal development (29 responses at a ranking of 5), there was also a smaller local peak with no familiarity at all (11 responses at a ranking of 1). This result indicates the possible presence of two clusters in the data set (Everit et al., 2011).

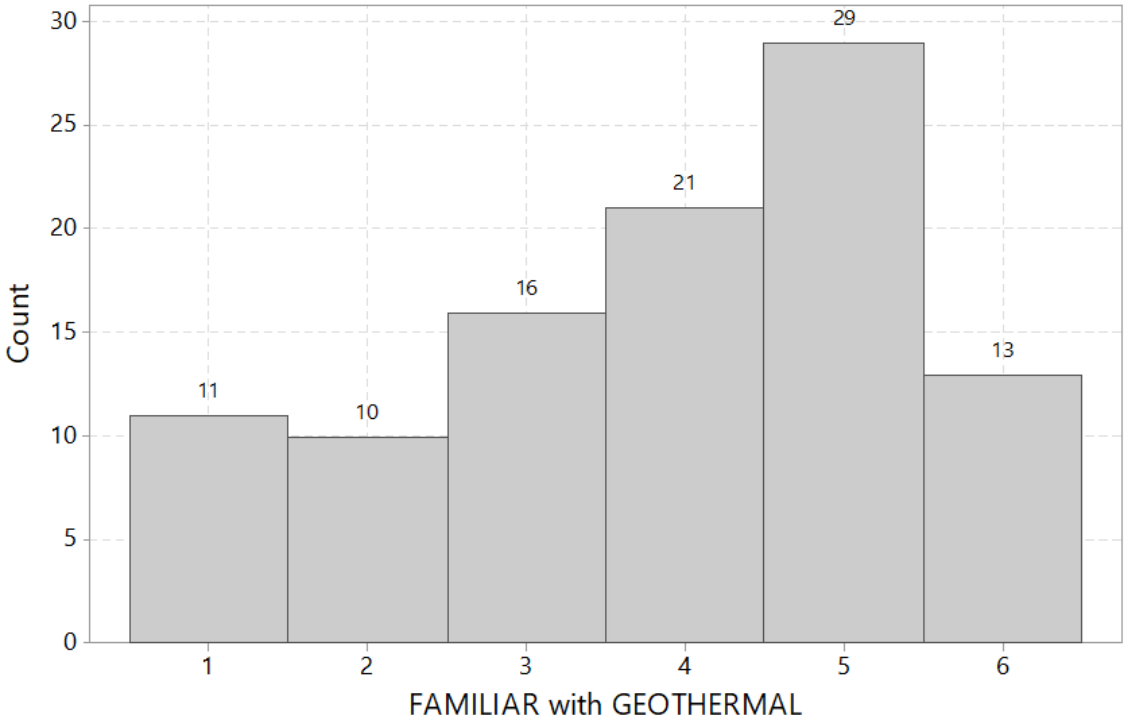

Figure B.17. How familiar are you with geothermal energy exploration and development (including drilling)?

Figure B.18 charts the average familiarity with geothermal development per country, showing a high familiarity in Australia, Ukraine, the US, and the UK; and the lowest familiarity in Poland, Albania, and Greece.These results potentially hint at the potential presence of two to three clusters in the sample.

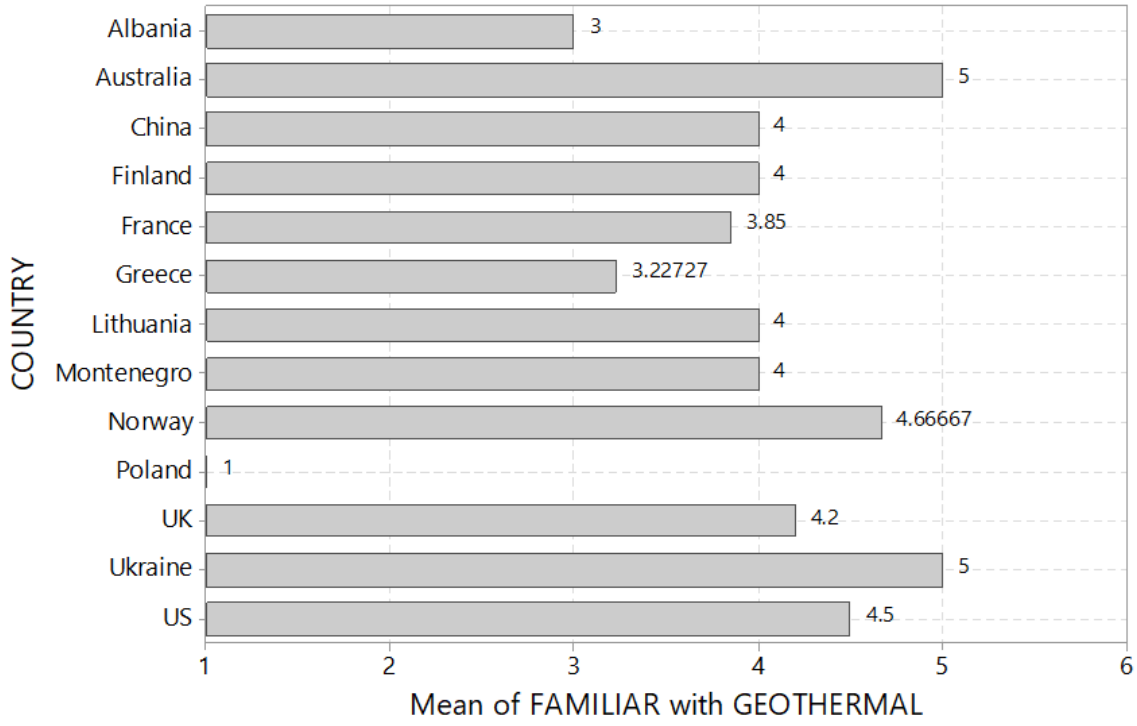

Figure B.18. Mean of “How familiar are you with geothermal energy exploration and development (including drilling)?” per country

Figure B.19 shows that 49 respondents were not sure of the distance of their location to geothermal exploration, while 24 were over 50 km to geothermal exploration, 14 up to 25 km to geothermal exploration, and 8 from 25 to 50 km to geothermal exploration.

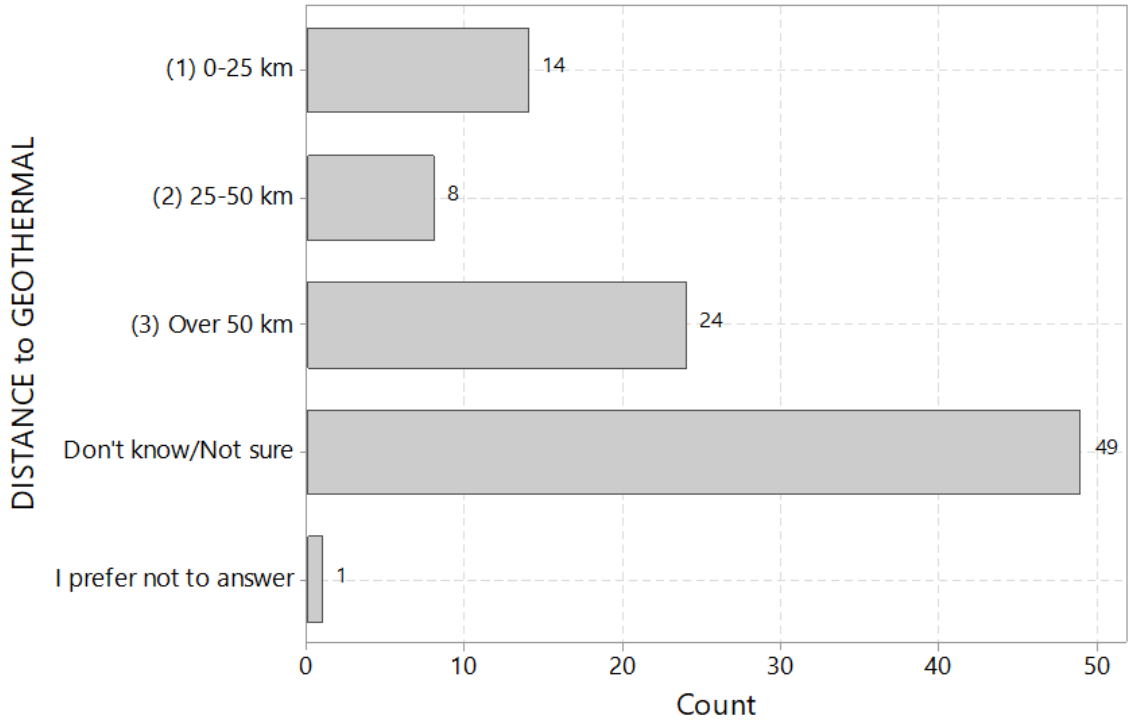

Figure B.19. What is the distance between your residence and the closest known to you geothermal exploration activities (e.g. drilling)?

Figure B.20 shows that most respondents felt that public acceptance was very significant for geothermal exploration.

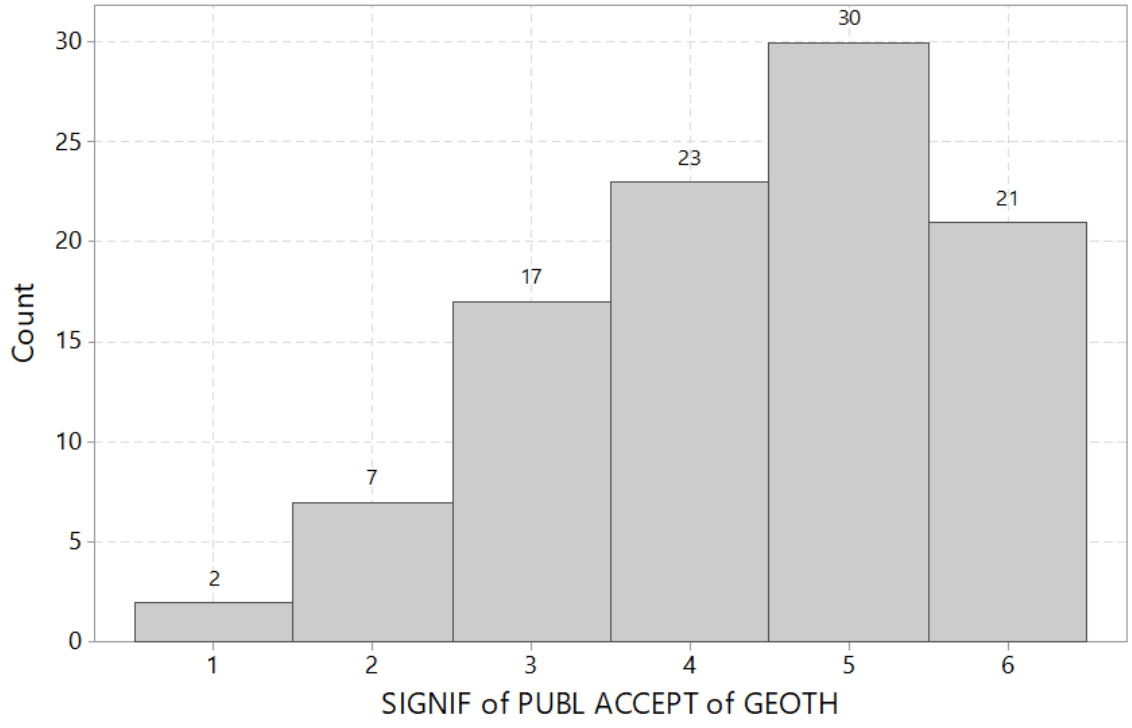

Figure B.20. What is the significance of public acceptance of geothermal energy development, in your opinion?

As to the significance of public acceptance of geothermal exploration per country (Figure B.21), Australia, Lithuania, Montenegro, and Poland thought it was very significant, while many European countries thought it was also significant, but to a lesser degree. Albania and Ukraine did not think that the public acceptance of geothermal was significant. These results also hint at the potential presence of two to three clusters in the sample.

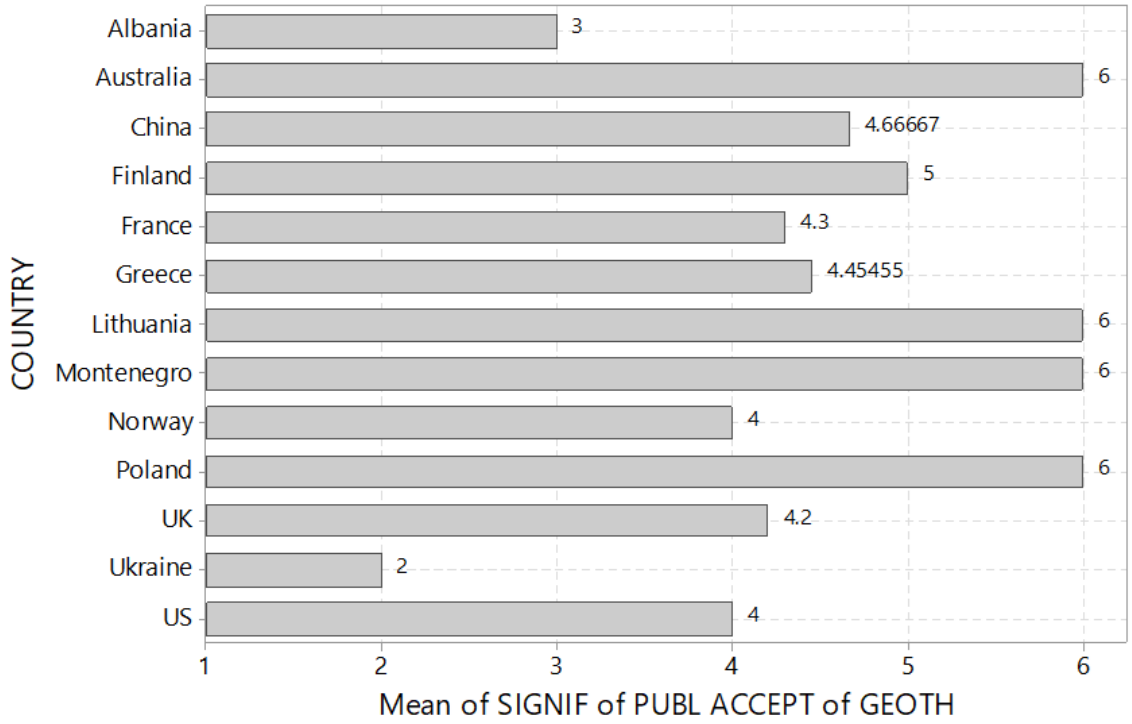

Figure B.21. Mean of “What is the significance of public acceptance of geothermal energy development, in your opinion?” per country

B.2. Environmental concern variables (Section 2)

Figures 4.22 to 4.28 depict the urgency (in the opinion of respondents) of the following issues: decline of biodiversity, river and seawater pollution, air pollution, acid rain, soil pollution/contamination, waste disposal, temperature increase, extreme weather conditions, exploitation of natural resources, traffic congestion, and noise.

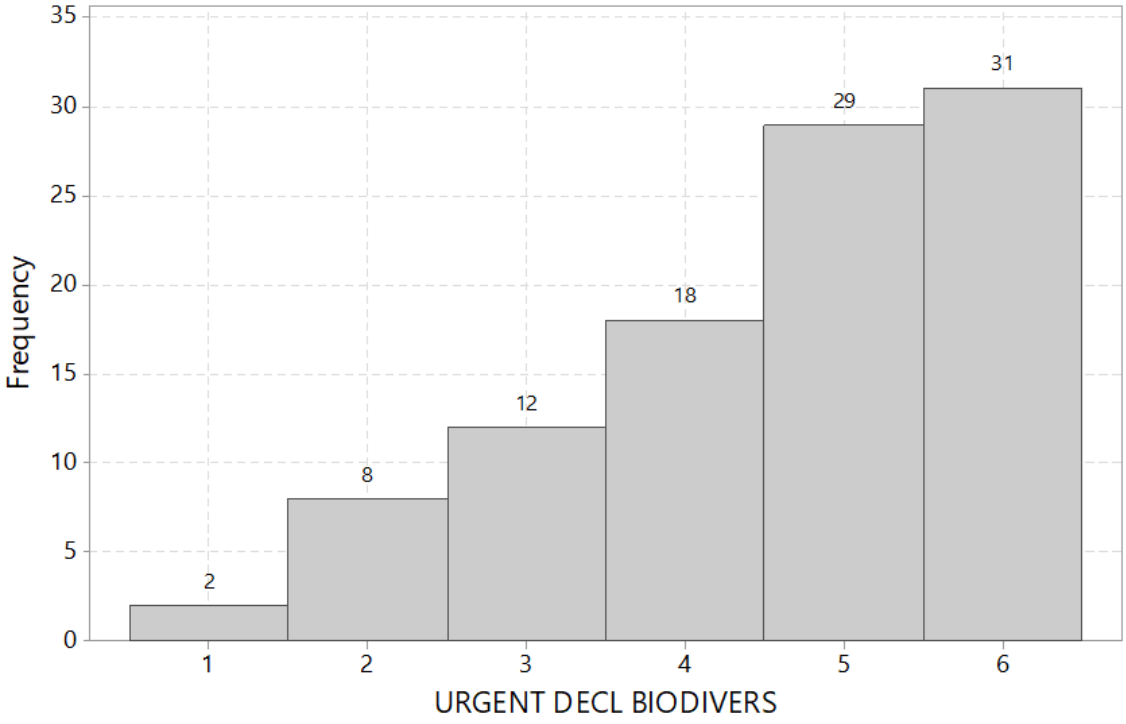

Figure B.22. How urgent, in your opinion, is the decline of biodiversity?

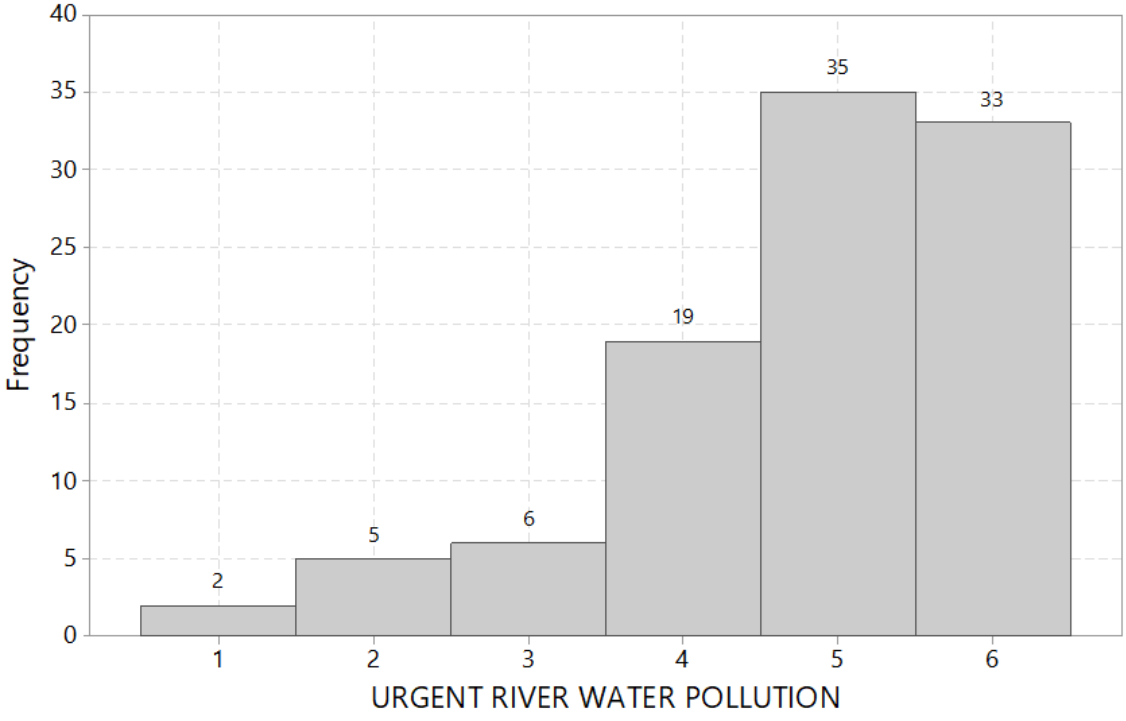

Figure B.23. How urgent, in your opinion, is river and seawater pollution?

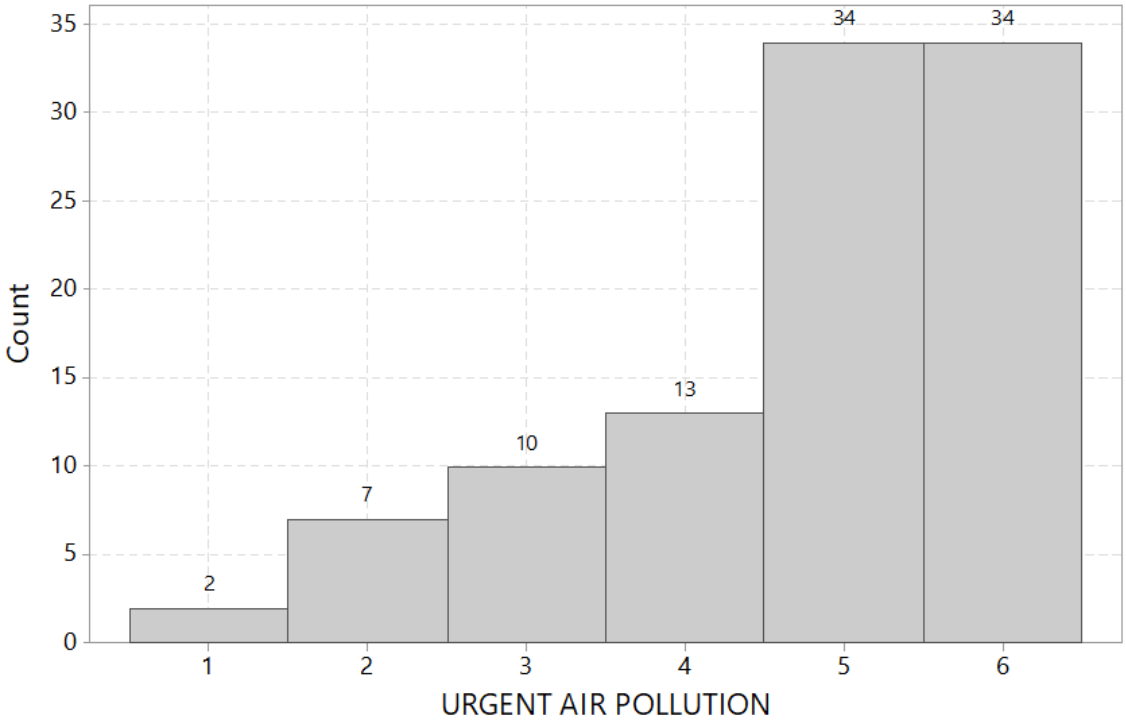

Figure B.24. How urgent, in your opinion, is air pollution?

Air pollution, soil contamination, and waste disposal, as shown in Figures 4.25 to 4.27, were seen as less urgent.

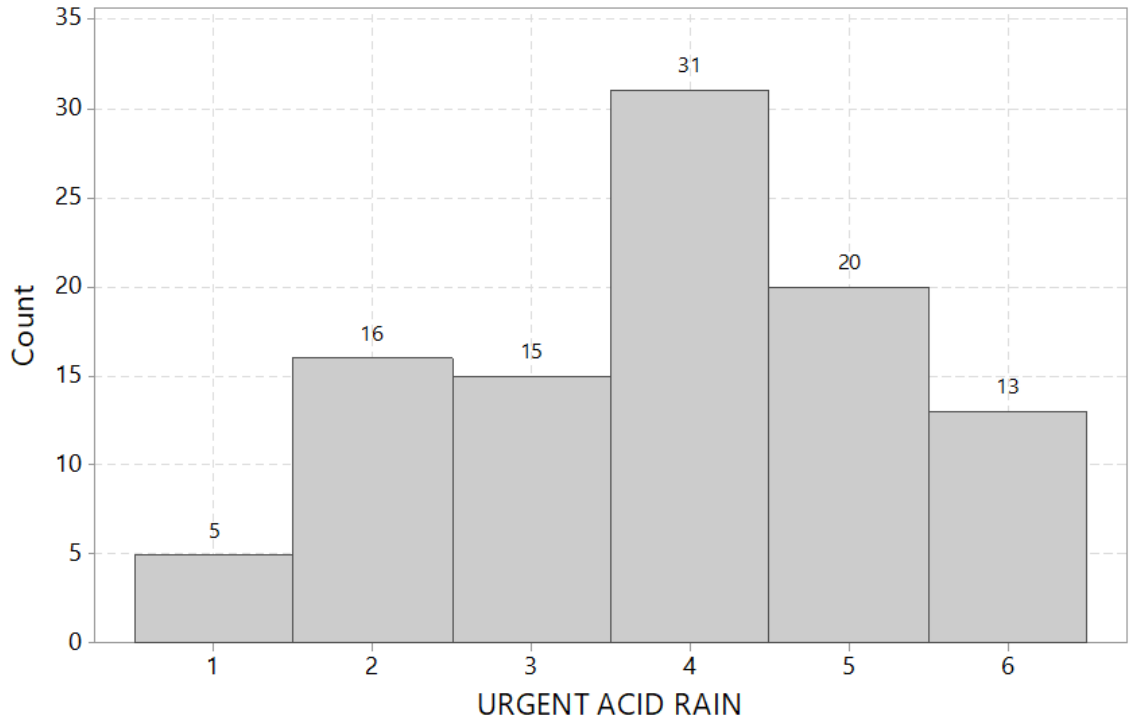

Figure B.25. How urgent, in your opinion, is acid rain

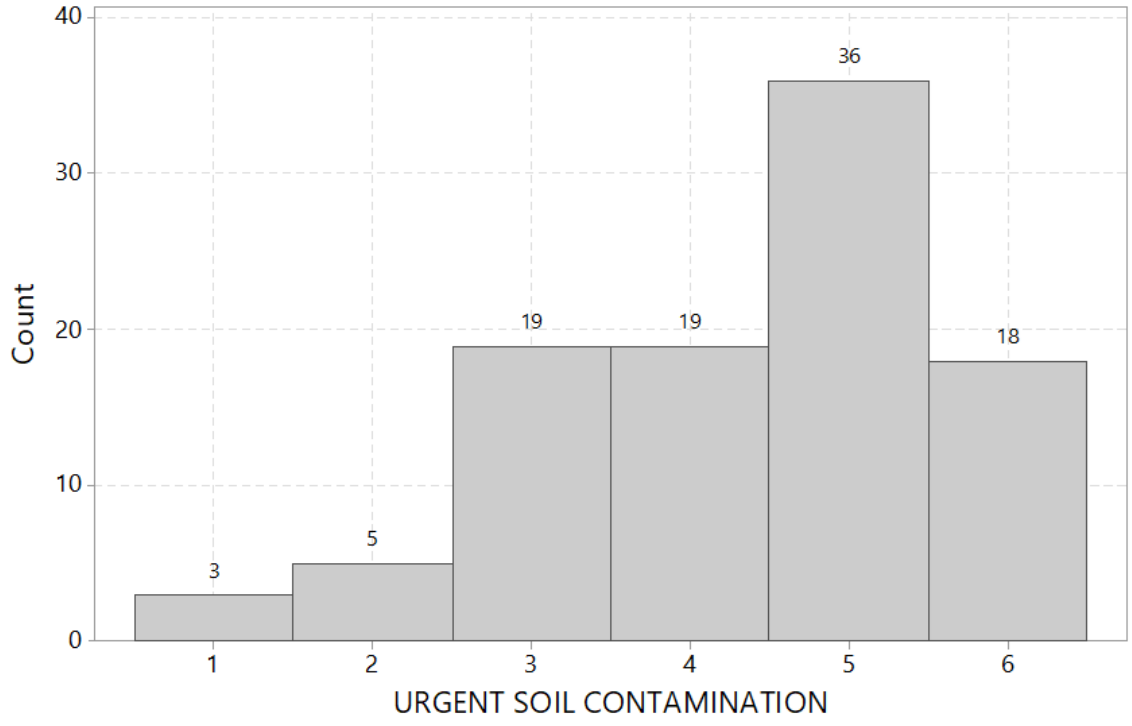

Figure B.26. How urgent, in your opinion, is soil pollution/contamination?

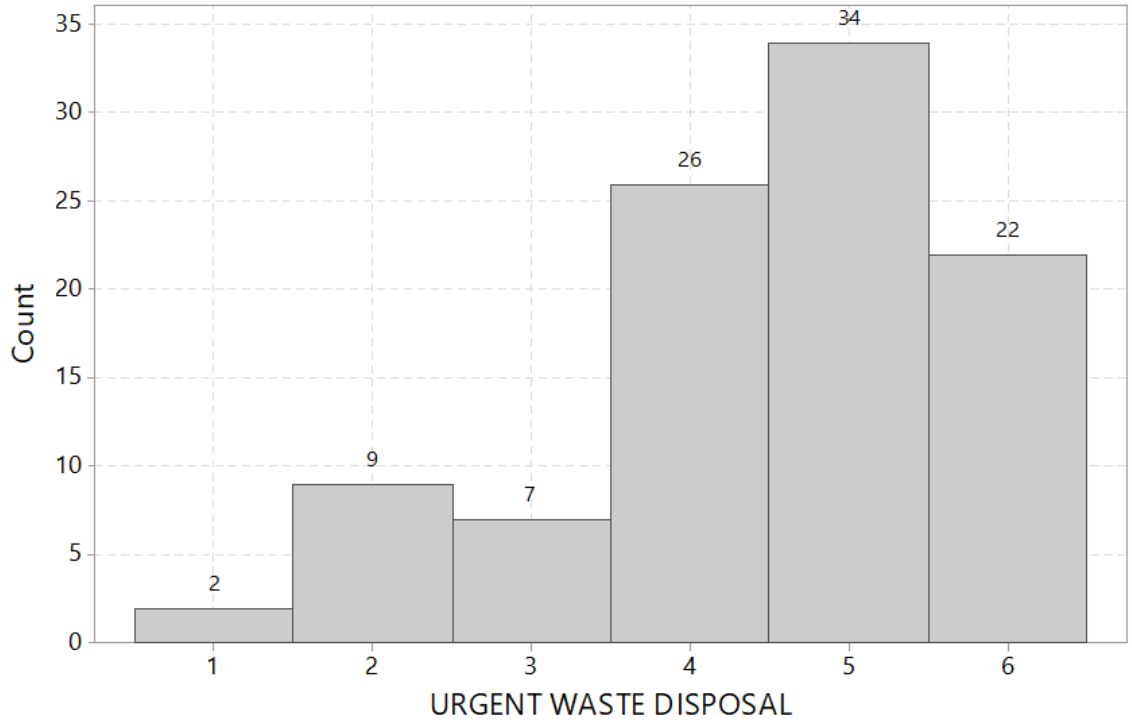

Figure B.27. How urgent, in your opinion, is waste disposal?

Temperature decrease, on the other hand, was deemed more pressing, as illustrated in Figure B.28.

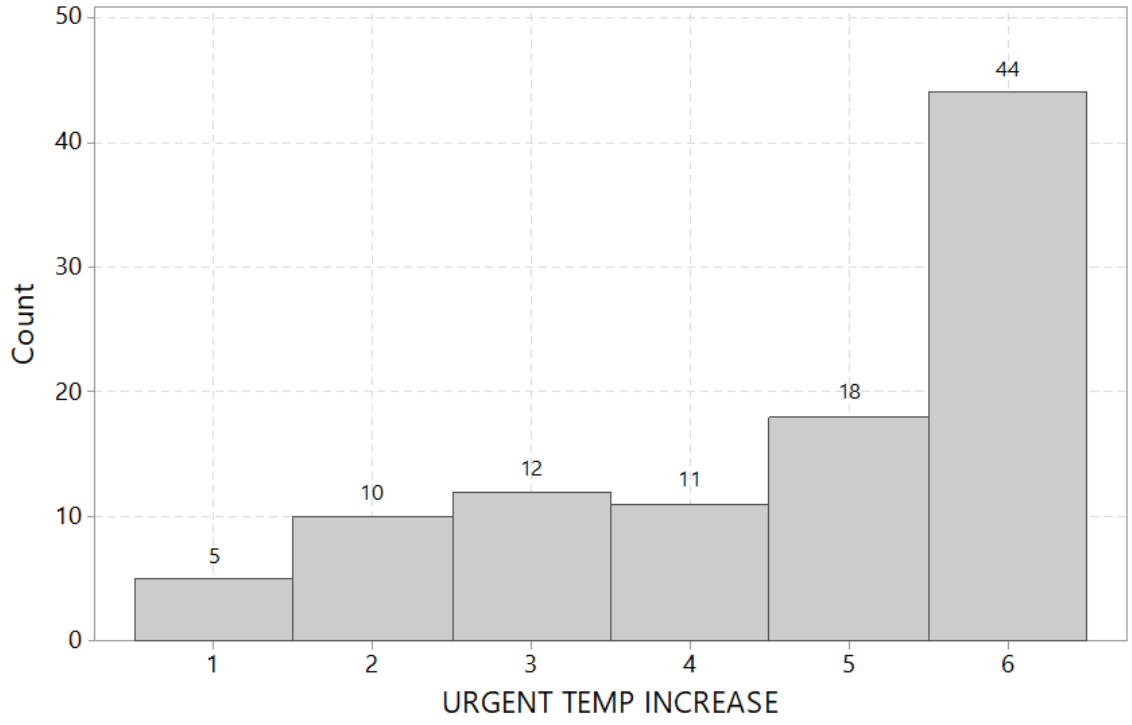

Figure B.28. How urgent, in your opinion, is temperature increase?

The urgency of temperature increase (i.e. global climate change) per country is shown in Figure B.29. Contrary to other European countries, Albania, Poland, Ukraine, the US, and China, viewed it as less urgent. These results also hint at the potential presence of two to three clusters in the sample.

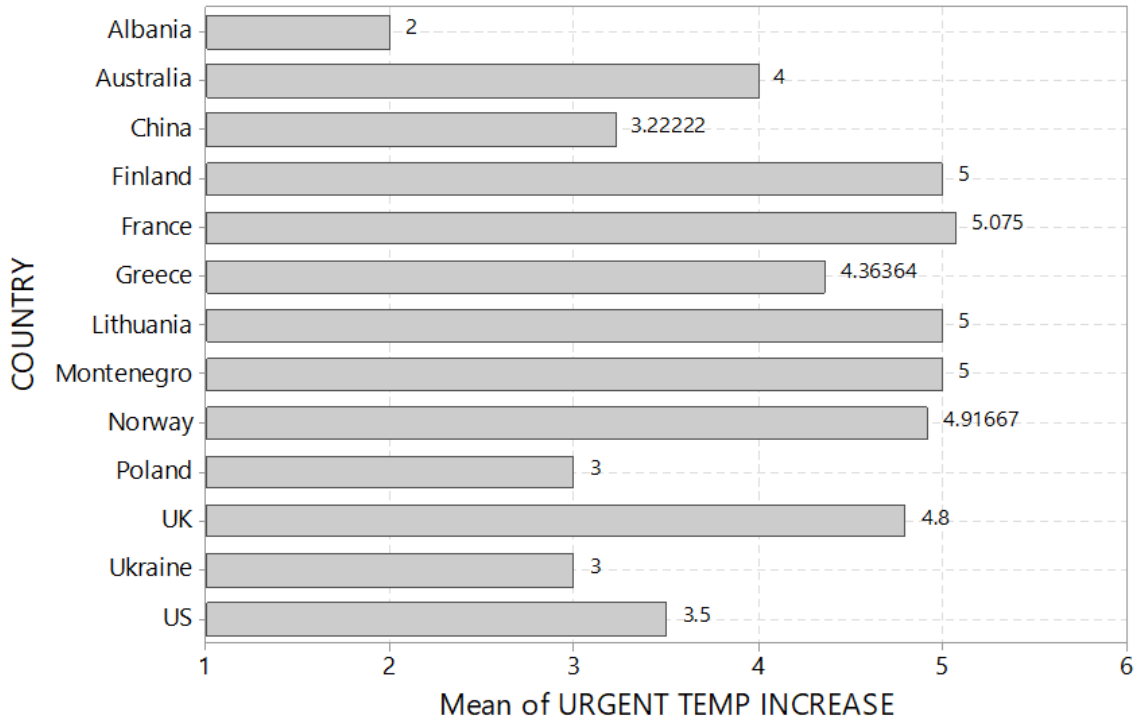

Figure B.29. Mean of “How urgent, in your opinion, is temperature increase?” per country

As shown in Figure B.30, extreme weather was considered very urgent by many respondents (peak at the right end of the graph), but also less urgent by a smaller group (peak at the left part of the graph, including the 14 respondents who selected a ranking of 2 out of 6). This graph again suggests the presence of two clusters in the response sample.

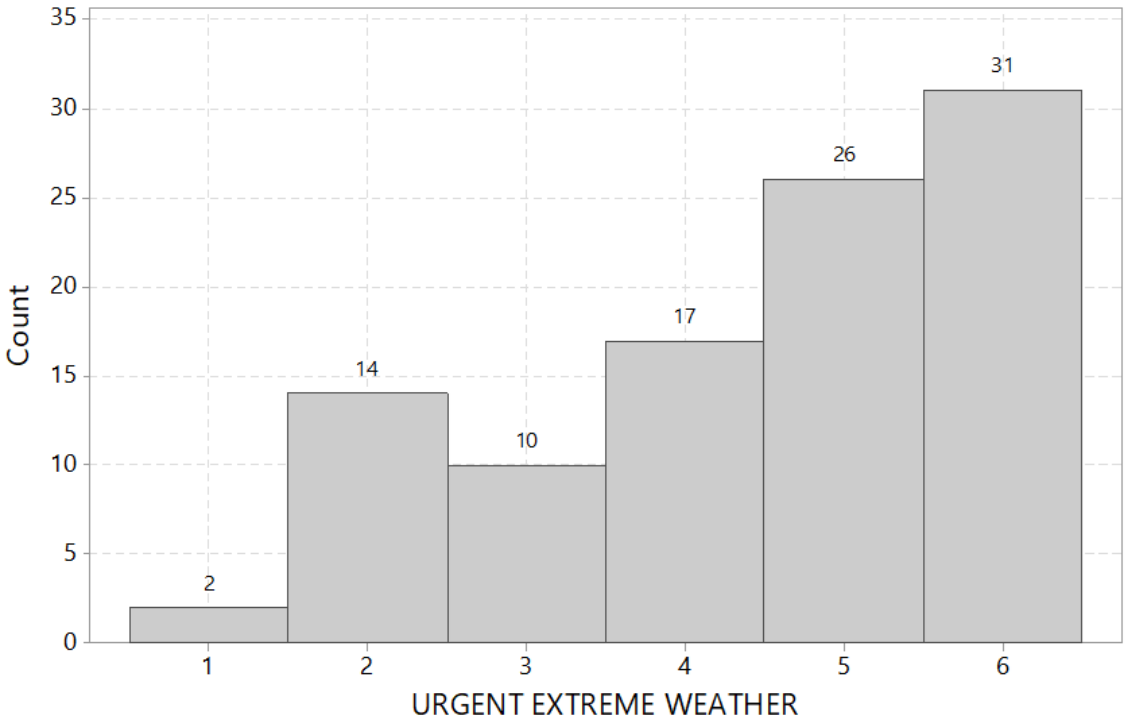

Figure B.30. How urgent, in your opinion, is extreme weather?

Figure B.31 graphs the mean urgency of extreme weather per country, showing that respondents from Albania and Ukraine did not think it is urgent; respondents from the US, China, Greece, Australia, the UK, and possibly Montenegro considered it to be of mediocre urgency; and respondents from other European countries (including Finland, Lithuania, Poland, France, Norway) considered it to be very urgent. These results also hint at the potential presence of two to three clusters in the sample.

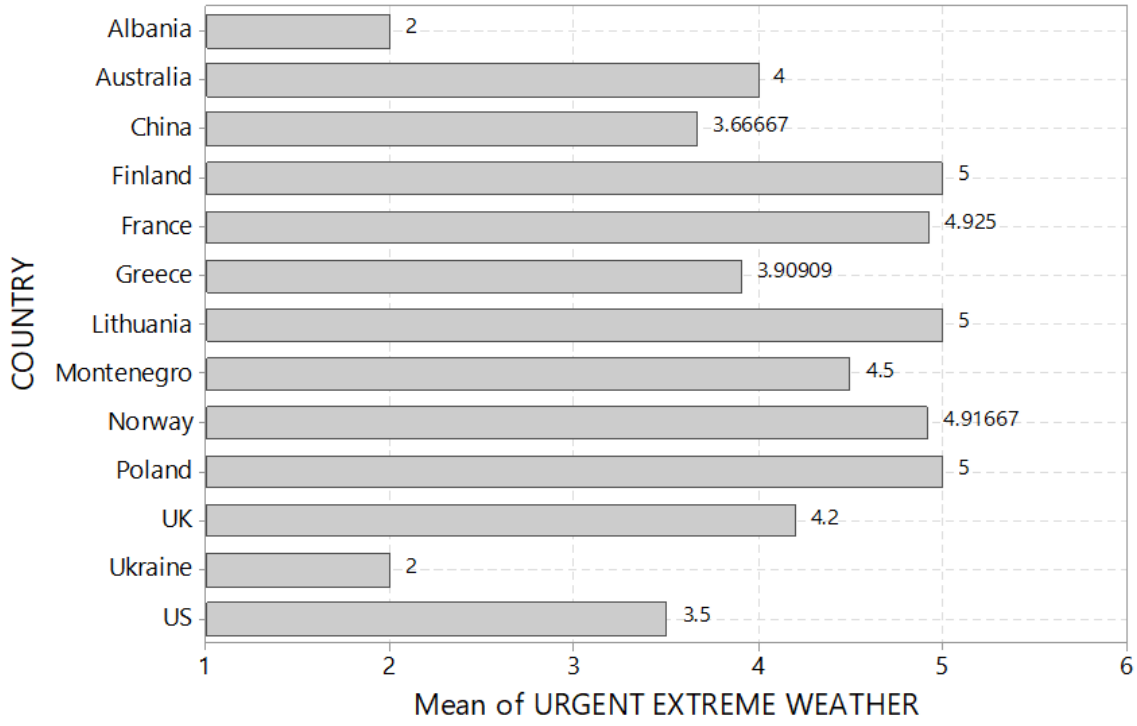

Figure B.31. Mean of “How urgent, in your opinion, is extreme weather?” per country

Figure B.32 shows that respondents found the exploitation of natural resources to be a very urgent issue.

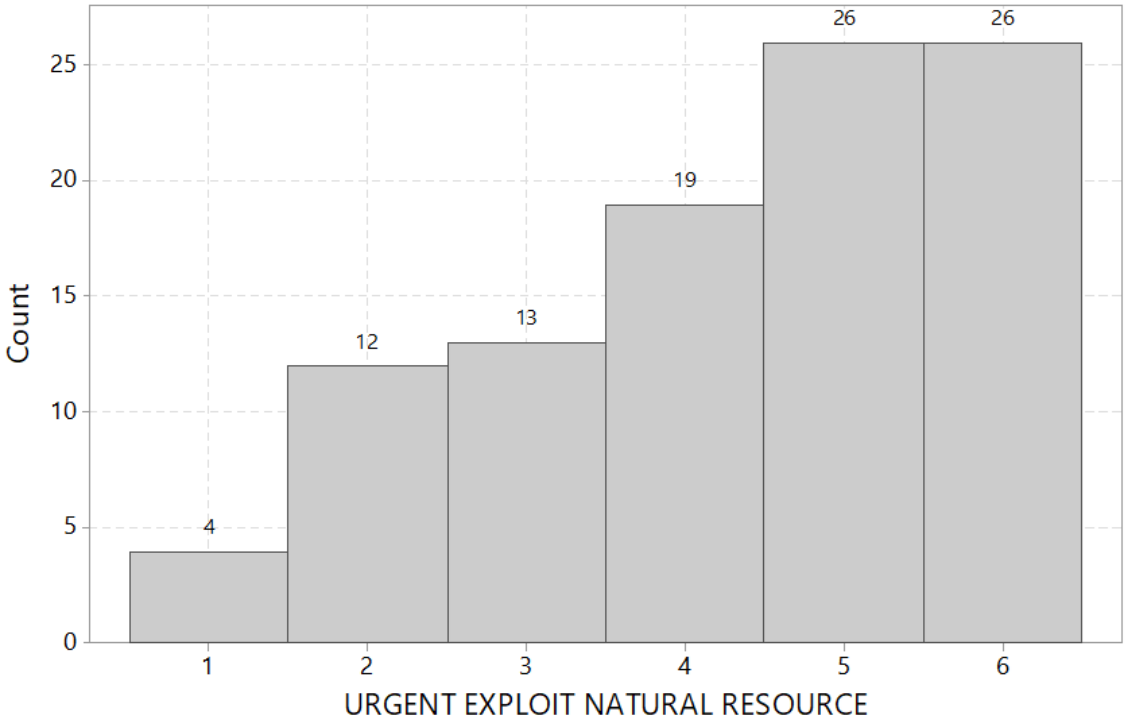

Figure B.32. How urgent, in your opinion, is exploitation of natural resources?

Figure B.33 shows two peaks in the graph of the rating of urgency of traffic congestion: one corresponding to the 30 respondents who rated it with a 4, and a second one corresponding to the 23 respondents who rated it with a 2. The shape of this distribution indicates the presence of two clusters in the group.

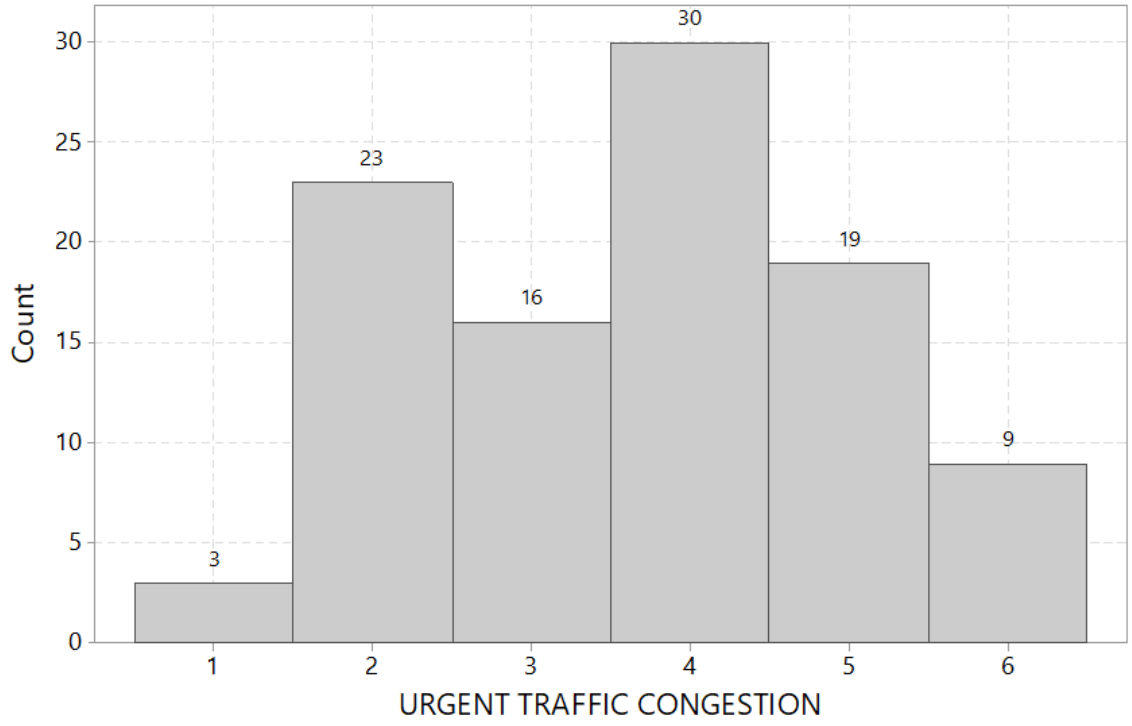

Figure B.33. How urgent, in your opinion, is traffic congestion?

Noise was considered less urgent, as shown in Figure B.34.

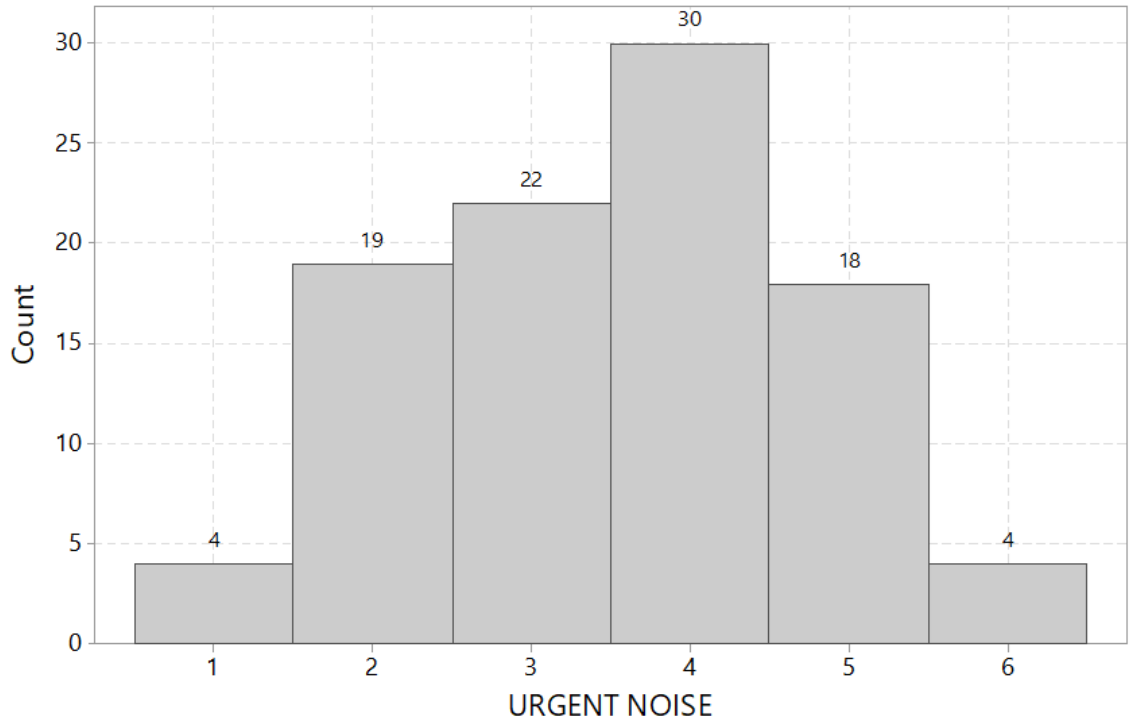

Figure B.34. How urgent, in your opinion, is noise?

The total environmental impact of the existing energy production model was considered urgent, as shown in Figure B.35.

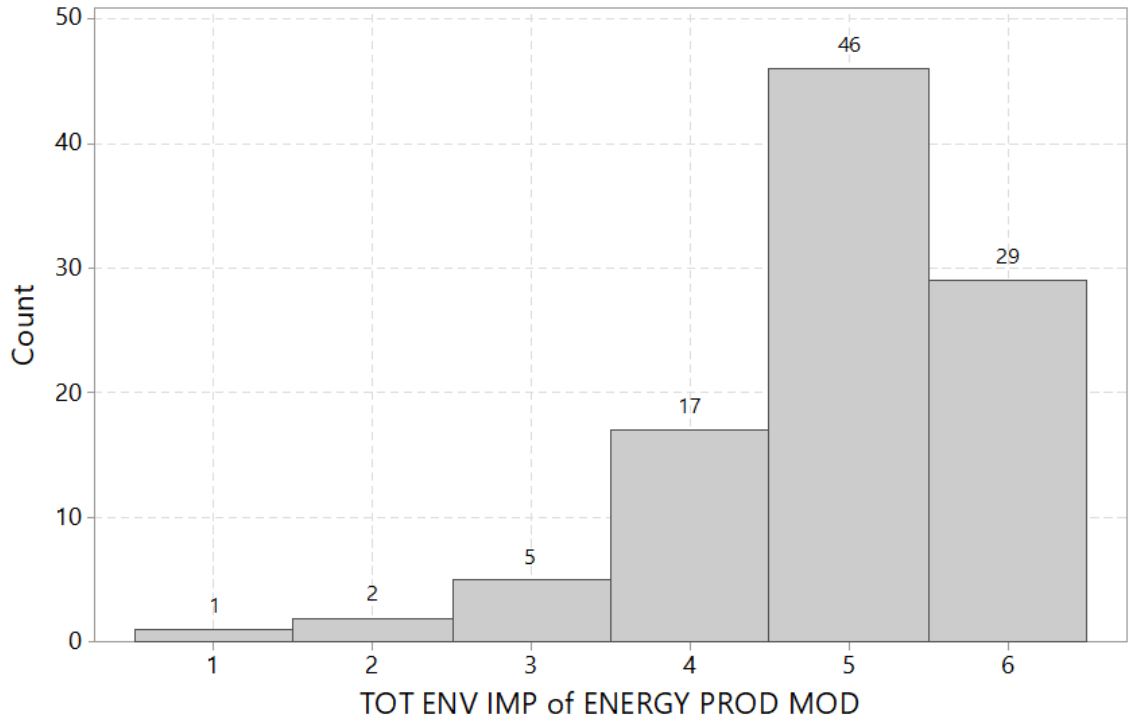

Figure B.35. In your opinion, how important is the total impact of the existing energy production model on the aforementioned environmental issues?

Figure B.36 shows that respondents felt that air pollution would affect their attitude towards geothermal development in their area (related to the Not in My Back Yard or NIMBY syndrome) rather significantly.

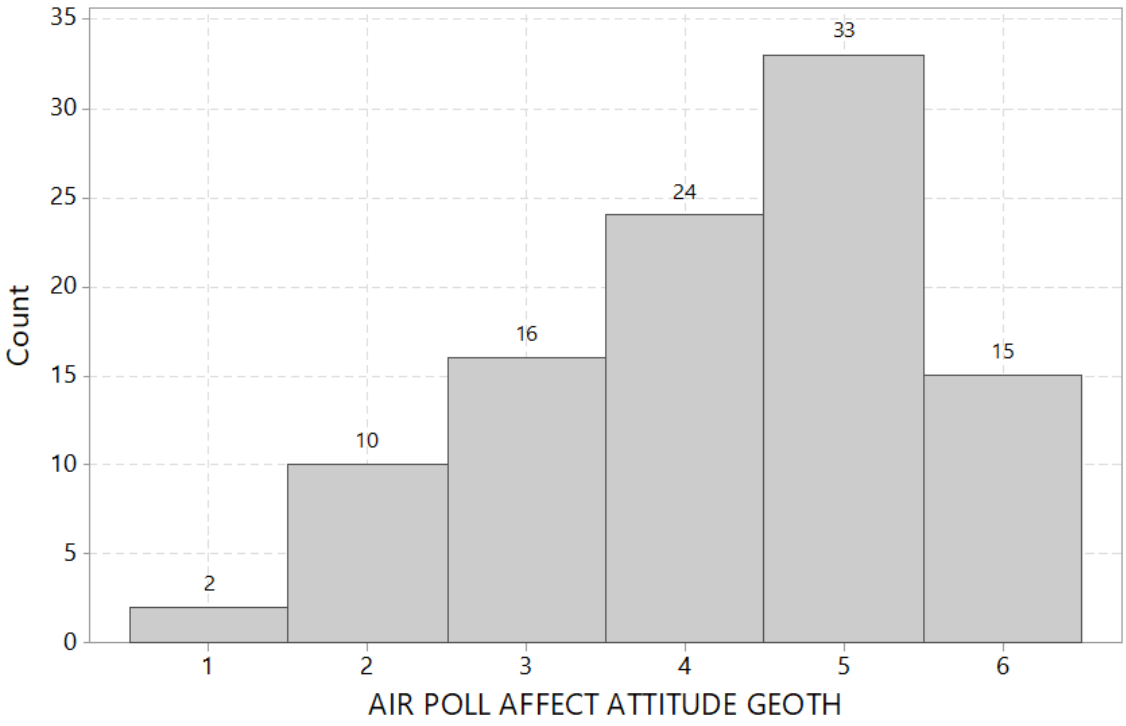

Figure B.36. How much would air pollution affect your attitude toward geothermal development in your area?

As to how noise would affect the perception towards geothermal development in their community, responses covered the range 2 to 5 rather homogeneously, as shown in Figure B.37.

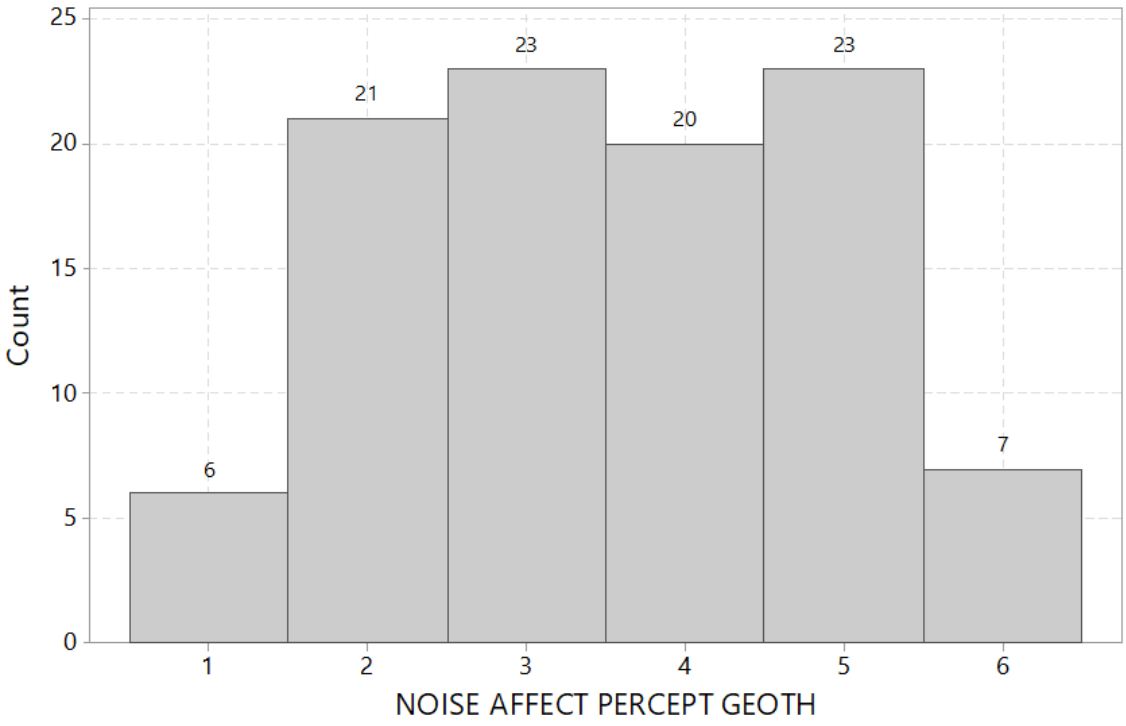

Figure B.37. How much would noise pollution affect your perception of geothermal development in your community?

A relatively similar distribution is shown in Figure B.38, regarding how much aesthetic degradation and visual intrusion would affect the attitude of respondents towards geothermal development.

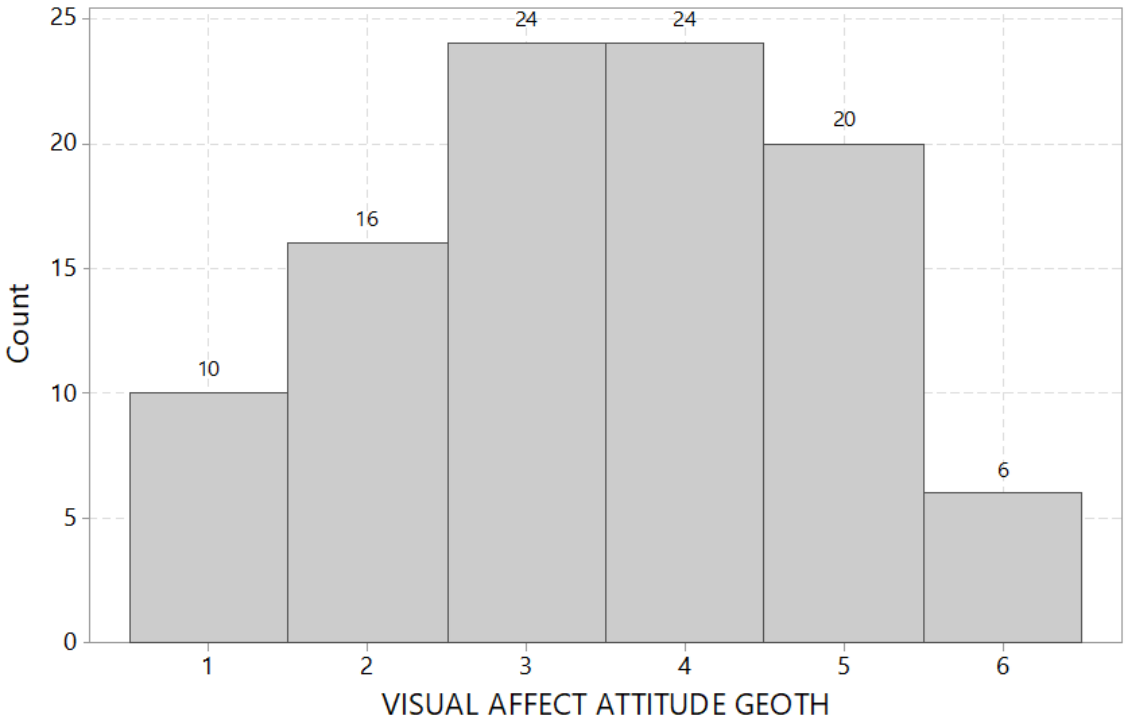

Figure B.38. How much would aesthetic degradation and visual intrusion affect your attitude toward geothermal development in your area?

As a final entry in the section on environmental concerns, Figure B.39 shows that the degradation and/or depletion of water resources was considered to affect the attitude of respondents towards geothermal development in their area rather significantly.

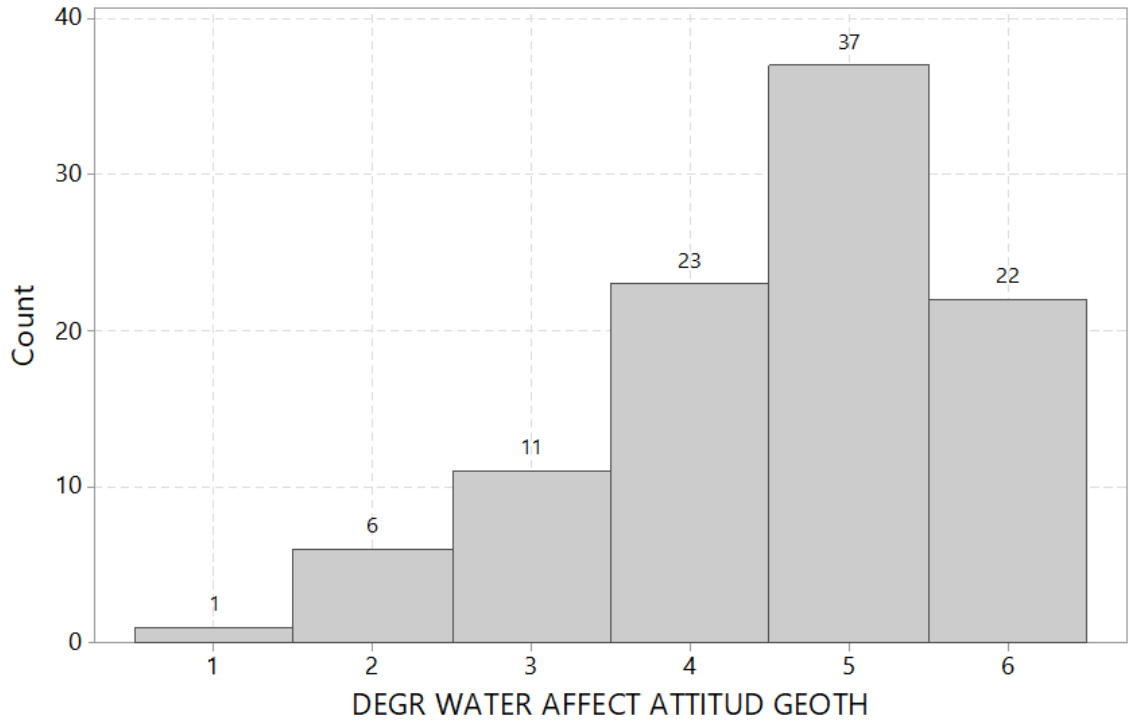

Figure B.39. How much would degradation and/or depletion of water resources affect your attitude towards geothermal development in your area?

B.3. Sociopolitical variables (Section 3)

As shown in Figure B.40, respondents felt that climate change was very urgent.

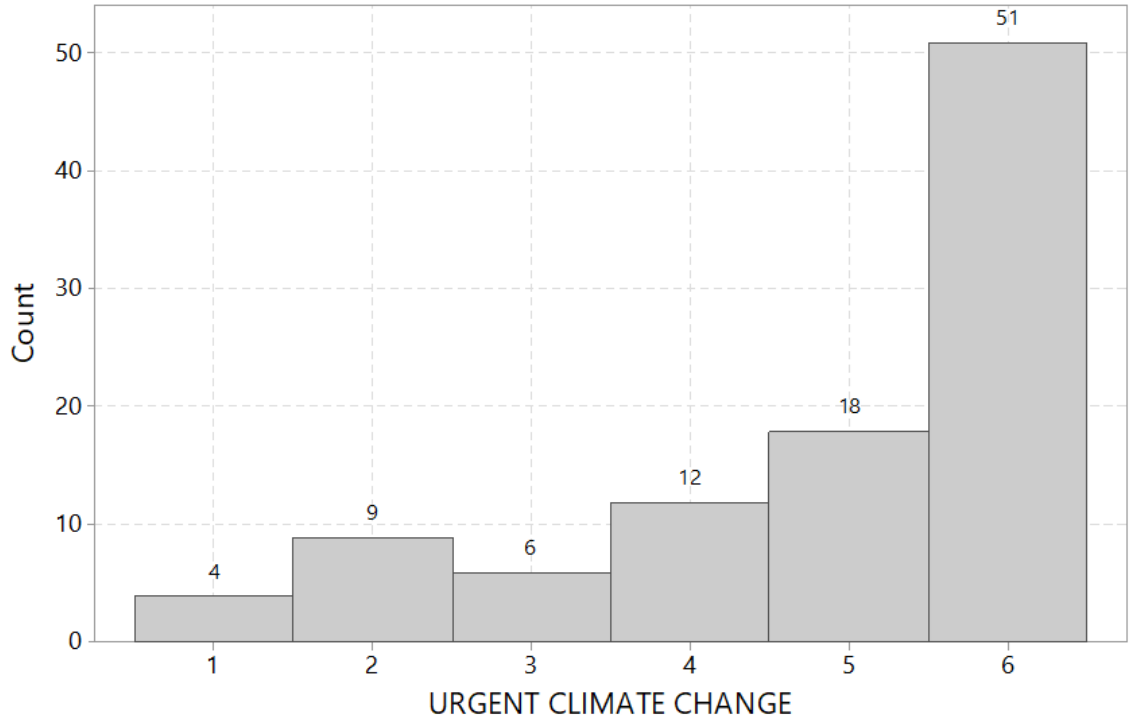

Figure B.40. In your opinion, how urgent is climate change?

Breaking down the urgency of climate change per country, Figure B.41 shows that respondents in Poland, Albania, China, Australia, Lithuania, Ukraine, and Greece attributed a mediocre urgency to climate change.

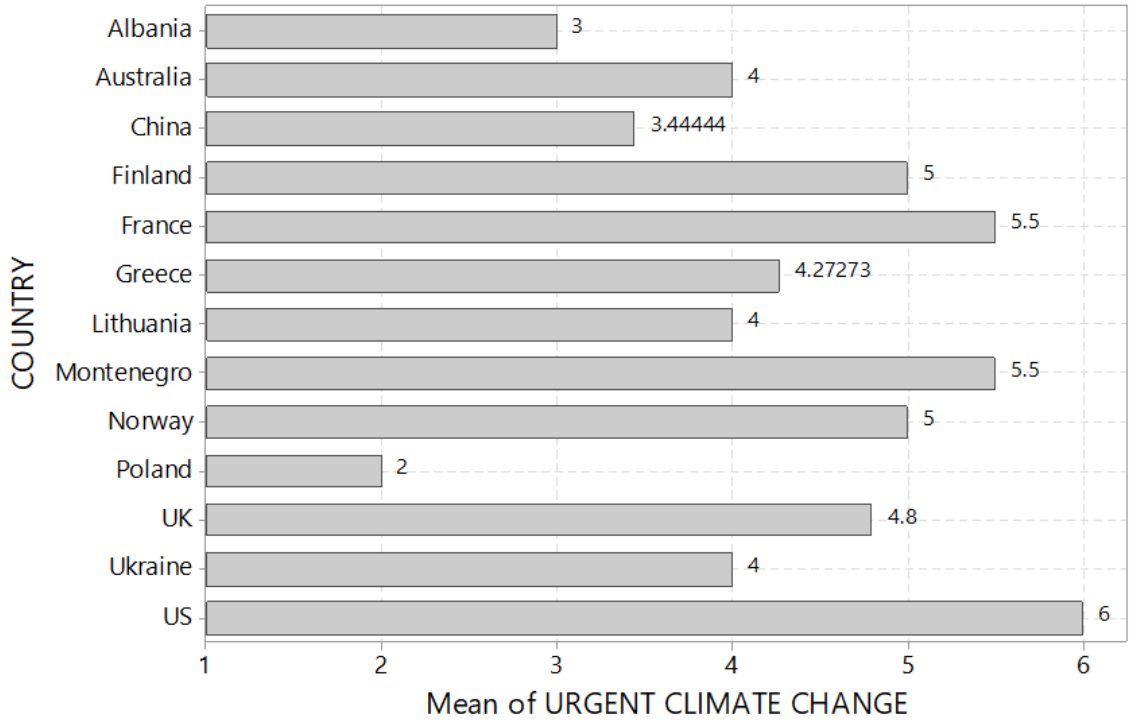

Figure B.41. Mean of “In your opinion, how urgent is climate change?” per country

Water and food shortages were also considered to be very urgent, according to Figures 4.42 and 4.43.

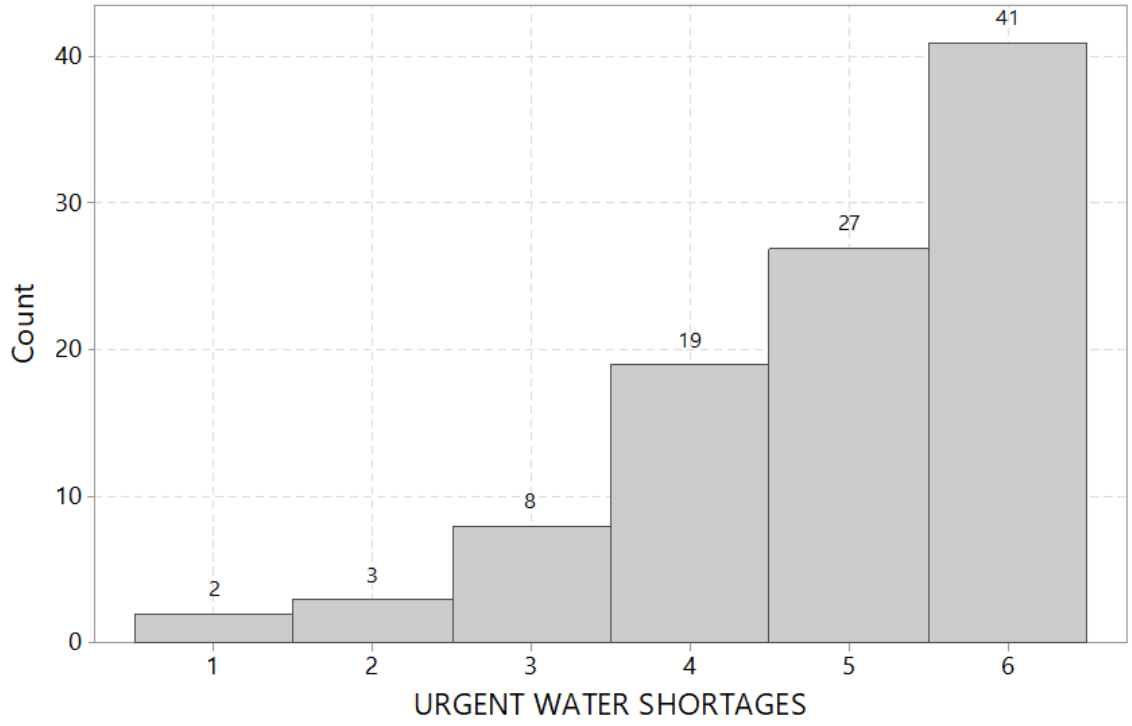

Figure B.42. In your opinion, how urgent are water shortages?

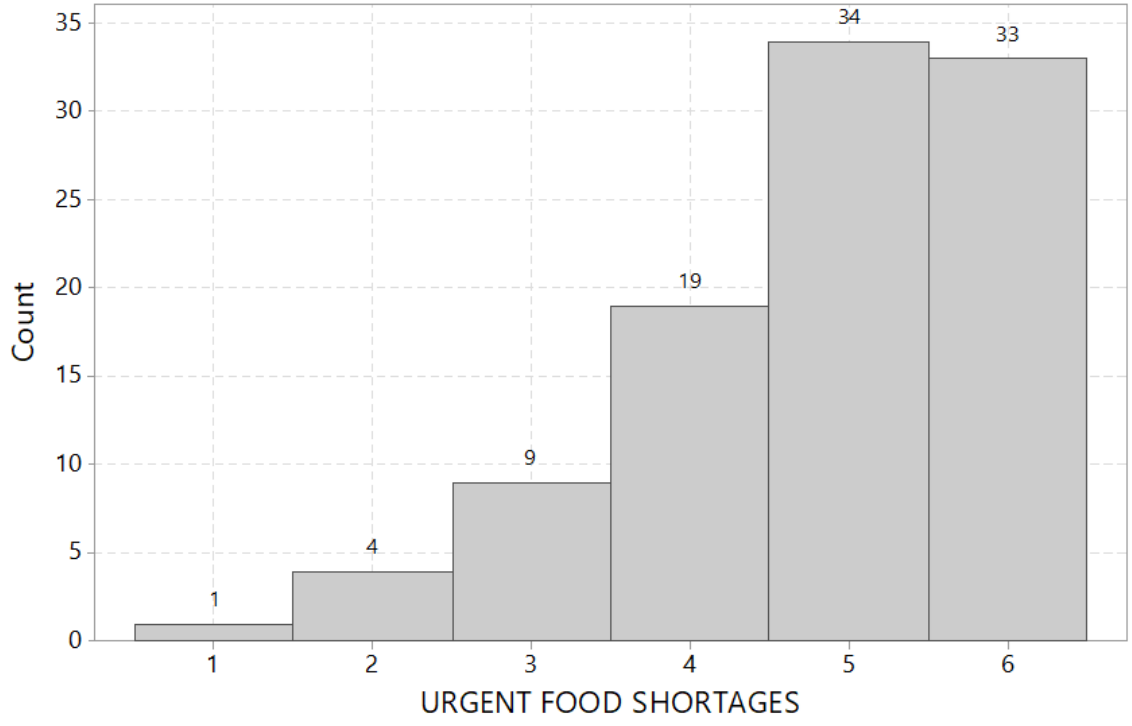

Figure B.43. In your opinion, how urgent are food shortages and famine?

As shown in Figure B.44, pandemics were also considered an urgent matter, although less so than water and food shortages.

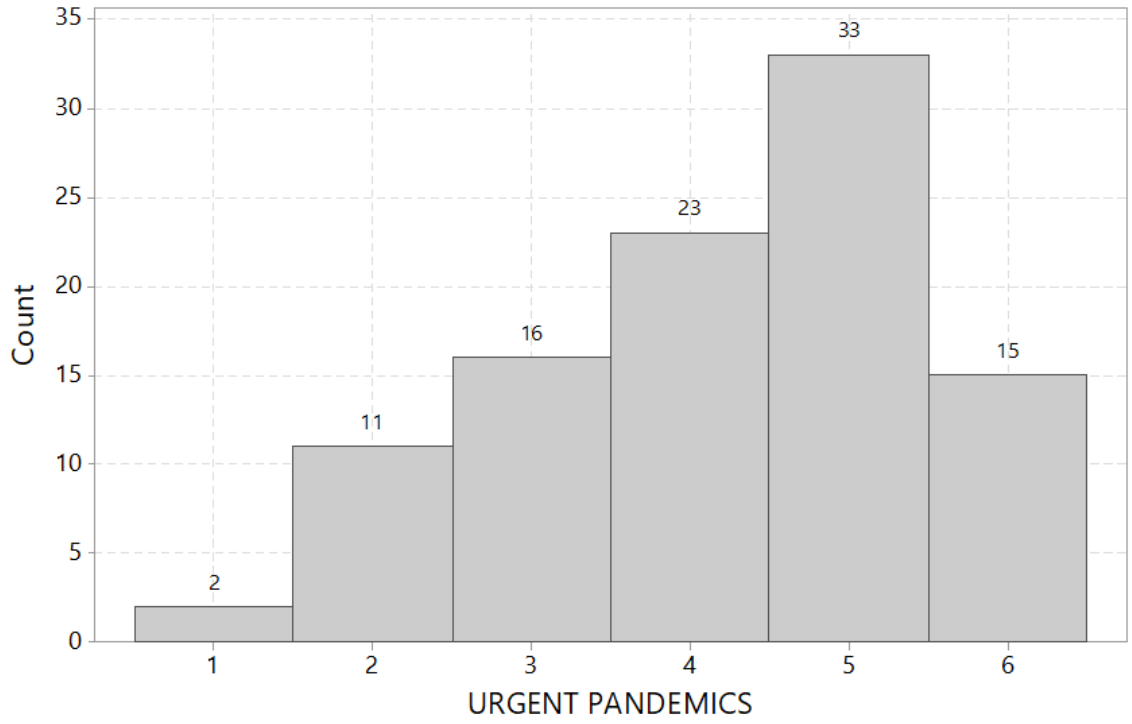

Figure B.44. In your opinion, how urgent are pandemic crises and their impacts?

Economic crises and unemployment were also considered to be of mediocre importance, as shown in Figure B.45.

Figure B.45. In your opinion, how urgent are economic crises and unemployment?

As shown in Figure B.46, almost all respondents thought that poverty was (very) urgent, with only 5 respondents assigning it an urgency of 1 or 2 (out of a maximum ranking of 6).

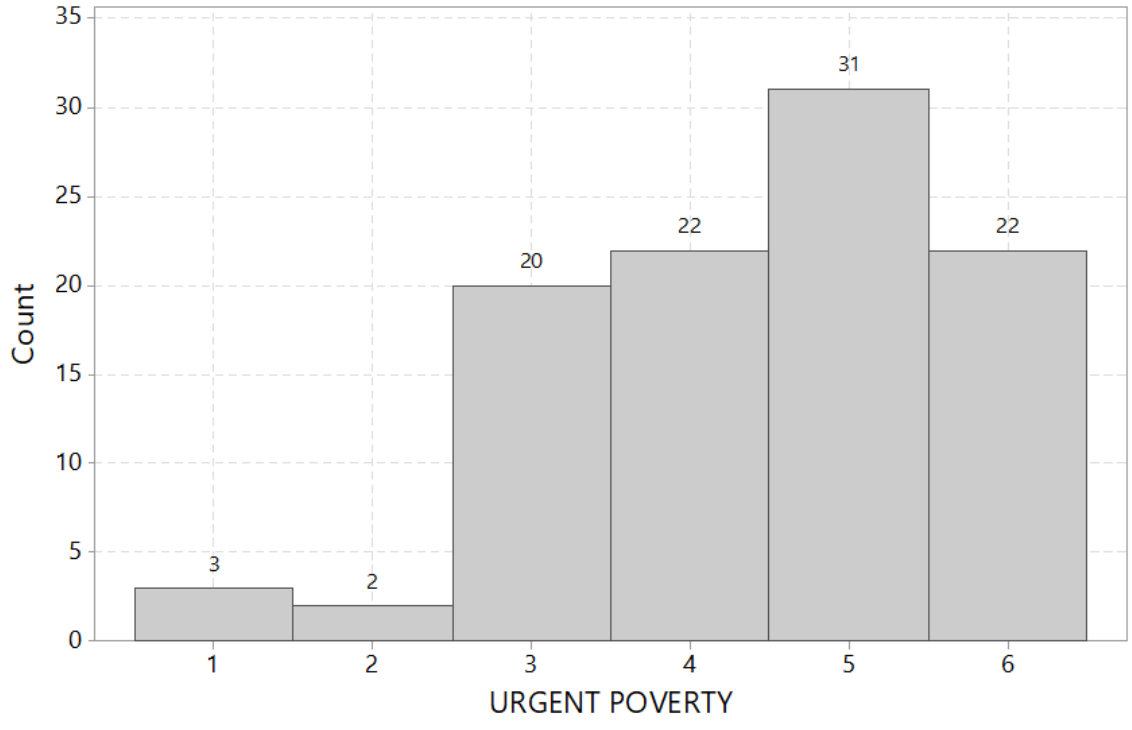

Figure B.46. In your opinion, how urgent is poverty?

Terrorism was considered to be of of mediocre urgency, as shown in Figure B.47, exhibiting an almost normal distribution of values among rankings.

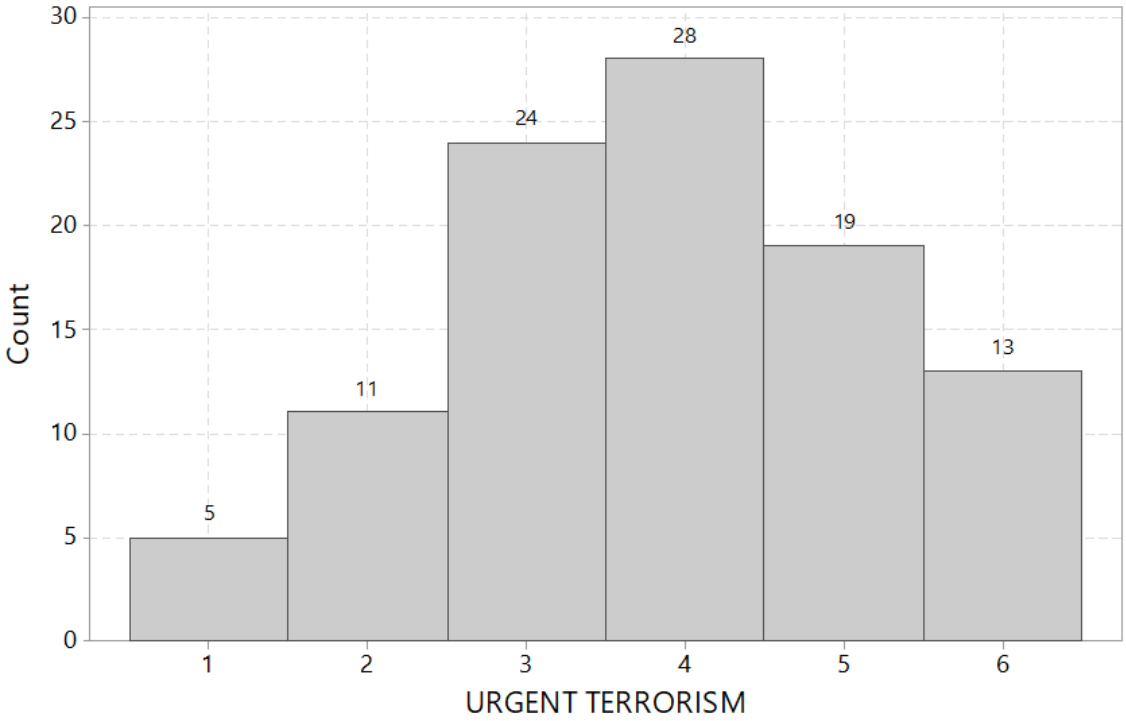

Figure B.47. In your opinion, how urgent is terrorism?

Turning to the decision maker that should ultimately decide on geothermal exploration and drilling, as shown in Figure B.48, 71 respondents thought that such decisions should be made by national governments, 49 by regional government, 48 by the European Union (EU), 46 by local authorities, and 24 or fewer each by various other groups.

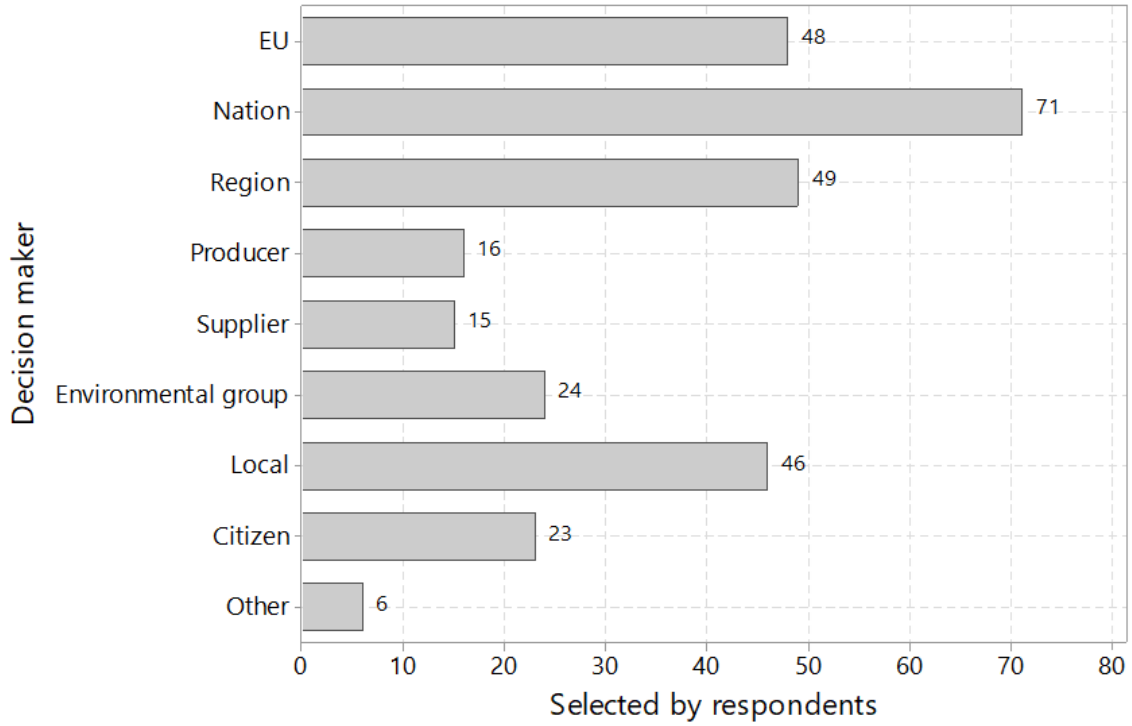

Figure B.48. Who, in your opinion, should ultimately decide on geothermal exploration and drilling?

Figure B.49 shows that awareness of the existence and content of initiatives promoting sustainable energy generation and consumption was rather low, with only 5 respondents being aware (with some surety) of such initiatives.

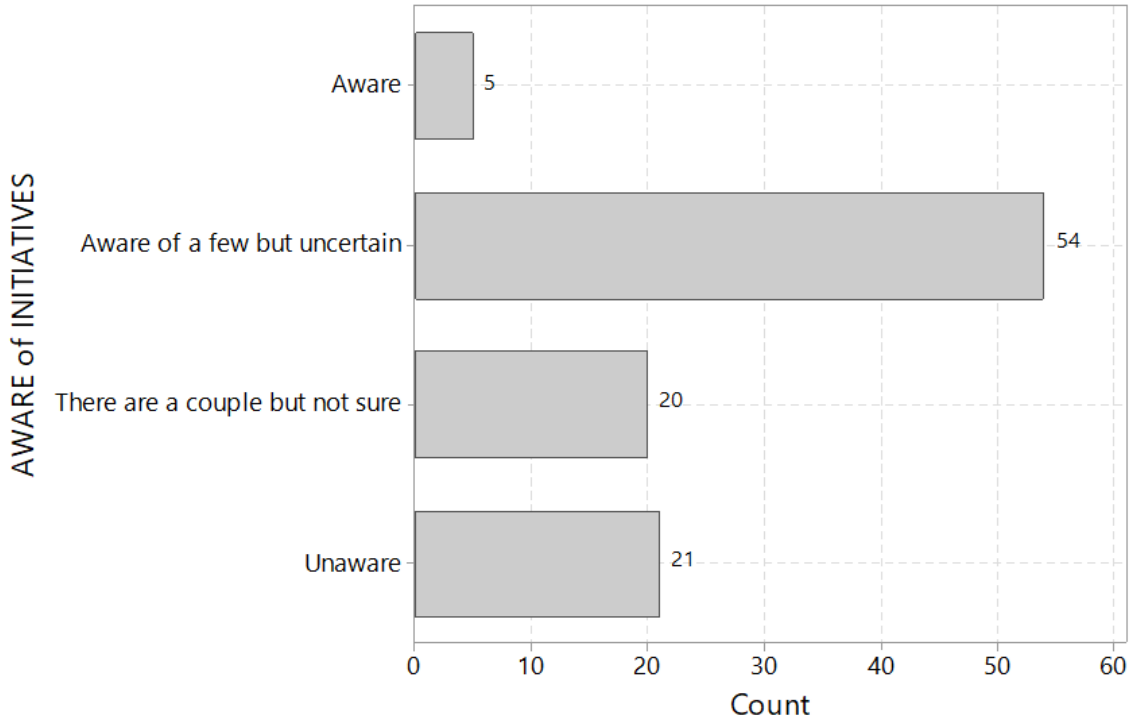

Figure B.49. Are you aware of any recent initiatives to promote more sustainable energy generation and consumption?

Figure B.50 shows that respondents felt that environmental regulations were important or very important in developing effective strategies for sustainable energy systems.

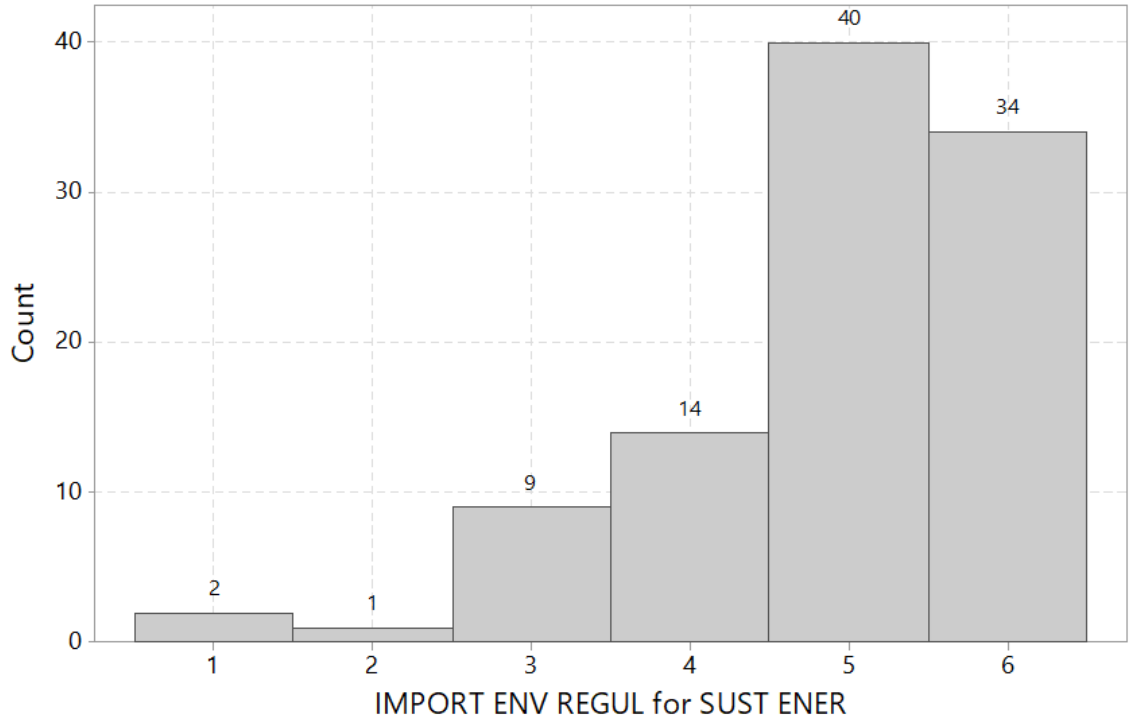

Figure B.50. How important do you think environmental regulations are in developing effective strategies for sustainable energy systems?

Similarly, Figure B.51 shows that respondents felt that pollution reduction was important or very important.

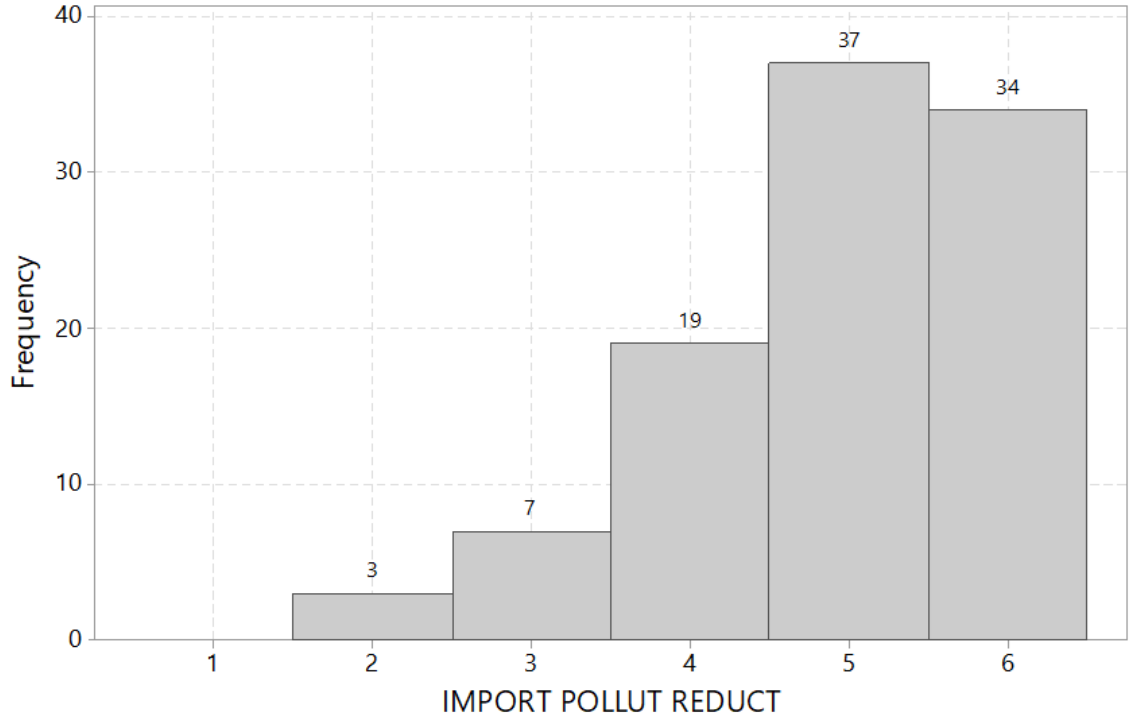

Figure B.51. How important do you think pollution reduction is?

The mitigation of greenhouse (GHS) gas emissions was also considered to be very important, as shown in Figure B.52.

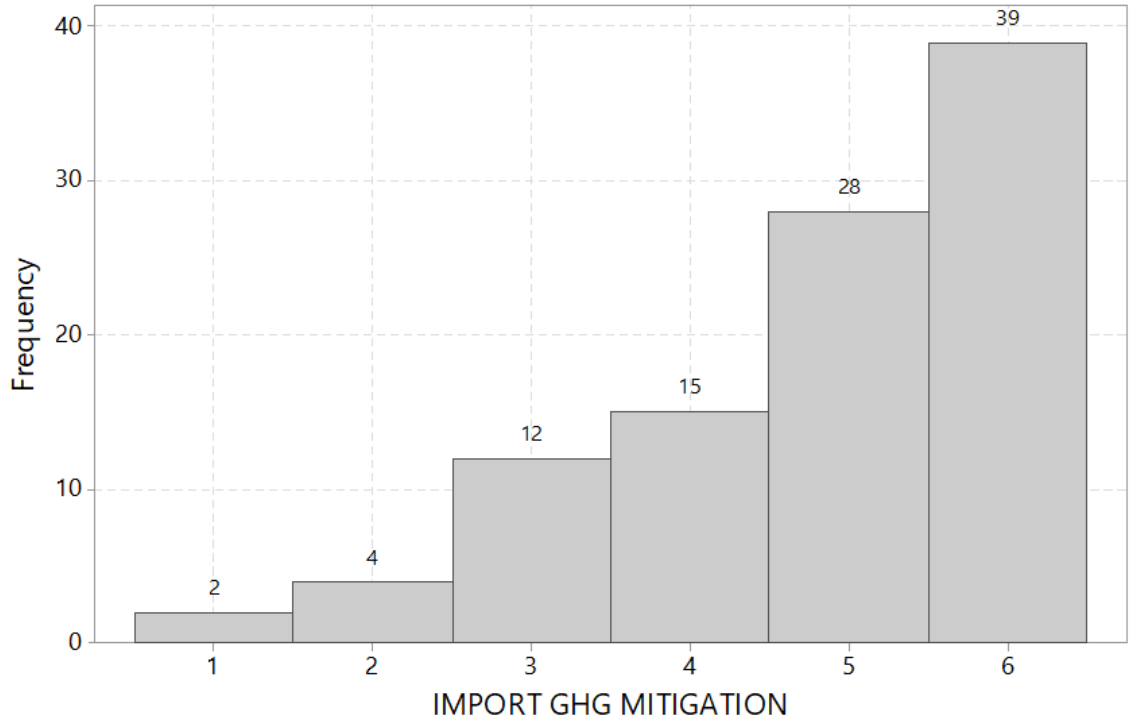

Figure B.52. How important do you think mitigation of greenhouse gas emissions is?

As shown in Figure B.53, energy conservation was considered of mediocre to high importance.

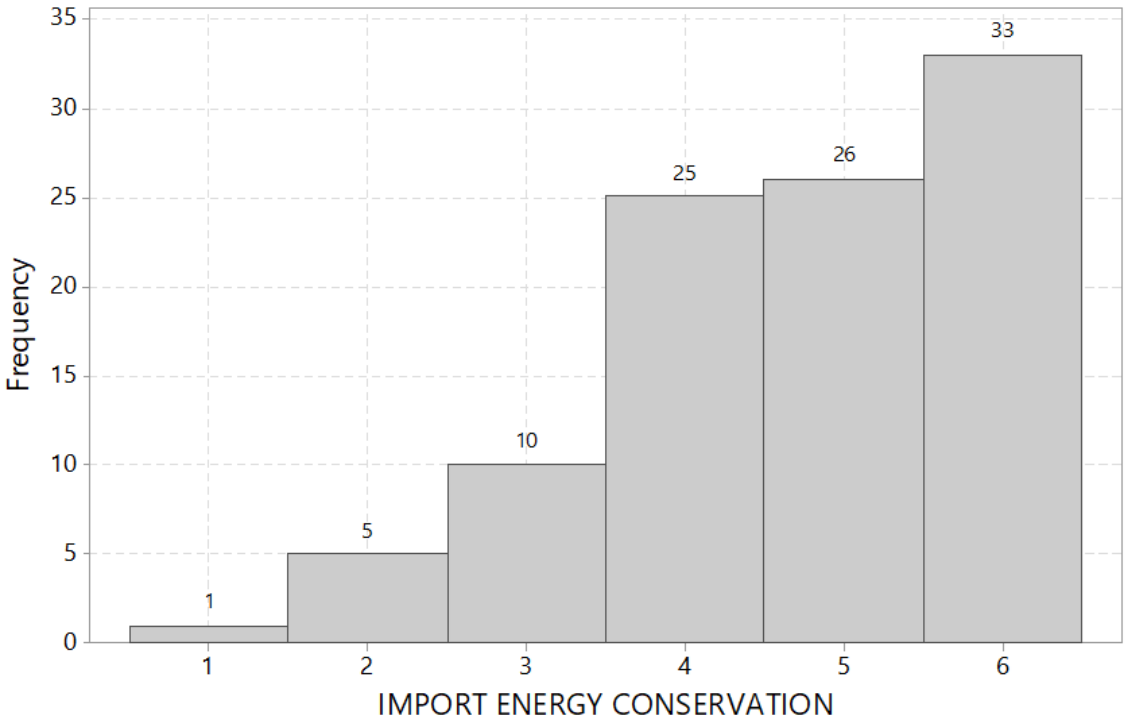

Figure B.53. How important do you think energy conservation is?

The development of renewable energy was considered to be important or very important, as shown in Figure B.54.

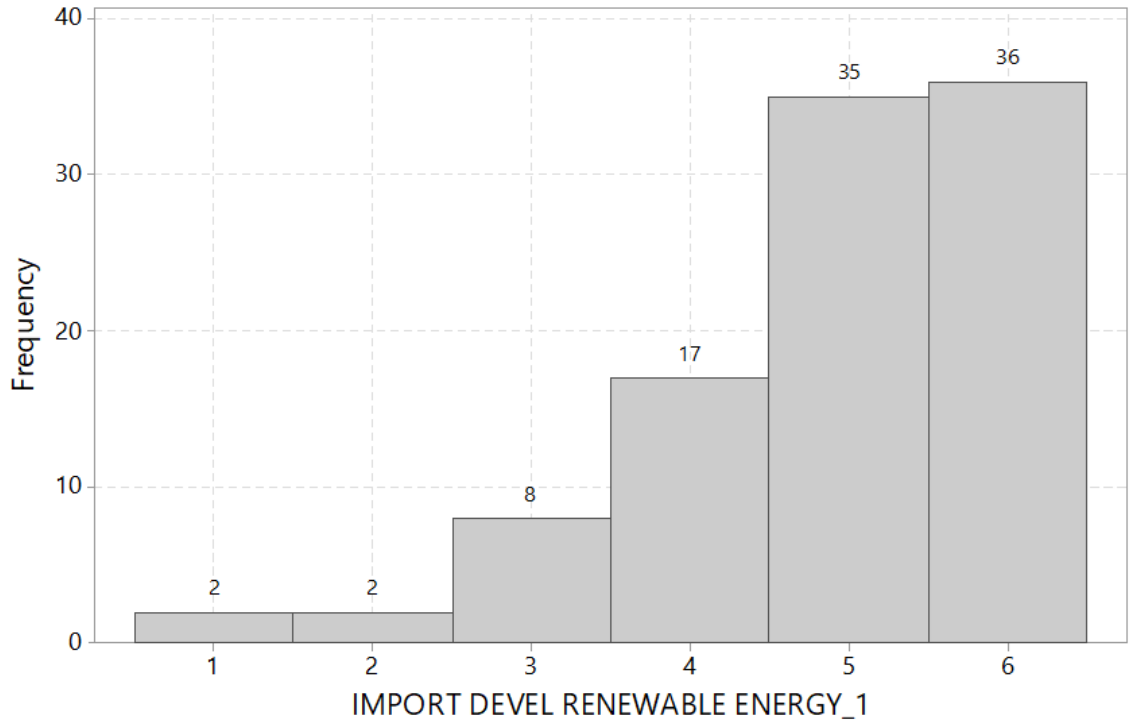

Figure B.54. How important do you think the development of renewable energy is?

Figure B.55 shows that energy accessibility was considered important or very important.

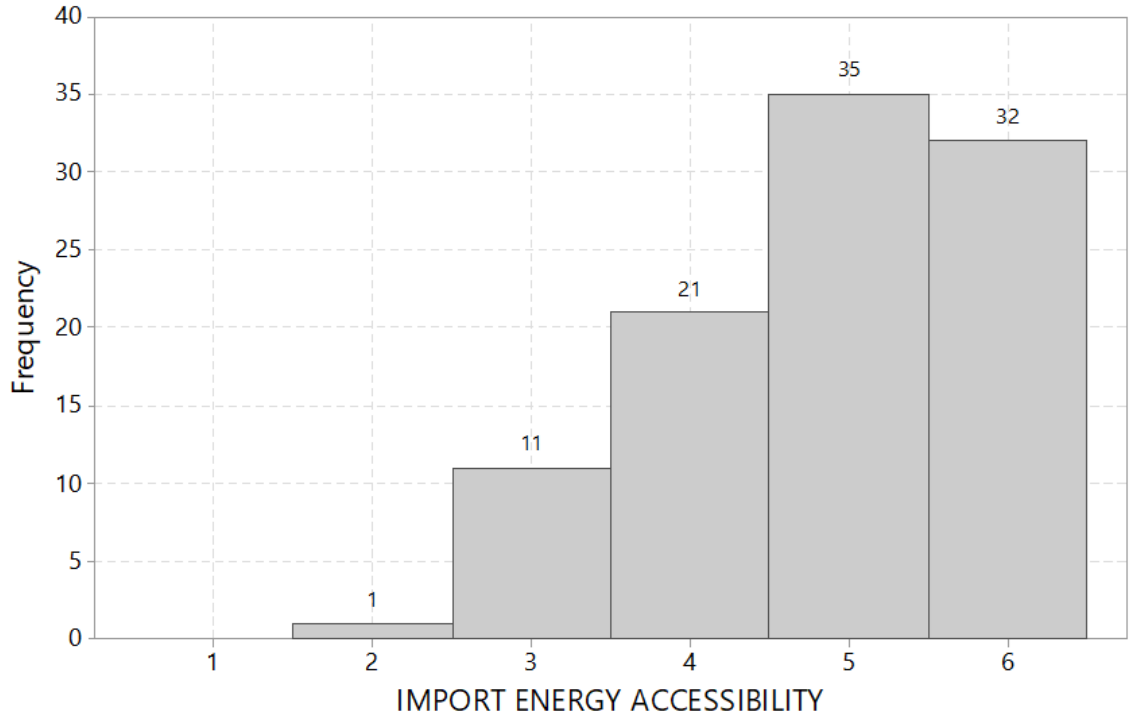

Figure B.55. How important do you think energy accessibility is?

Figure B.56 shows that energy price stability was considered to be important or very important.

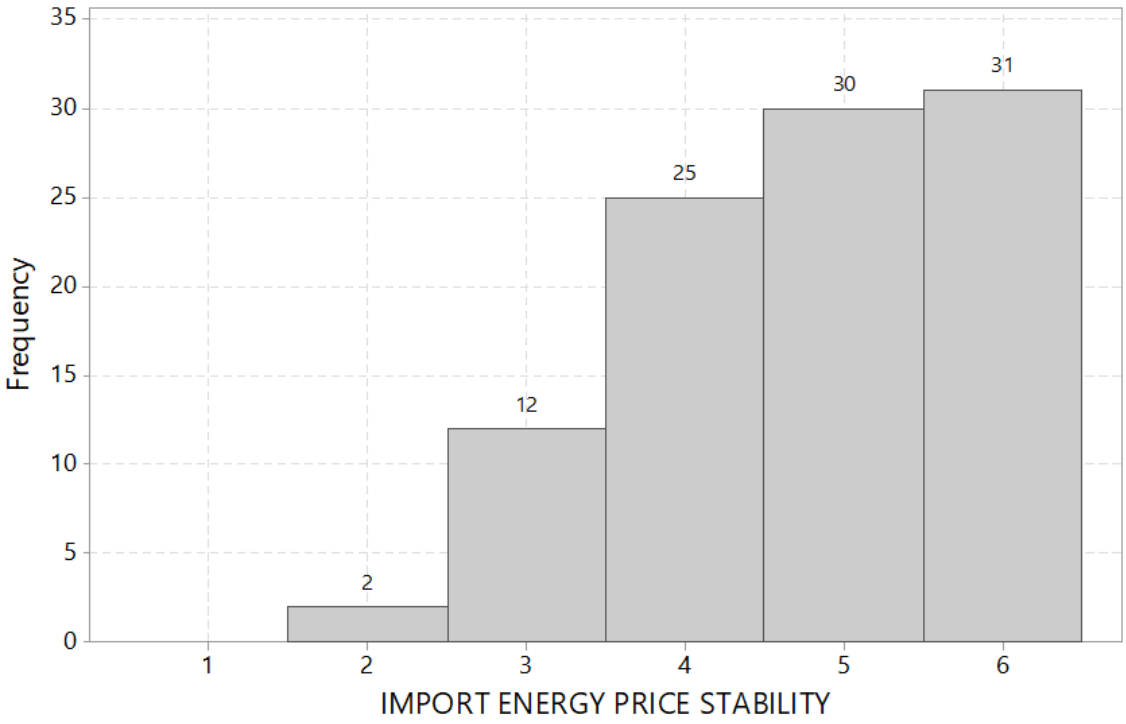

Figure B.56. How important do you think energy price stability is?

Turning to questions related to impacts on our way of life in the coming years, Figure B.57 shows a bimodally distributed ranking of the significance of the expected impact of coal, with values across the entire range, indicating the presence of two clusters in the sample.

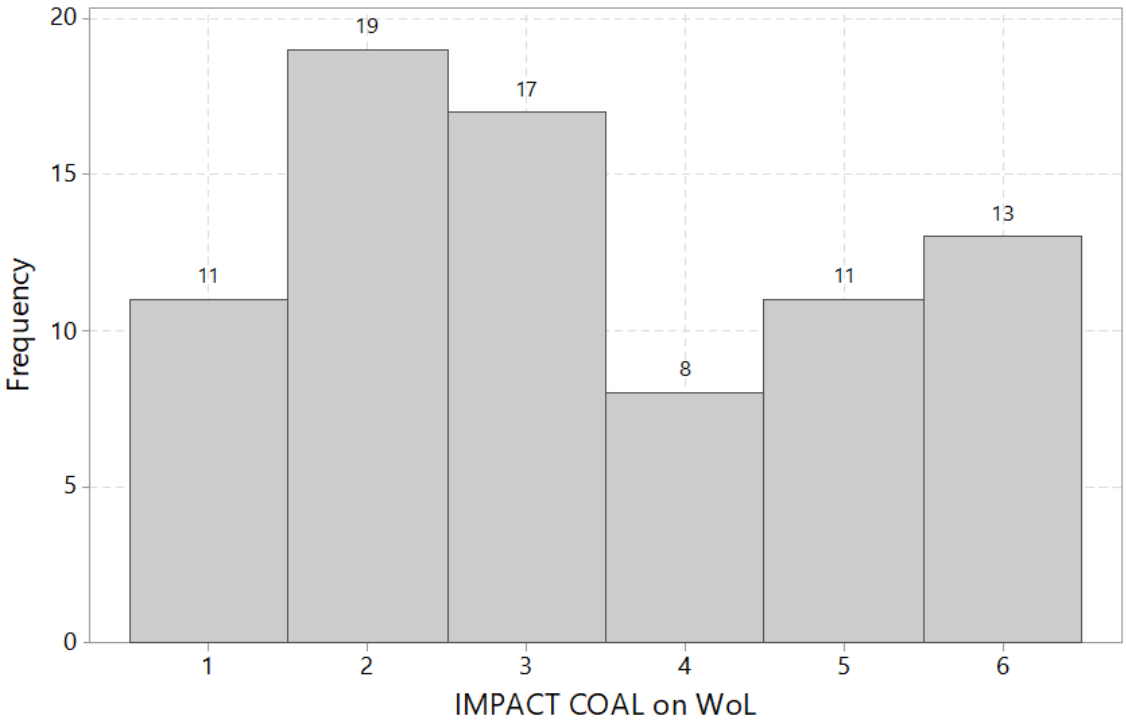

Figure B.57. How significant, in your opinion, will the impact of coal be on our way of life in the coming years?

Rather similar, although less evident, bimodal distributions of the significance of the impact of oil and natural gas on our way of life are shown in Figures 4.58 and 4.59, with fewer values in the lower ranking classes.

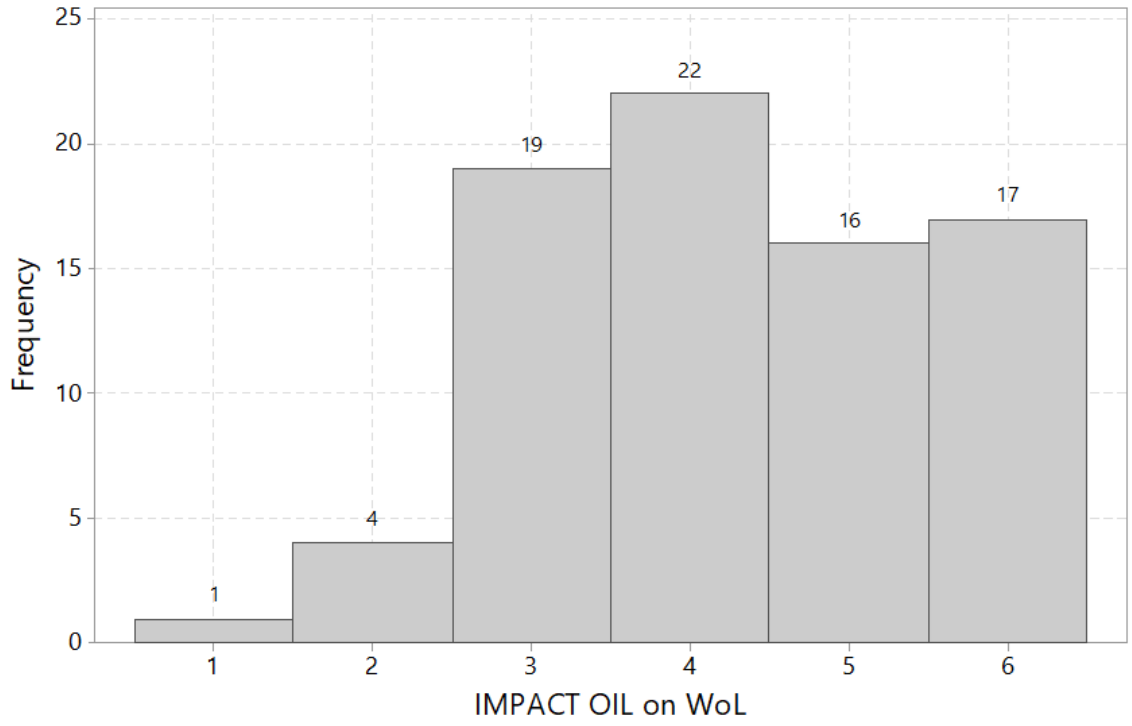

Figure B.58. How significant, in your opinion, will the impact of oil be on our way of life in the coming years?

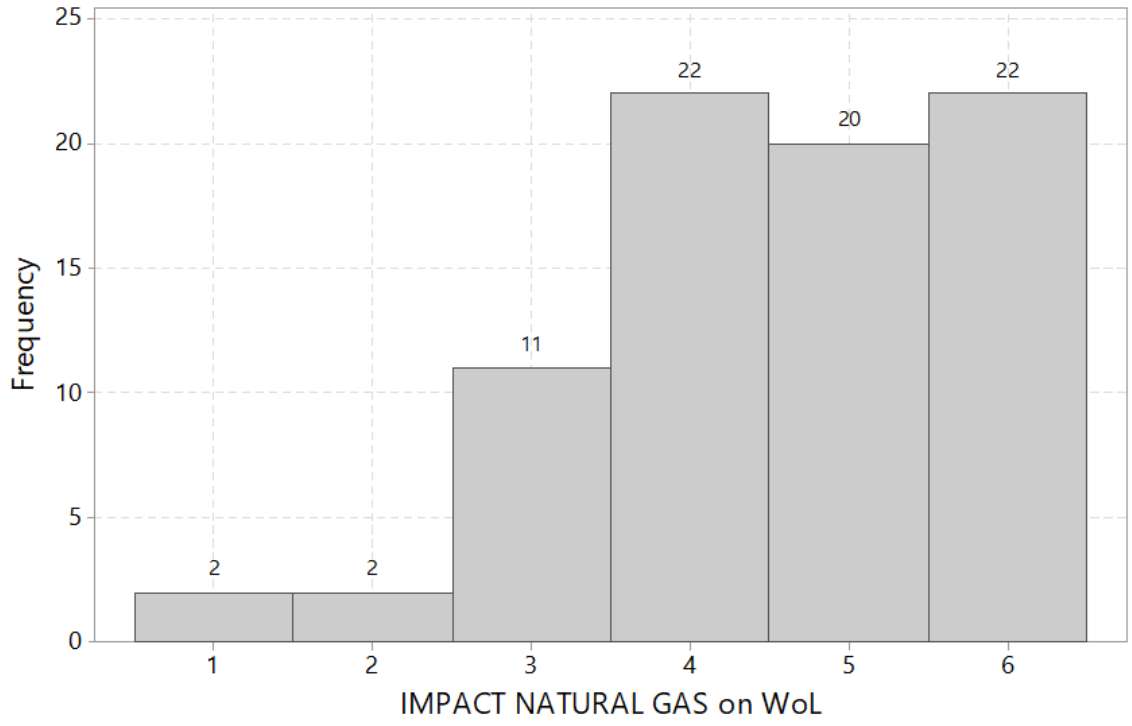

Figure B.59. How significant, in your opinion, will the impact of natural gas be on our way of life in the coming years?

Figures 4.60, 4.61 and 4.62 show that the impacts of solar, wind and hydro energy on our way of life were considered to be significant or very significant, although wind rankings were distributed more uniformly across the range of ranking values.

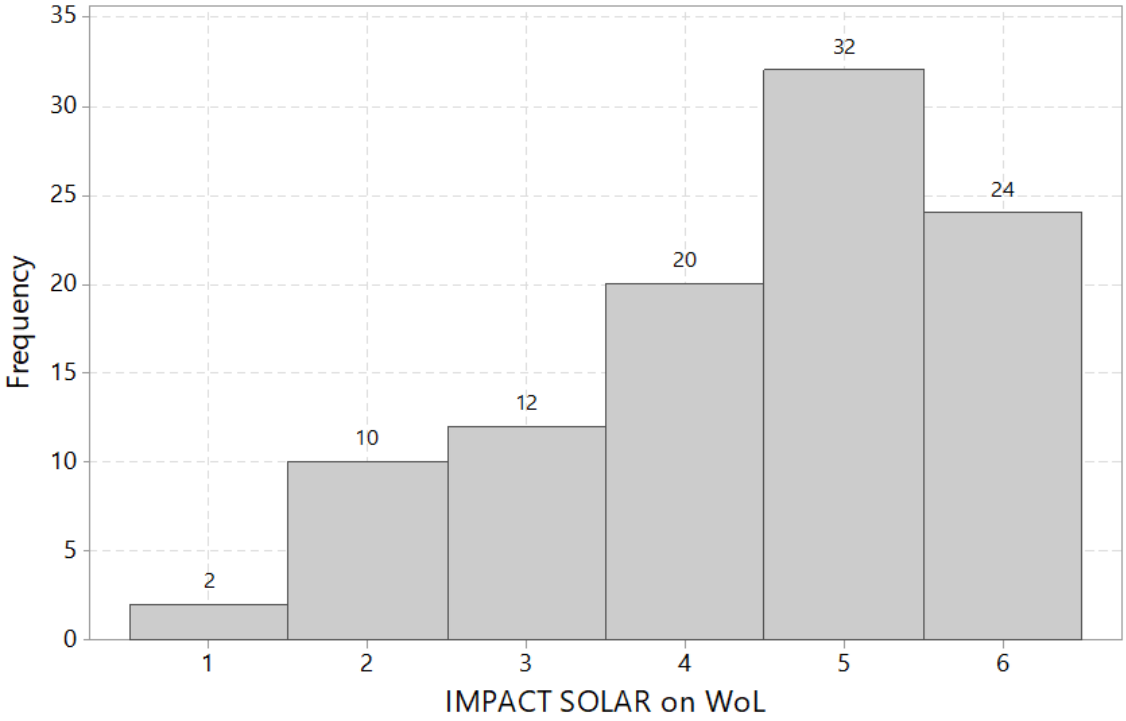

Figure B.60. How significant, in your opinion, will the impact of solar be on our way of life in the coming years?

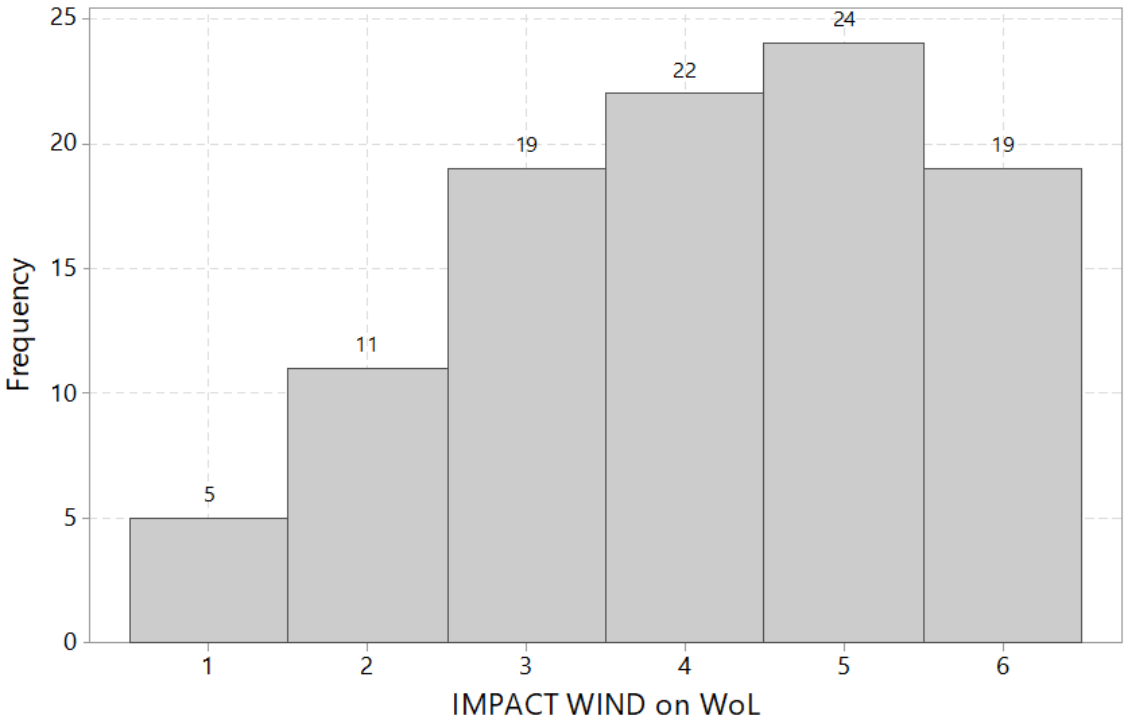

Figure B.61. How significant, in your opinion, will the impact of wind be on our way of life in the coming years?

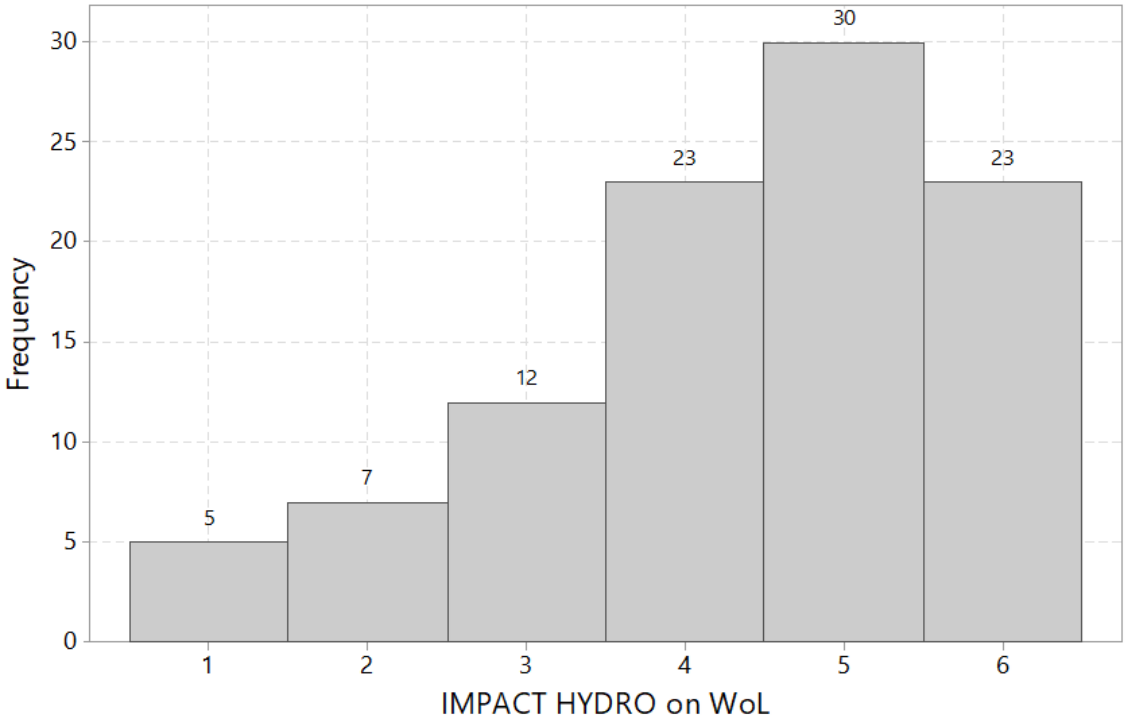

Figure B.62. How significant, in your opinion, will the impact of hydro be on our way of life in the coming years?

Turning to geothermal energy, Figure B.63 shows that its impact on our way of life was considered to be above average by most respondents.

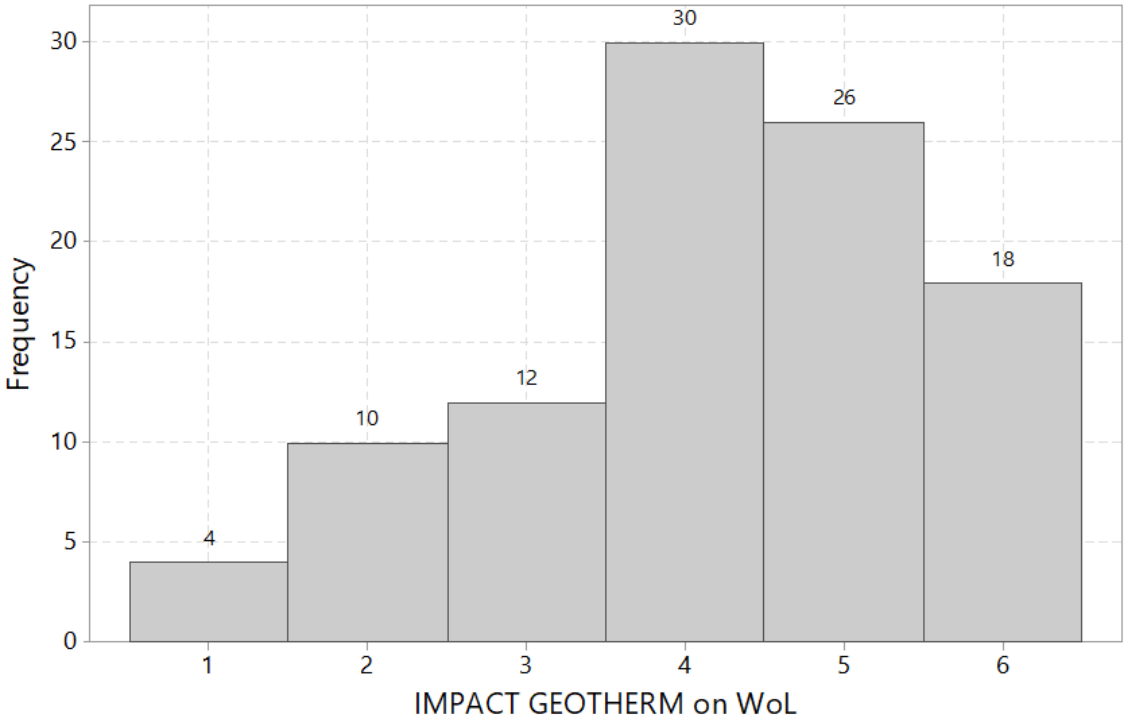

Figure B.63. How significant, in your opinion, will the impact of geothermal be on our way of life in the coming years?

On the other hand, Figure B.64 shows that the impact of biomass and biofuels on our way of life was considered to be of lower significance, possibly indicating two clusters in our sample.

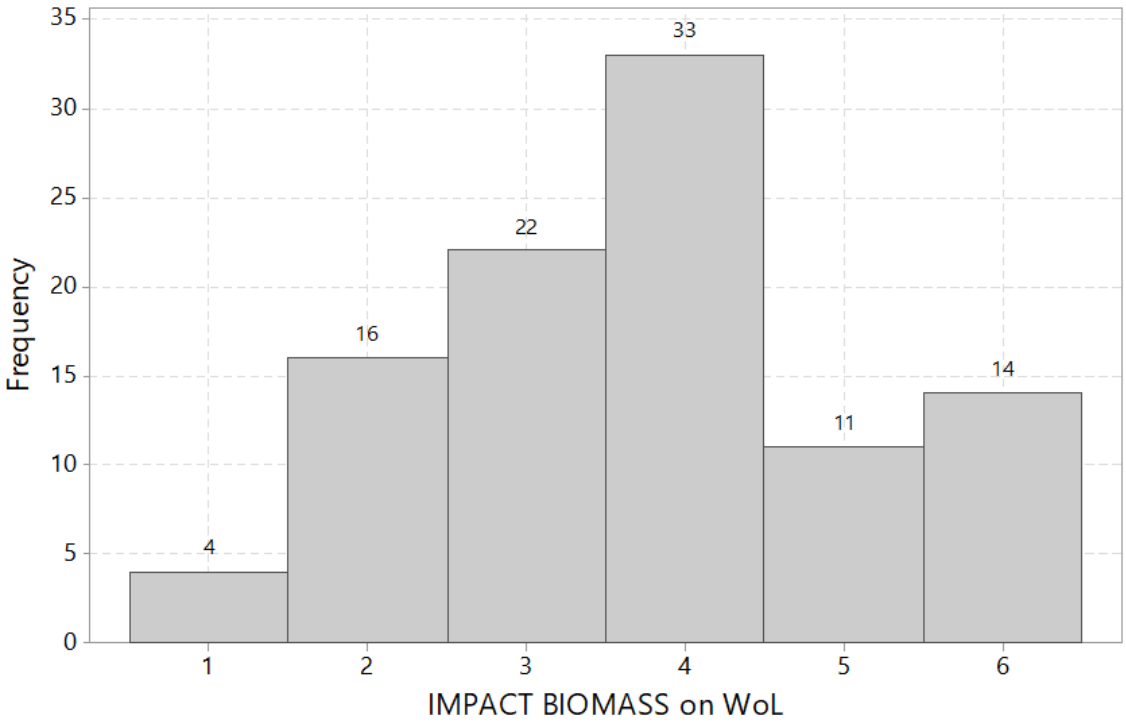

Figure B.64. How significant, in your opinion, will the impact of biomass/biofuels be on our way of life in the coming years?

On the impact of hydrogen on our way of life, Figure B.65 shows responses to be distributed along much of the range of responses, with most indicating a mediocre to higher significance.

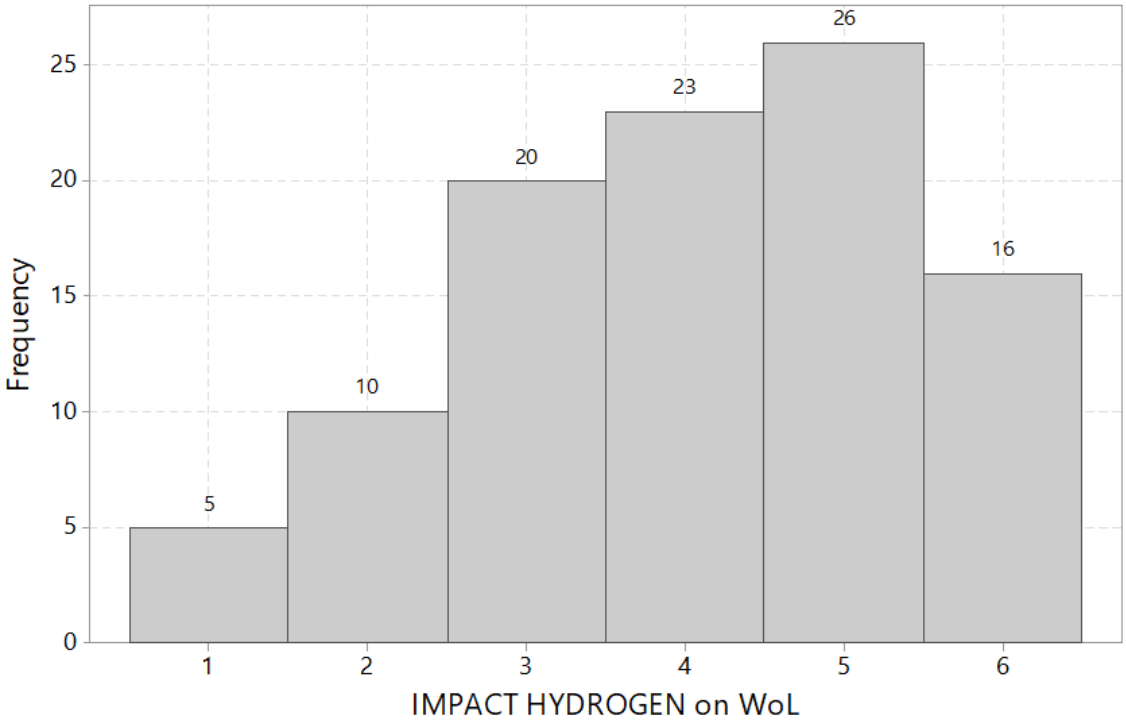

Figure B.65. How significant, in your opinion, will the impact of hydrogen be on our way of life in the coming years?

As to the impact of nuclear on our way of life, Figure B.66 shows it is considered to be very significant, with a few responses thinking that it will not be significant, again indicating the presence of two clusters in our sample, one of them possibly smaller in size.

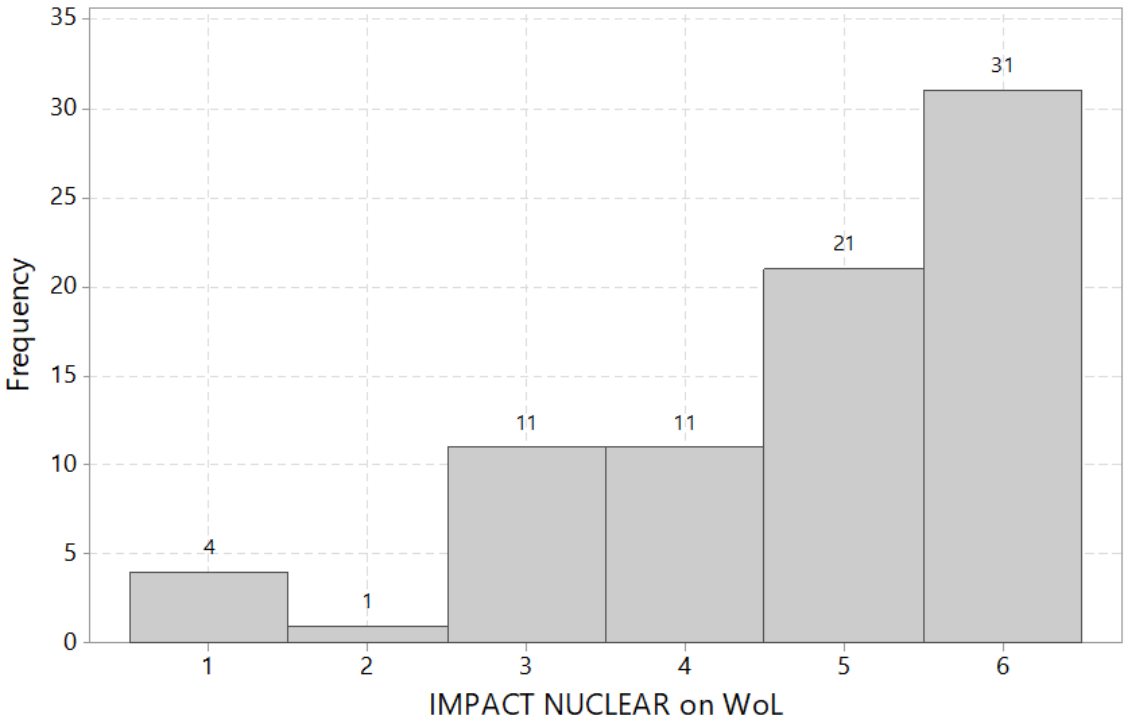

Figure B.66. How significant, in your opinion, will the impact of nuclear energy be on our way of life in the coming years?

Figures 4.67 to 4.69 graphs the opinion of the respondents on the significance of selecting the EU, national governments, and local authorities in the energy selection process. All three parties were considered important to very important, with national governments being more so.

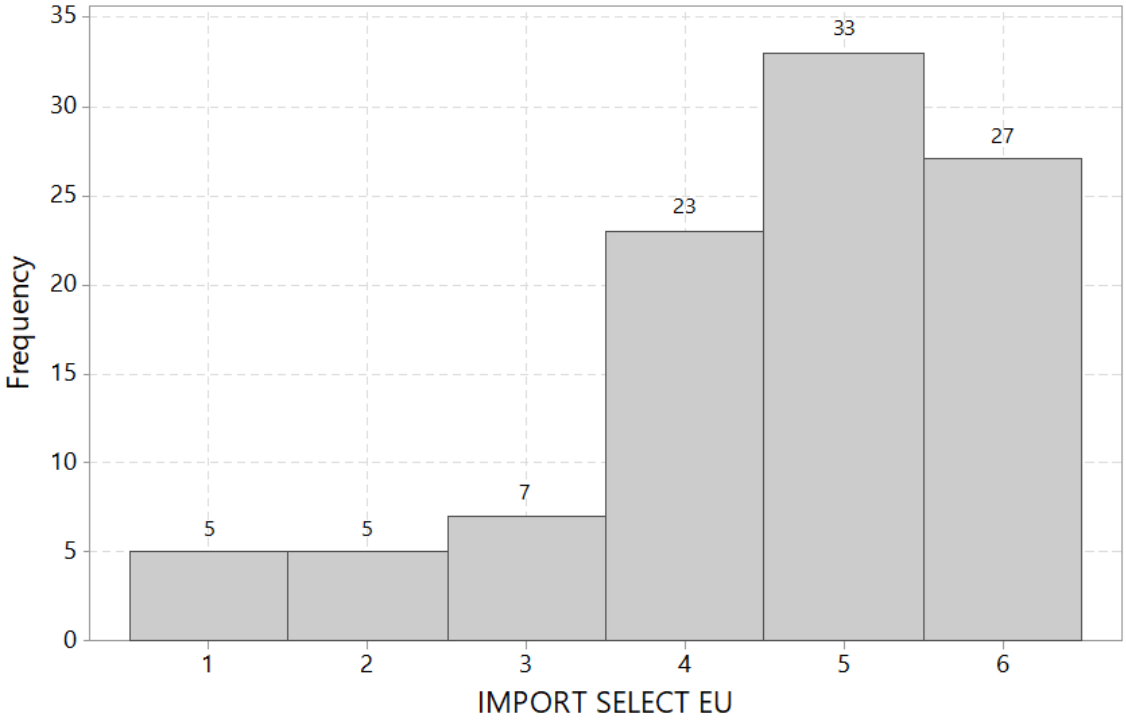

Figure B.67. How important do you consider the EU in the energy selection process?

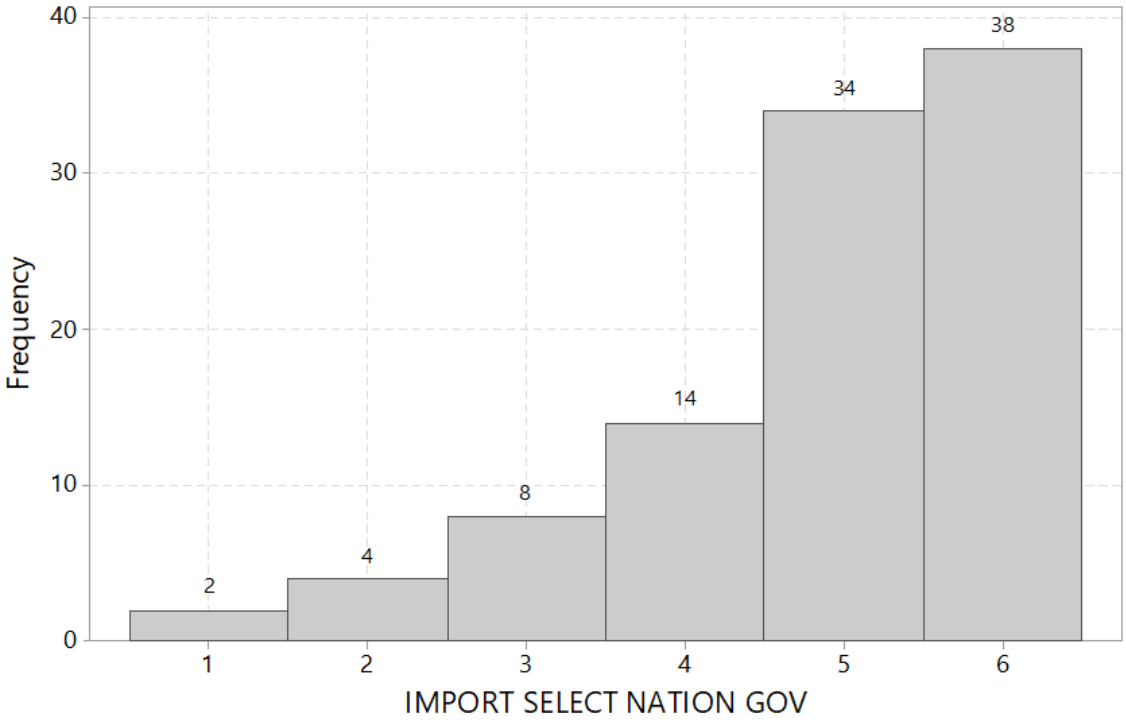

Figure B.68. How important do you consider national governments in the energy selection process?

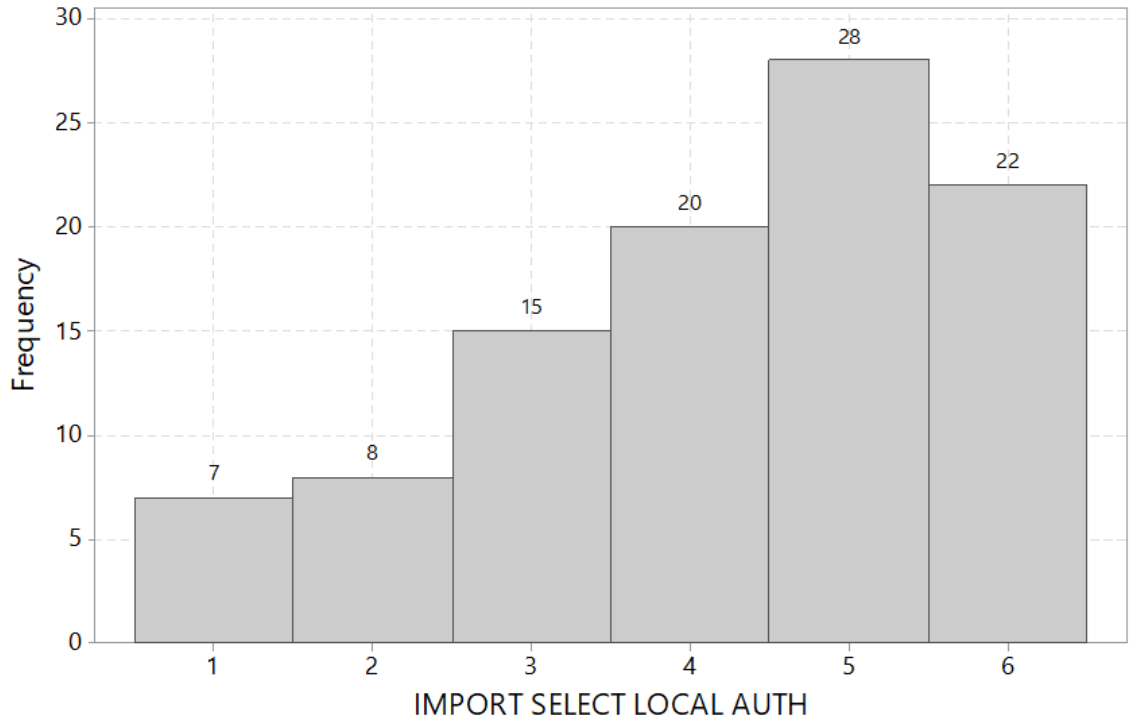

Figure B.69. How important do you consider local authorities in the energy selection process?

Figures 4.70 and 4.71, which show respondent rankings of the importance of energy companies as well as scientists and researchers in the energy selection process to vary more than in the previous three figures, also indicate the presence of two clusters in the sample, more eminent in the case of the rankings of scientists and researchers.

Figure B.70. How important do you consider energy companies in the energy selection process?

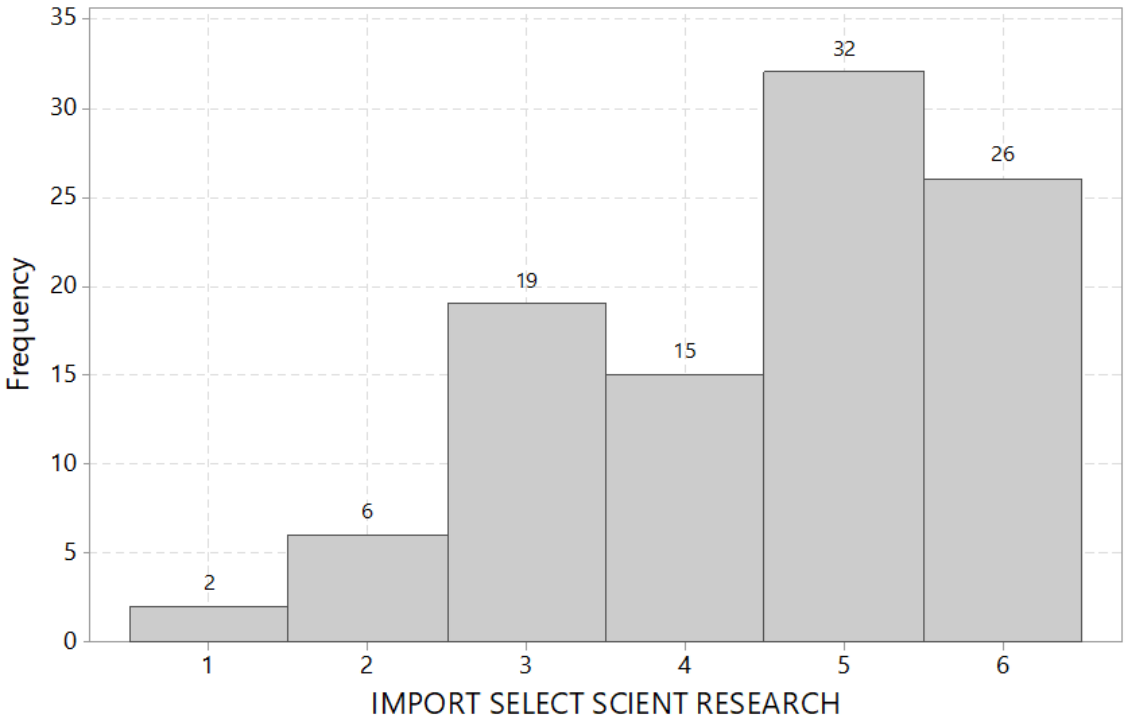

Figure B.71. How important do you consider the following scientists and researchers in the energy selection process?

Figure B.72 shows that respondent rankings of the importance of the media in the energy selection process, covered the entire range with more (23) responses selecting the ranking of 4 (out of a maximum of 6).

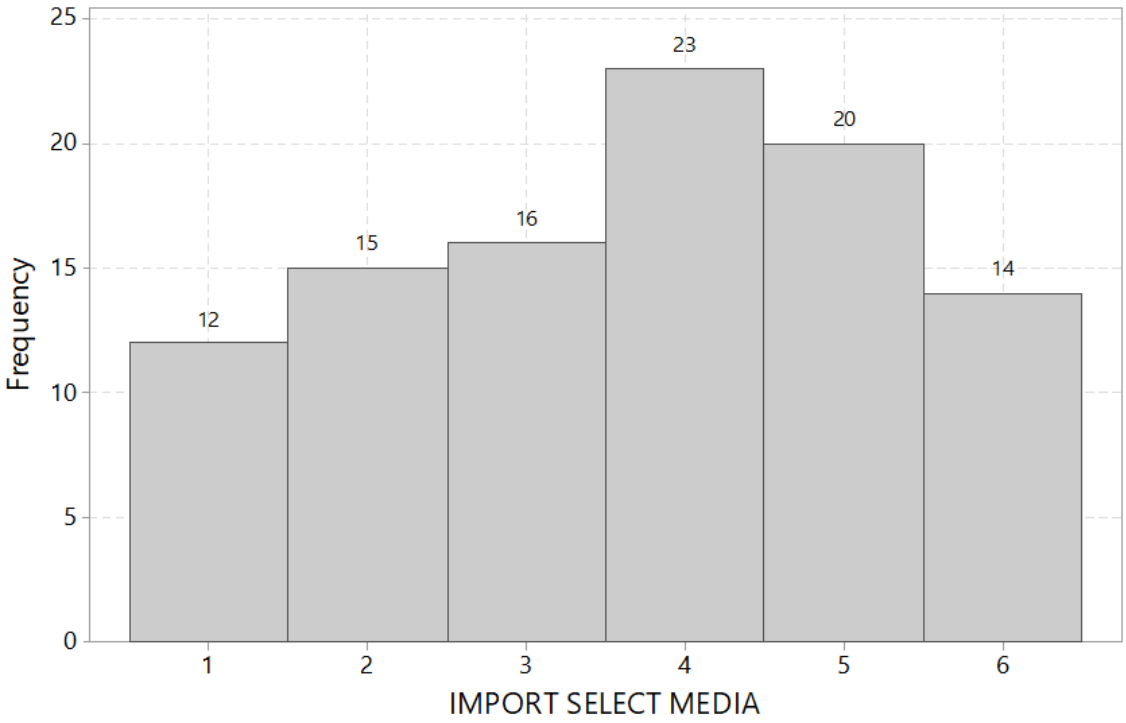

Figure B.72. How important do you consider the media in the energy selection process?

Figures 4.73 and 4.74 show that very few respondents considered non-governmental organizations (NGOs) and environmental organizations to be very important. The distribution of rankings on the importance of environmental organizations hinted at the presence of two clusters in the sample of responses, with one of them being smaller than the other.

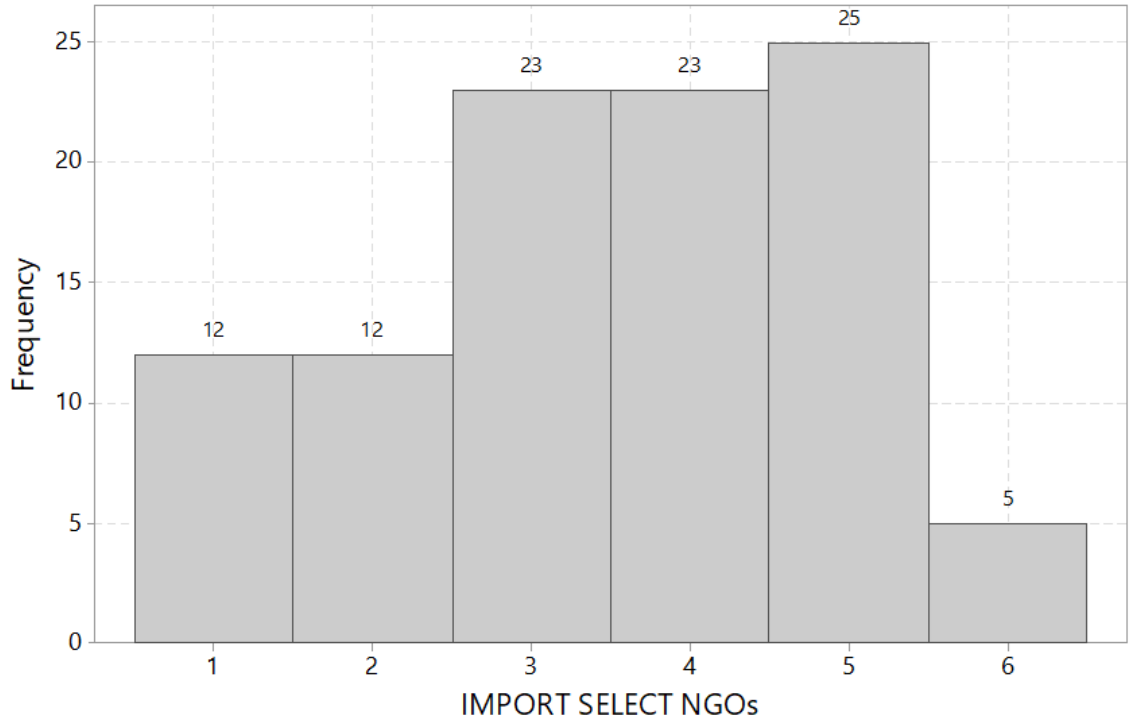

Figure B.73. How important do you consider Non-Governmental Organizations (NGOs) in the energy selection process?

Figure B.74. How important do you consider environmental organizations in the energy selection process?

Figure B.75, which shows that respondents felt that grassroots were not of overriding importance in the energy selection process, also indicates (more clearly than in some of the previous cases) the presence of two clusters in the sample.

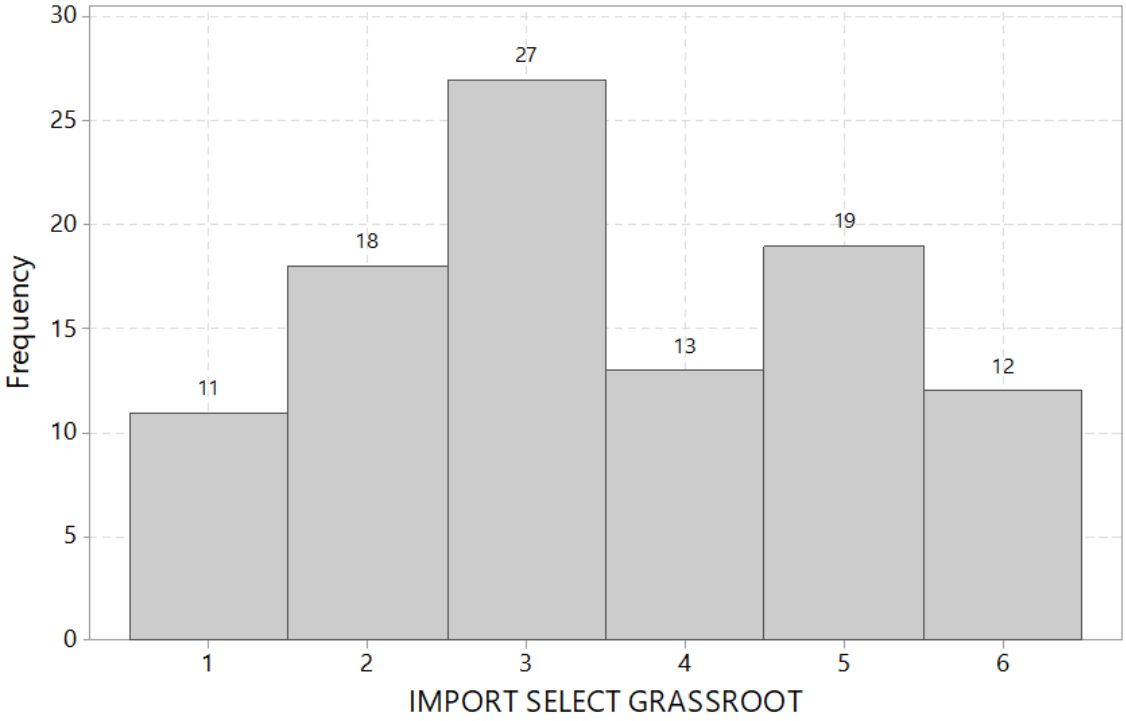

Figure B.75. How important do you consider grassroots movements in the energy selection process?

As to the importance of (individual) citizens in the energy selection process, Figure B.76 again shows a multimodel dispersion of values along the range of rankings, with potentially three (rather than two) clusters in the sample.

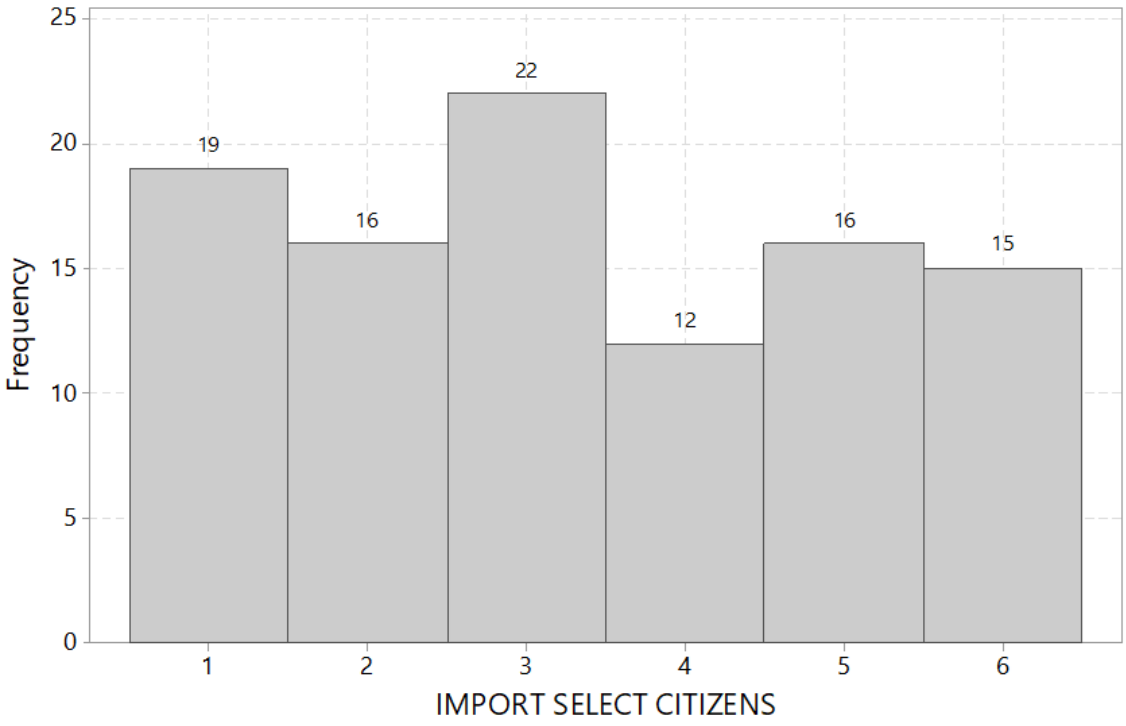

Figure B.76. How important do you consider individual citizens in the energy selection process?

Attention now turns to trust questions, which may characterize individuals possibly feeling left behind and thus adopting a reactionary antisystemic attitude, and will also be considered in the analysis.

- The EU was trusted (Figure B.77), although only 9 respondents felt that they trusted it very much. The bimodality of the distribution of rankings hints at the presence of two clusters in the sample.
- National governments were also trusted (Figure B.78), although only 3 respondents trusted them very much.
- The trust towards regional governments was mostly distributed from 2 to 5 (Figure B.79), with few respondents trusting them either very much (ranking of 6) or not at all (1).
- Energy companies (Figure B.80) and NGOs (Figure B.81) received lower trust rankings.
- The media (Figure B.82) was trusted even less, with the ranking of 2 (out of a maximum of 6) being the most frequent response (i.e. the mode).

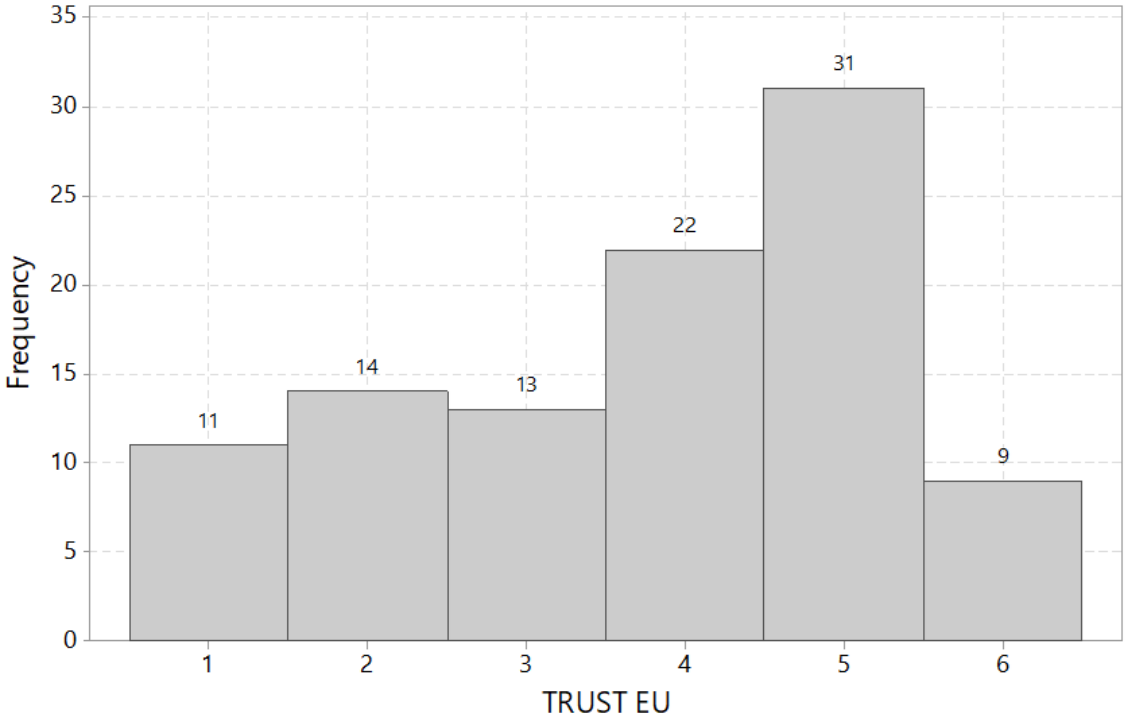

Figure B.77. How much do you trust the EU?

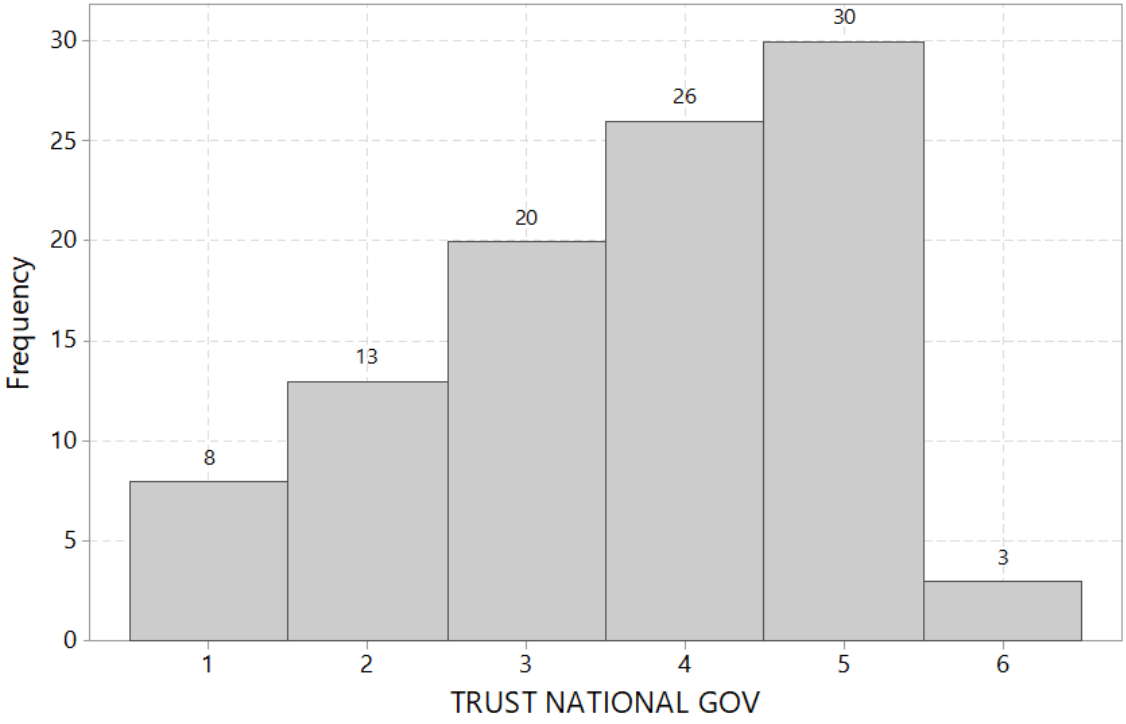

Figure B.78. How much do you trust national governments?

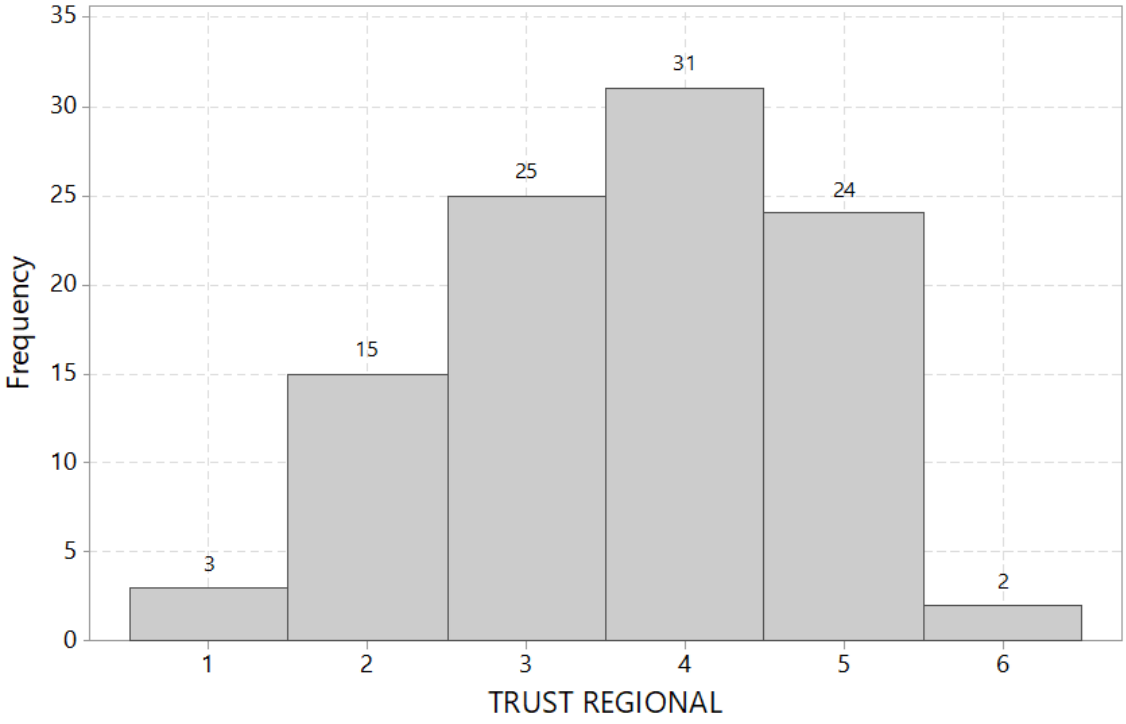

Figure B.79. How much do you trust regional/local governments?

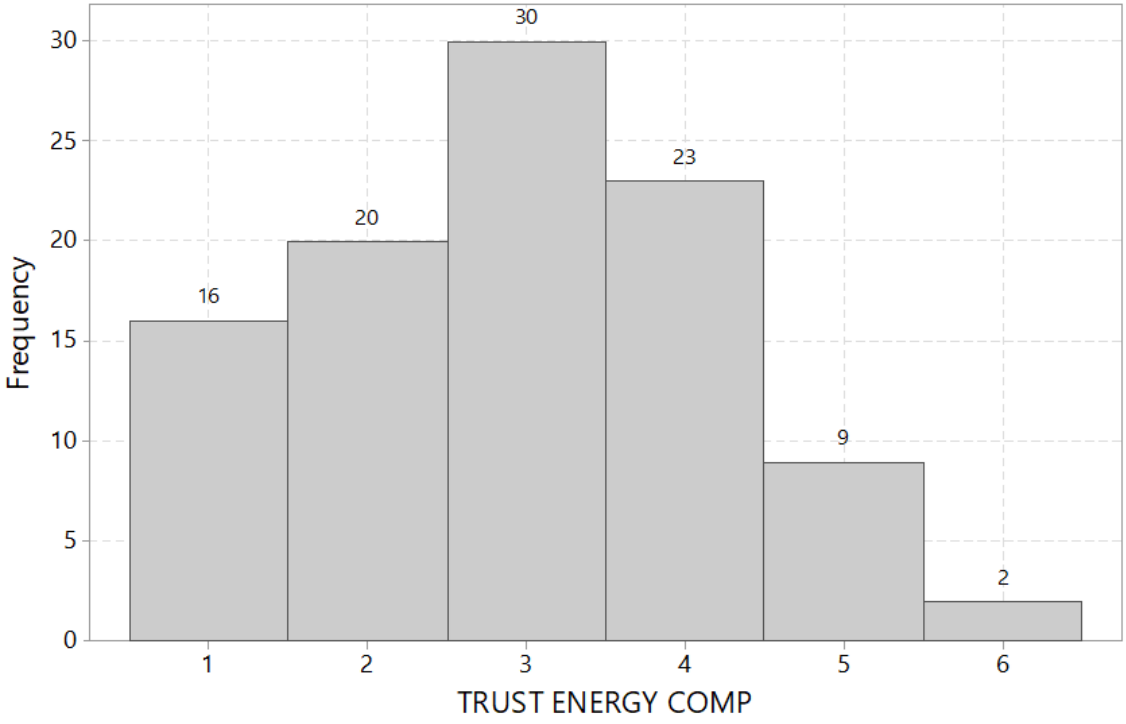

Figure B.80. How much do you trust energy companies?

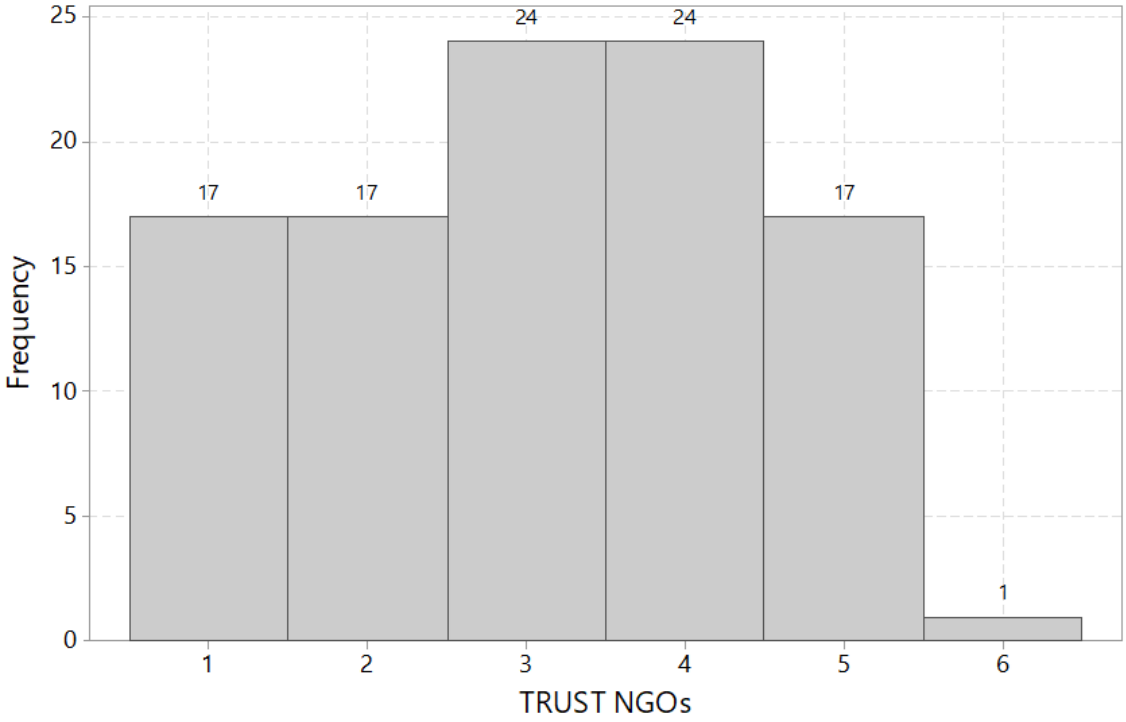

Figure B.81. How much do you trust Non-Governmental Organizations (NGOs)?

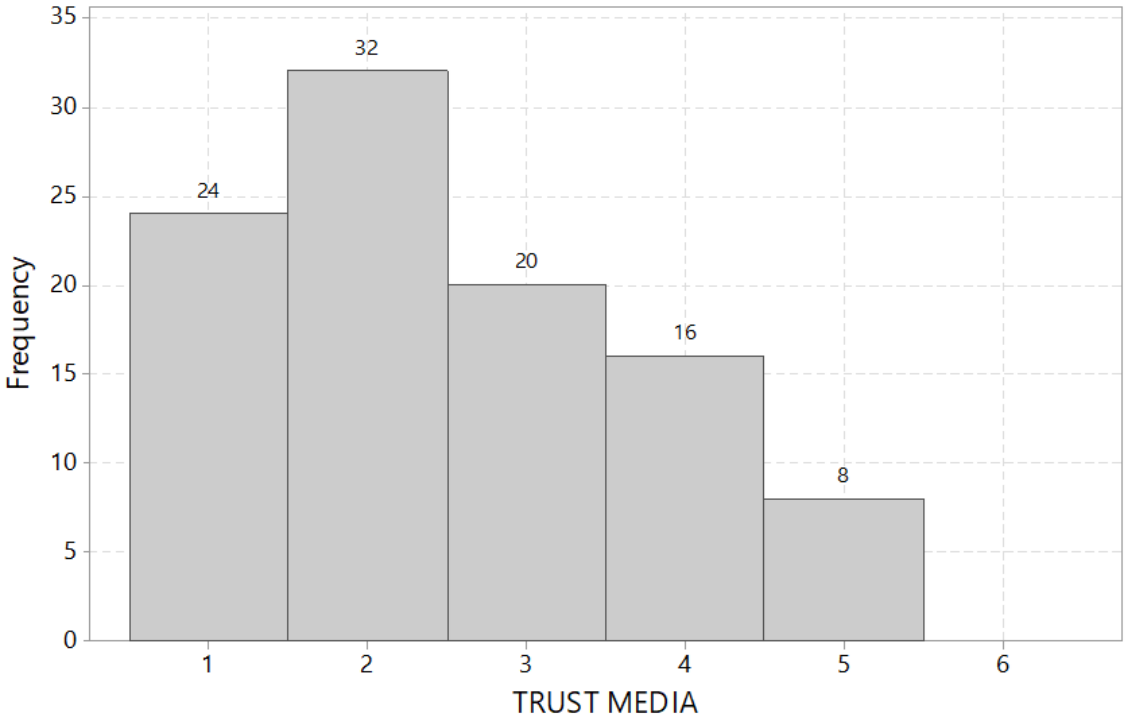

Figure B.82. How much do you trust print/broadcast and online media?

Figures 4.83 and 4.84 show that energy independence and energy efficiency were considered very important by respondents, with almost no respondents assigning them a ranking of one or two.

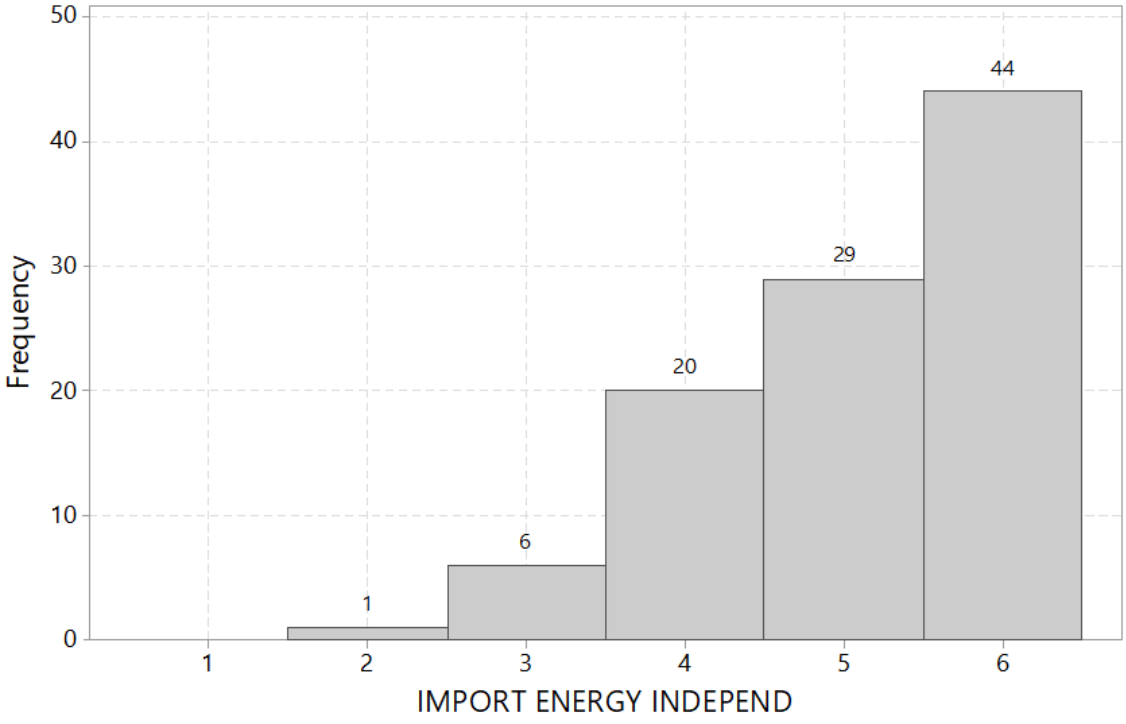

Figure B.83. How important is energy independence to you?

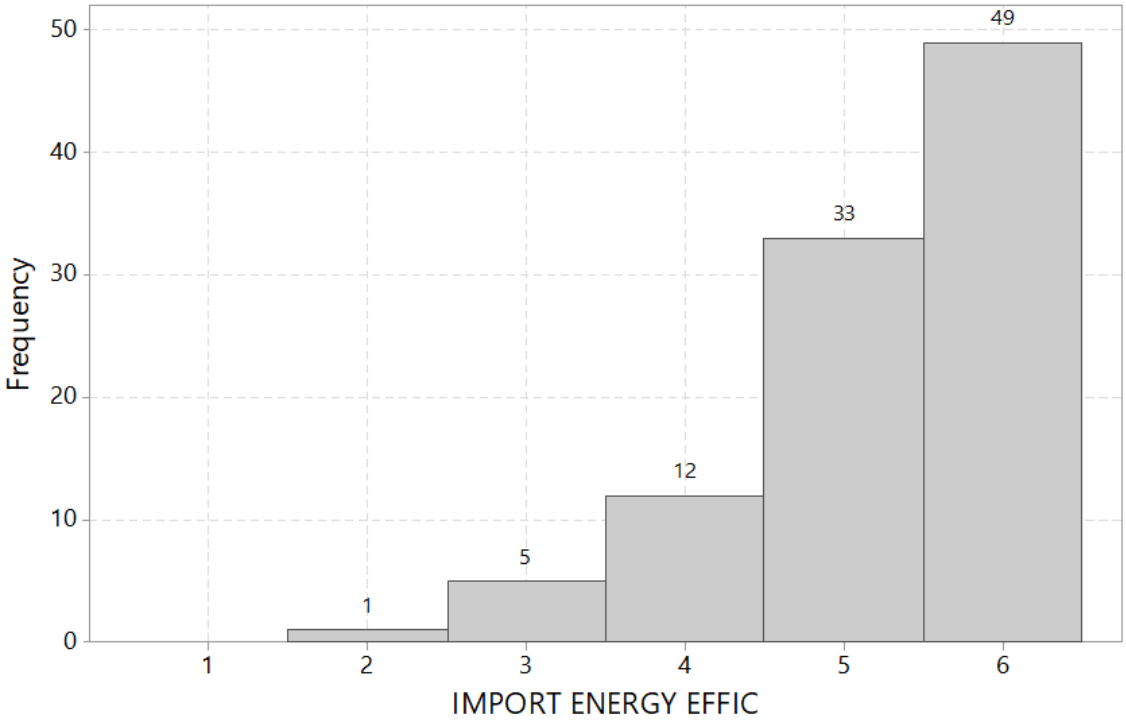

Figure B.84. How important is energy efficiency to you?

On the other hand, as shown in Figures 4.85 and 4.86, energy affordability and energy availability were considered important and very important, but less so that energy independence and energy efficiency, with almost no respondents assigning them a ranking of one or two

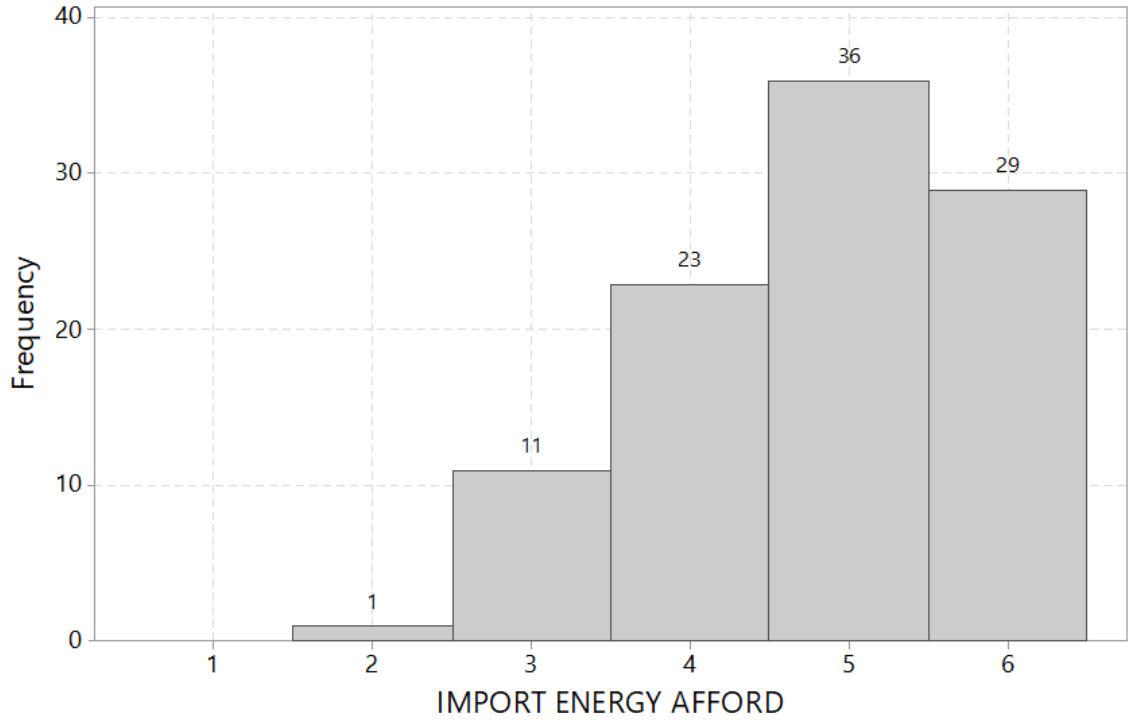

Figure B.85. How important is energy affordability to you?

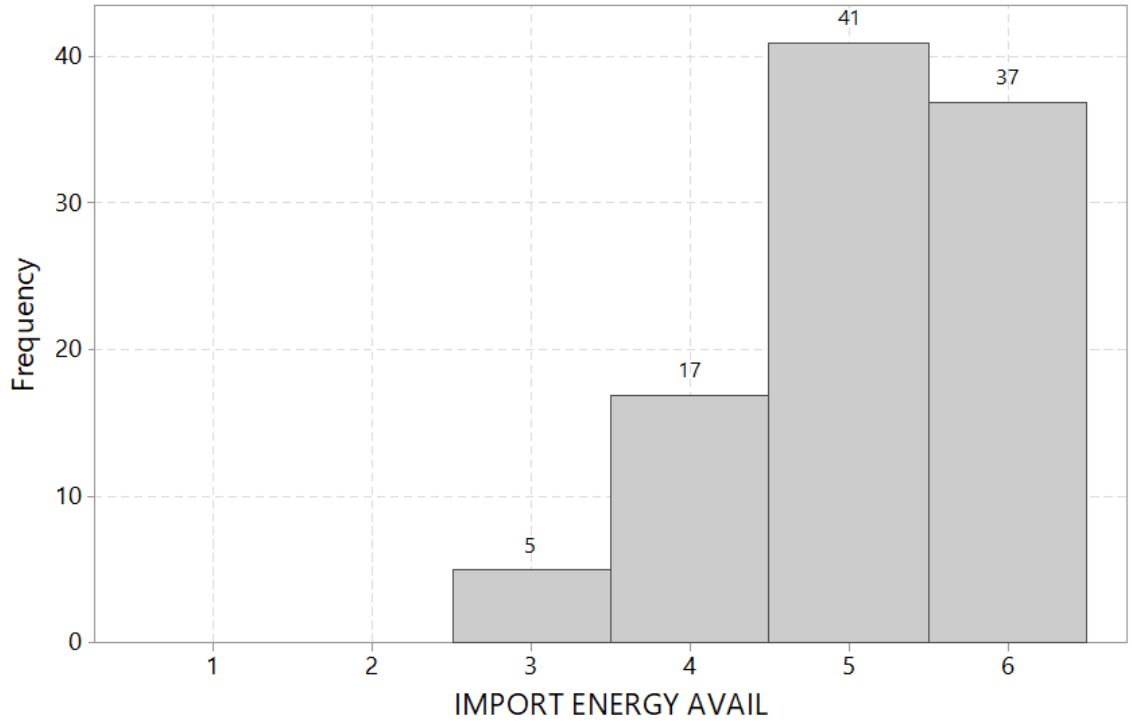

Figure B.86. How important is energy availability to you?

Figure B.87 shows that energy diversification was felt to be important to very important by respondents.

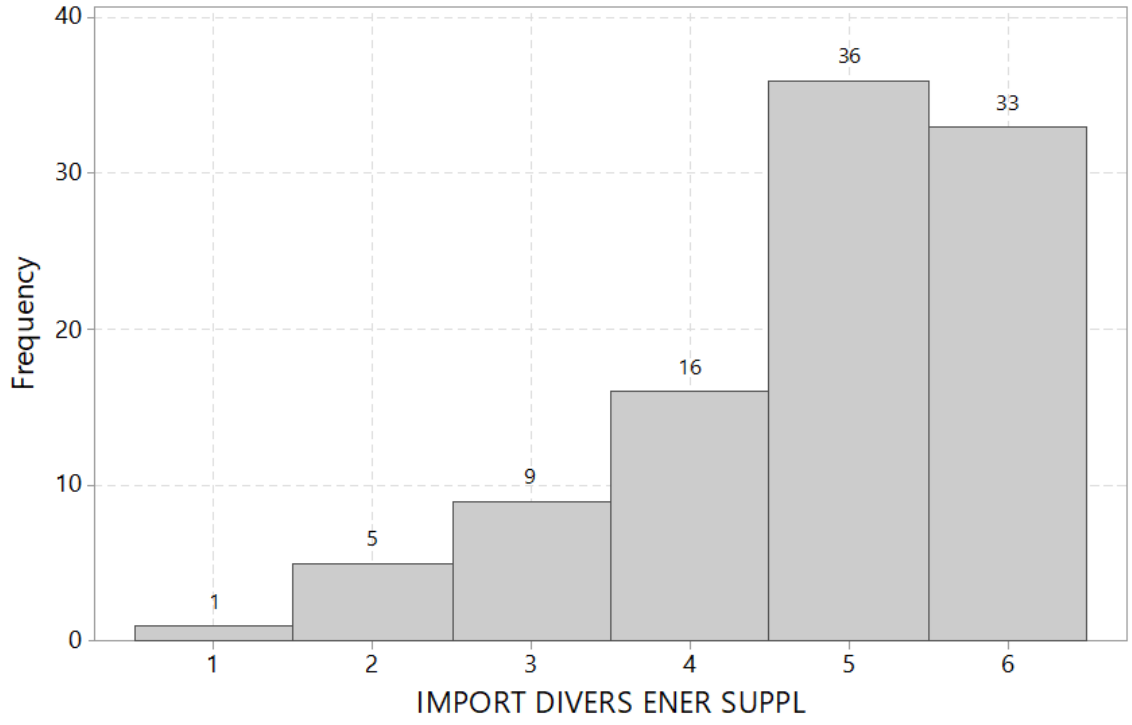

Figure B.87. How important is diversification of the energy supply to you?

Figure B.88 shows that the development of renewable energy was considered to be very important by respondents.

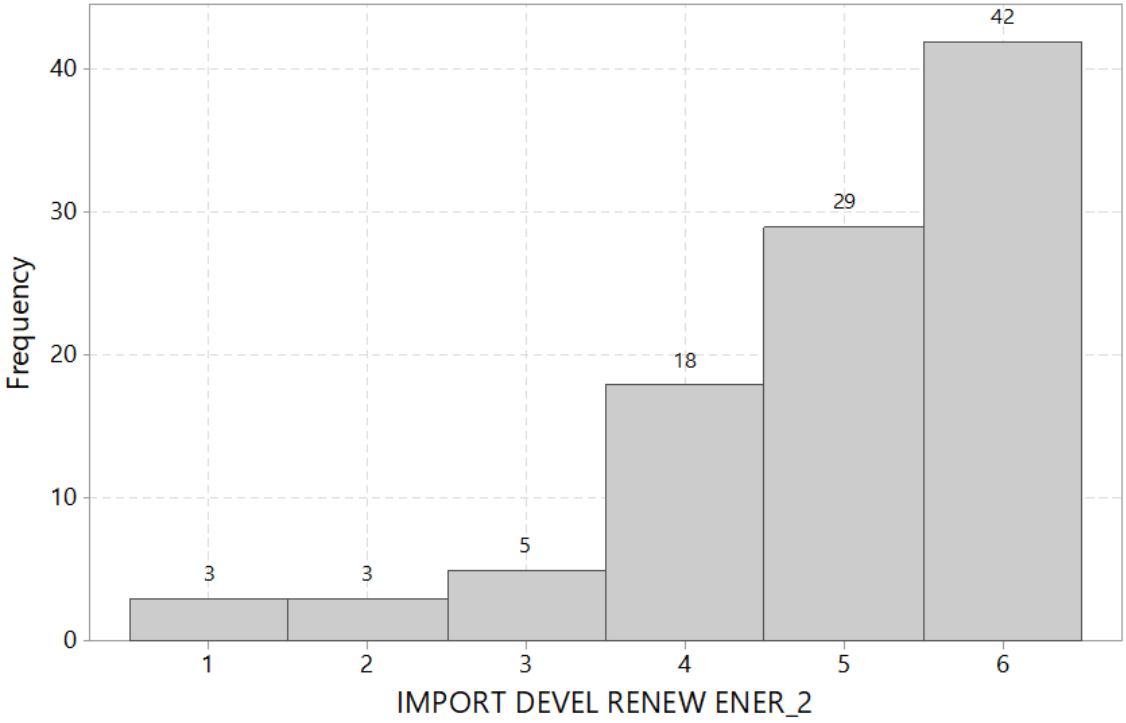

Figure B.88. How important is the development of renewable energy to you?

The environmental impacts of energy systems were also considered to be very important by respondents, as shown in Figure B.89.

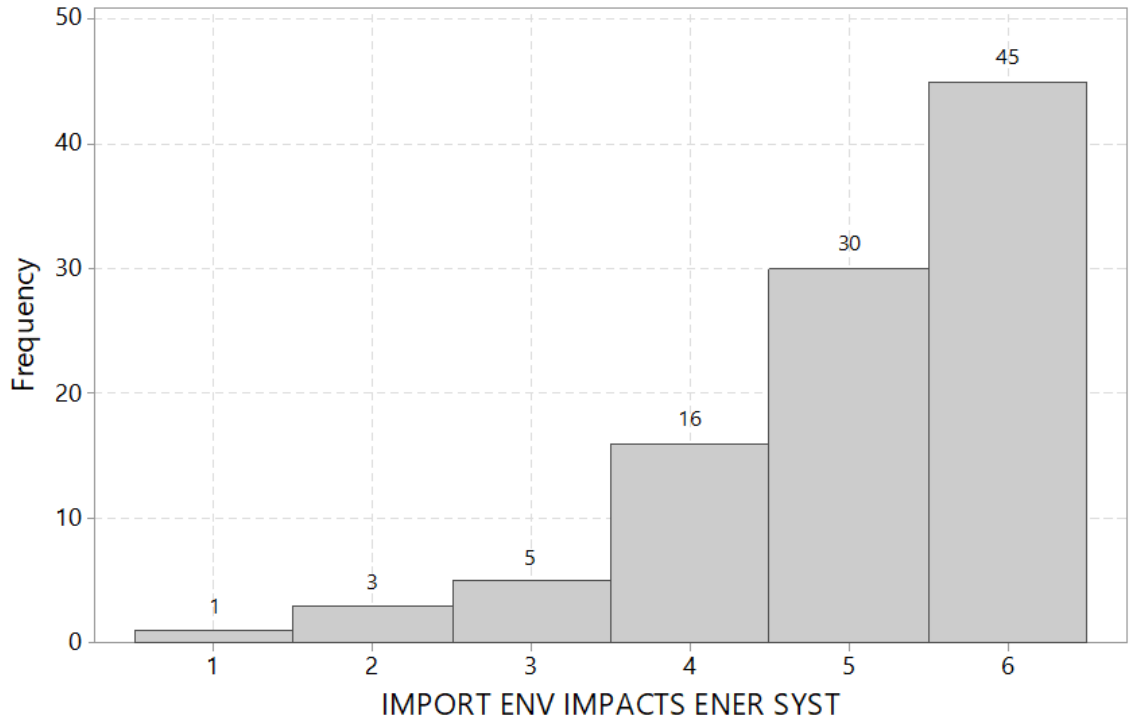

Figure B.89. How important are the environmental impacts of energy systems to you?

Public safety (Figure B.90) and environmental protection (Figure B.91) were considered to be very important for a geothermal project to gain acceptance and support.

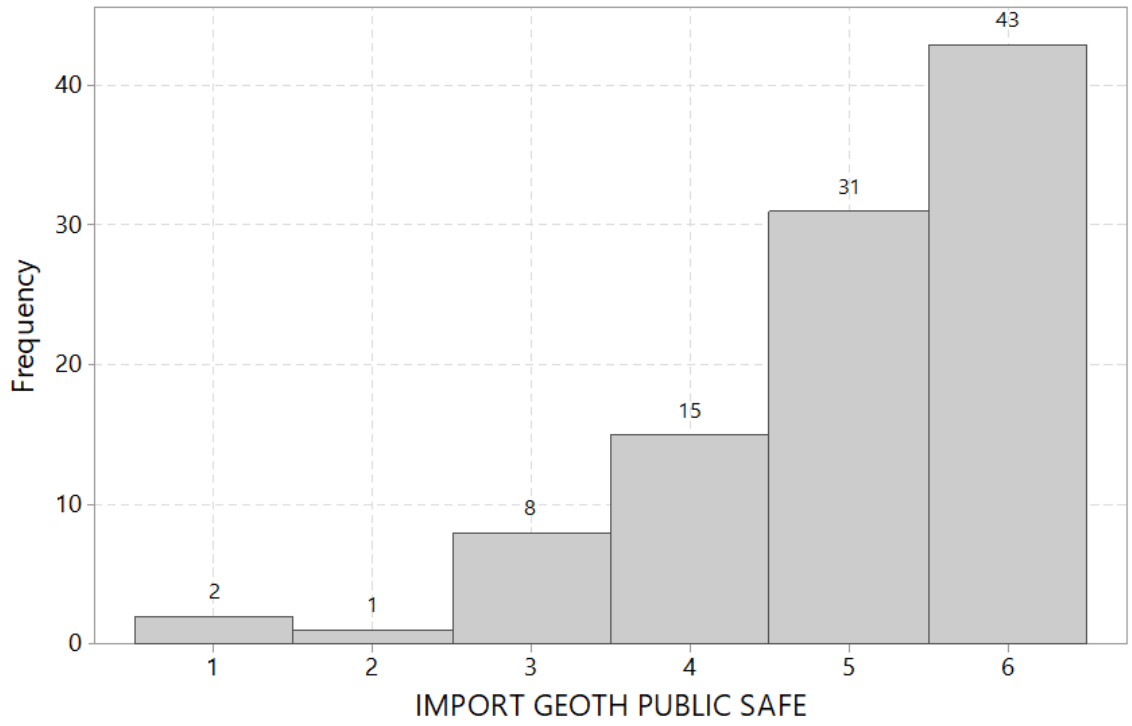

Figure B.90. How important do you believe public safety is for a geothermal energy exploration project to gain acceptance and support?

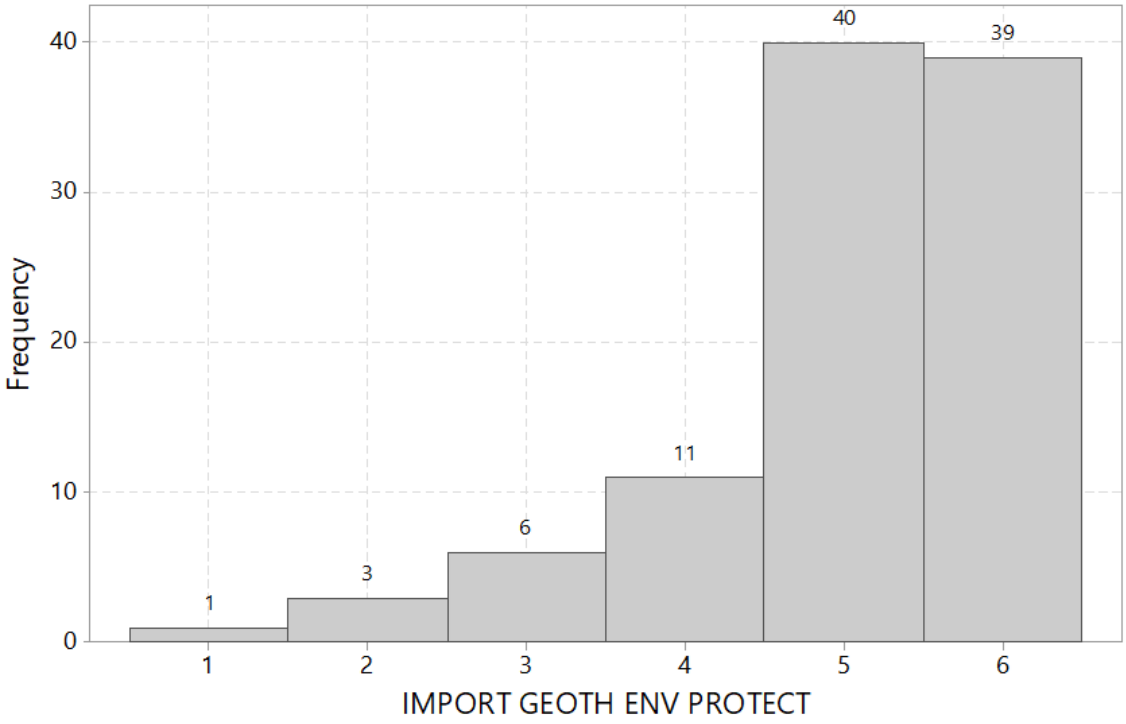

Figure B.91. How important do you believe environment protection is for a geothermal energy exploration project to gain acceptance and support?

Jobs and employment (Figure B.92), community awareness (Figure B.93), community consultation (Figure B.94), and community compensation (Figure B.95) were all considered to be important, but not very important for a geothermal energy exploration project to gain acceptance and support.

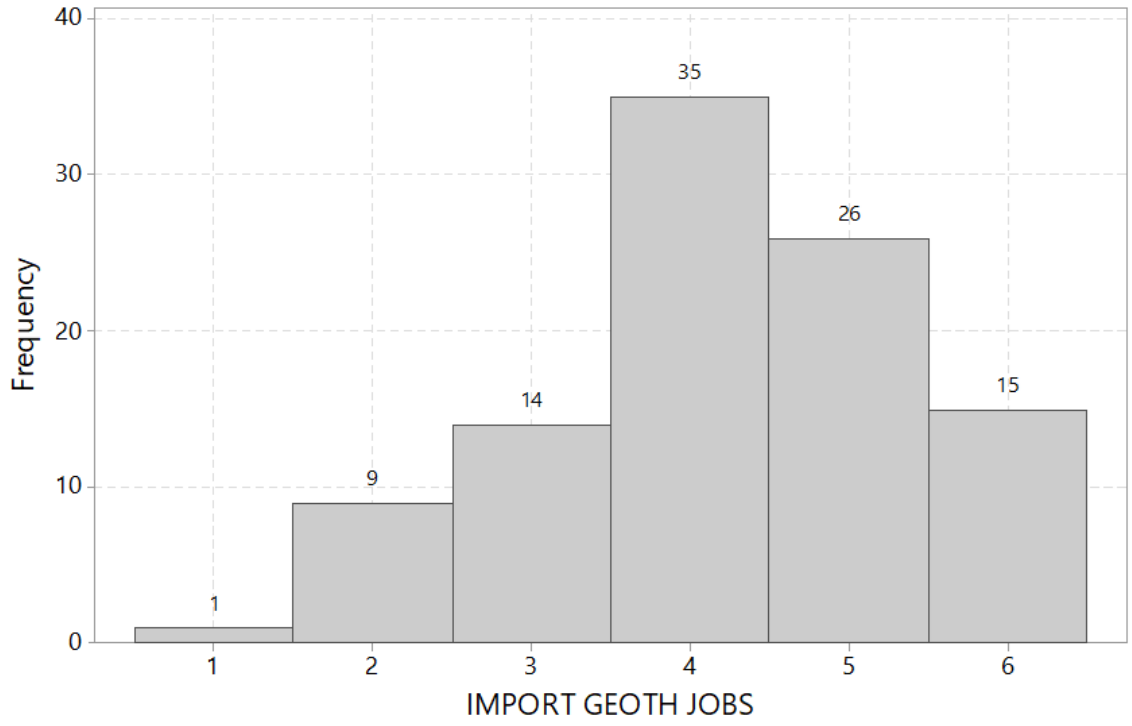

Figure B.92. How important do you believe jobs/employment are for a geothermal energy exploration project to gain acceptance and support?

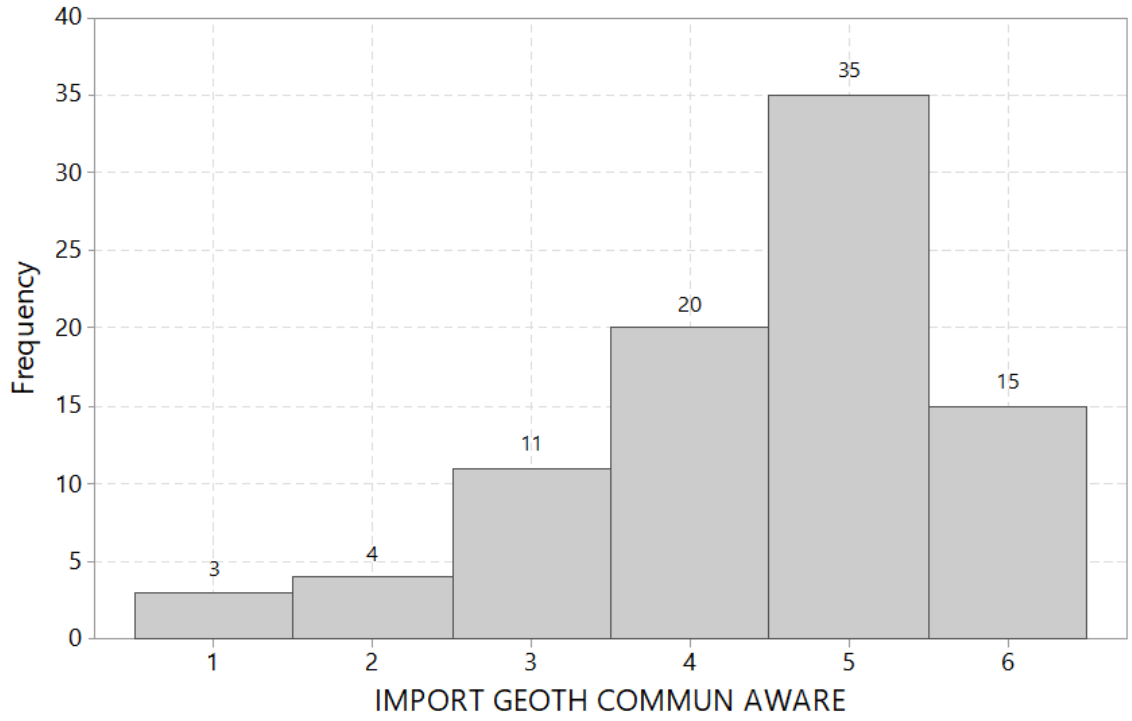

Figure B.93. How important do you believe community awareness is for a geothermal energy exploration project to gain acceptance and support?

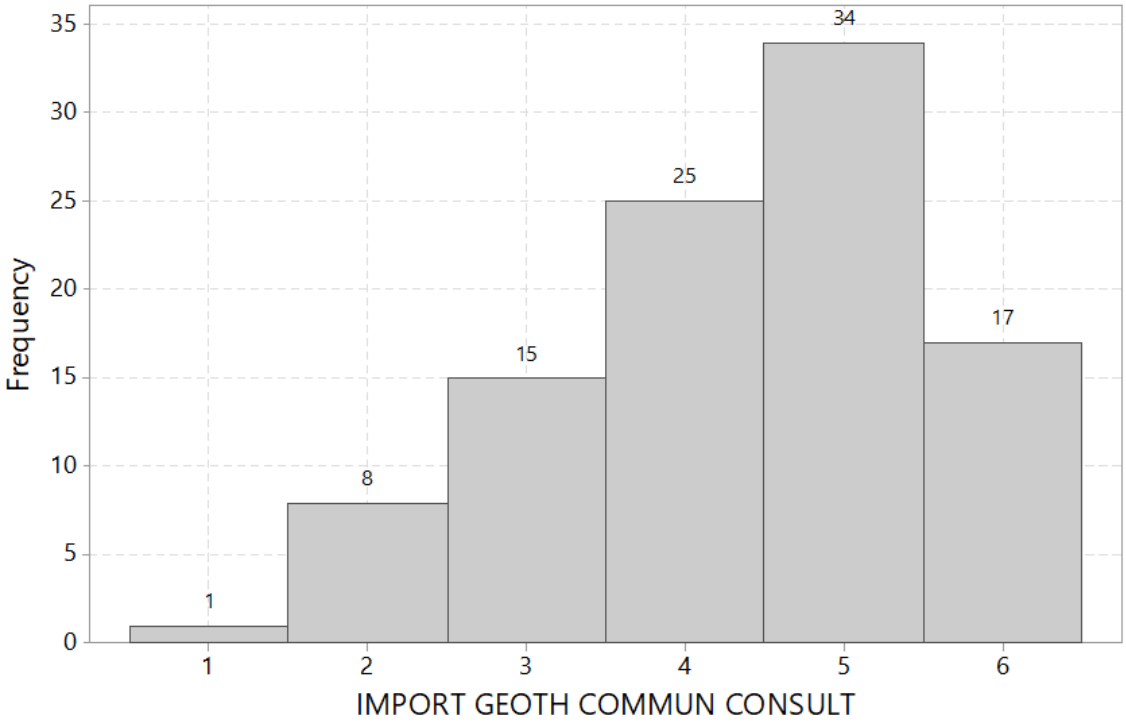

Figure B.94. How important do you believe community consultation is for a geothermal energy exploration project to gain acceptance and support?

Figure B.95. How important do you believe community compensation is for a geothermal energy exploration project to gain acceptance and support?

Figure B.96 shows that respondents have not been hearing about geothermal energy frequently in the news in their country. Similarly, Figure B.97 shows that respondents did not think that geothermal potential has been used much in geothermal energy debates in the news in their country. Both of these graphs indicate the existence of two clusters in the sample.

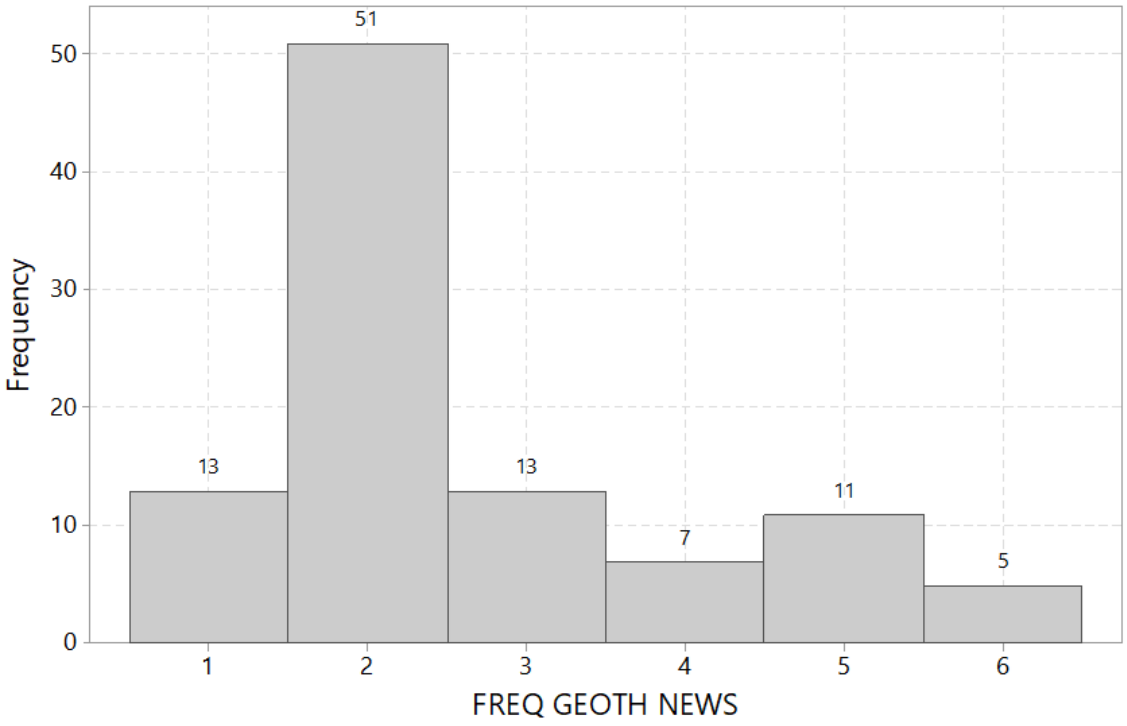

Figure B.96. How frequently do you hear about geothermal energy in the news in your country?

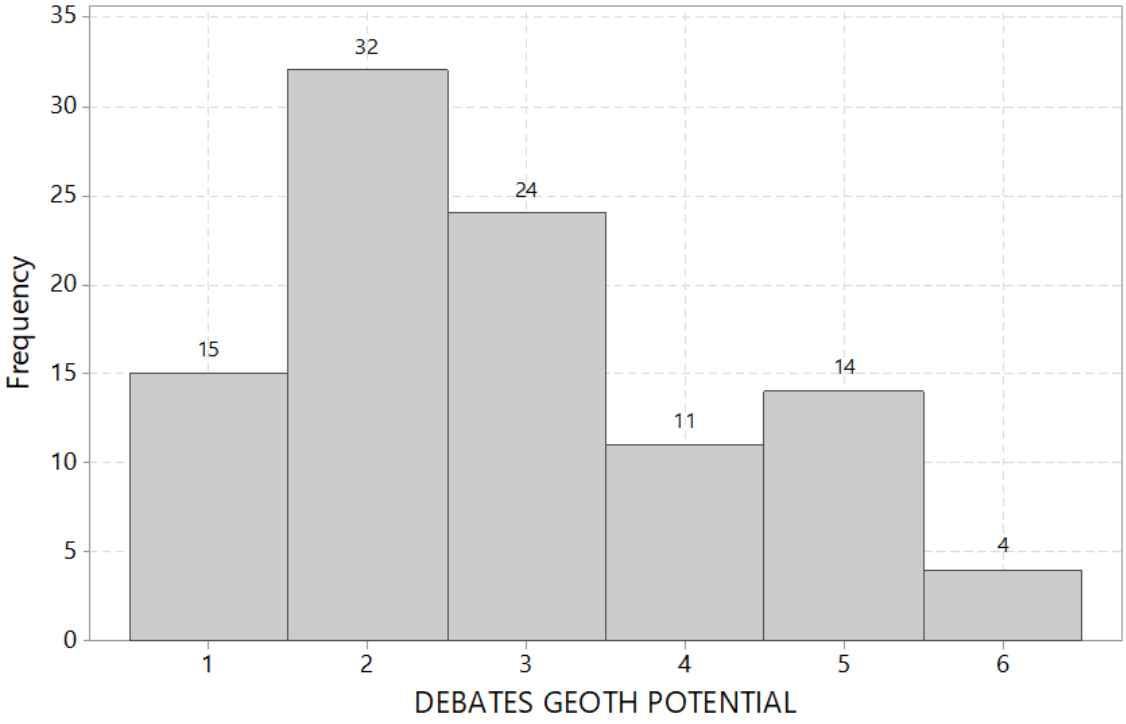

Figure B.97. In your opinion, how often is geothermal potential used in geothermal energy debates in the media of your country?

Figure B.98 shows that respondents felt that the economy was used at a mediocre frequency in geothermal energy debates in the media of their country, with a strong bimodality indicating the presence of two clusters in the sample.

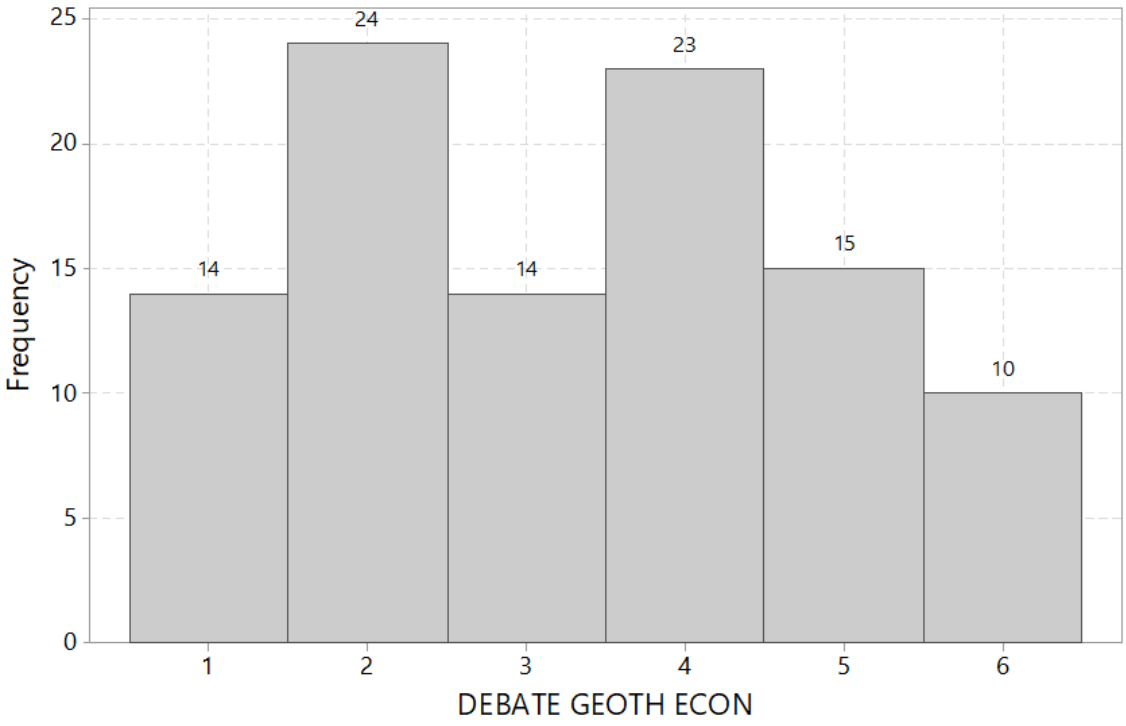

Figure B.98. In your opinion, how often is the economy used in geothermal energy debates in the media of your country?

As regards the frequency of hearing about climate change in geothermal energy debates in the media of their country, the rankings of respondents gave a rather similar picture, as shown in Figure B.99, with a bimodality also indicative of the presence of two clusters in the sample.

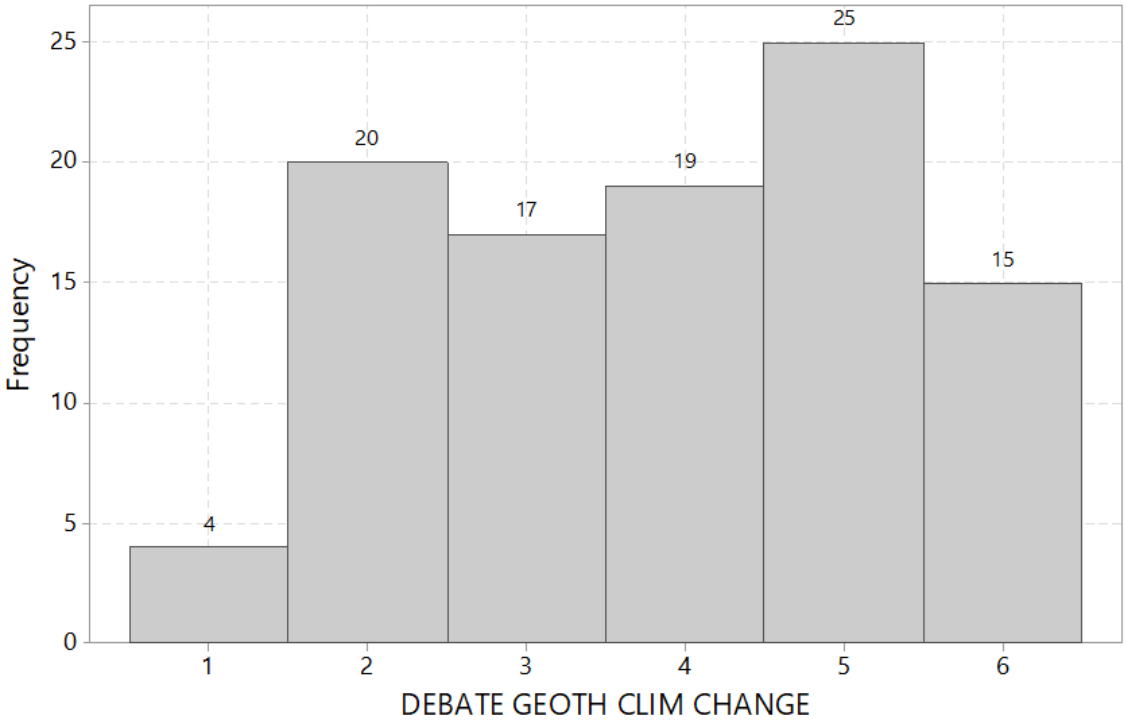

Figure B.99. In your opinion, how often is climate change used in geothermal energy debates in the media of your country?

Respondents did not feel that ecological security was used often in geothermal energy debates in the media of their country, as shown in Figure B.100, which also hints at the presence of two clusters in the sample.

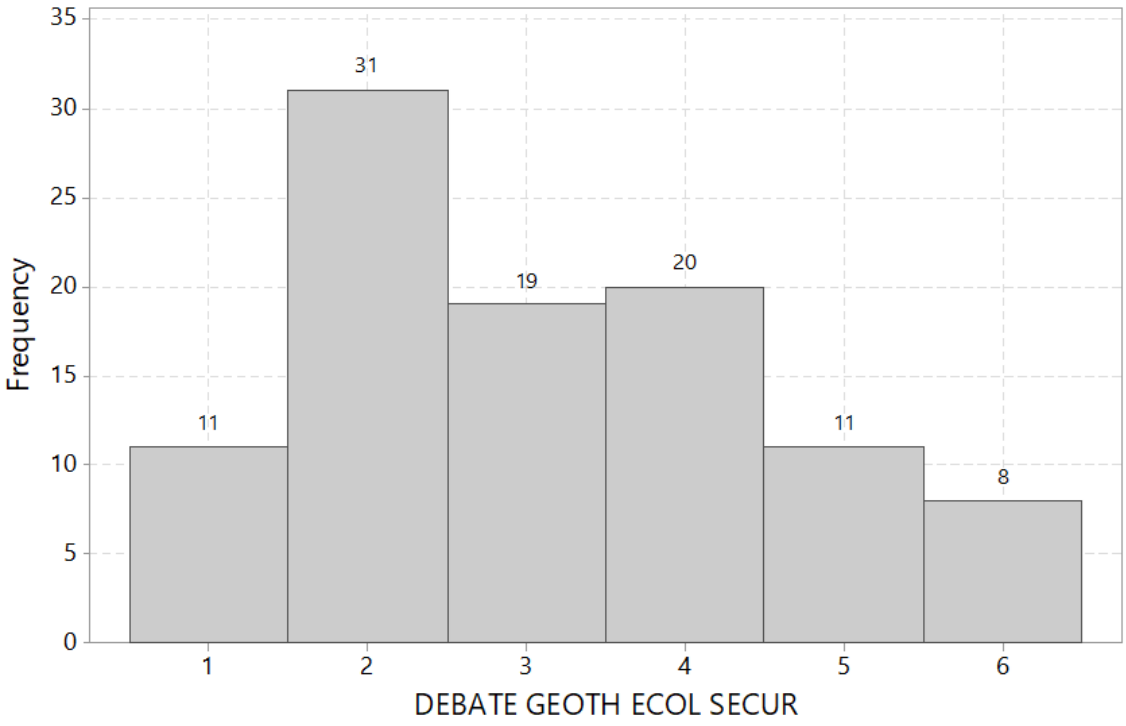

Figure B.100. In your opinion, how often is ecological security used in geothermal energy debates in the media of your country?

A strong indication of the presence of two clusters in the sample is also given by Figure B.101, which graphs the rankings of respondents as to the frequency of hearing energy security used in geothermal energy debates in the media of their country.

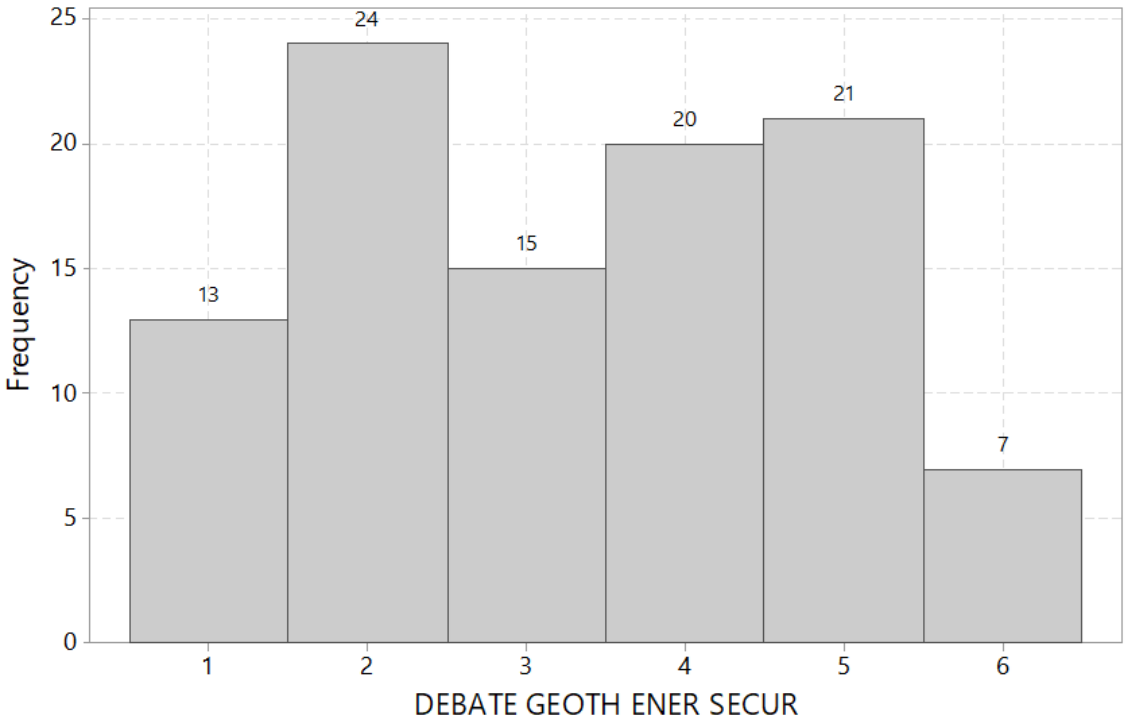

Figure B.101. In your opinion, how often is energy security used in geothermal energy debates in the media of your country?

Figure B.102 shows respondents did not feel that national security was used very often in geothermal energy debates in the media of their country.

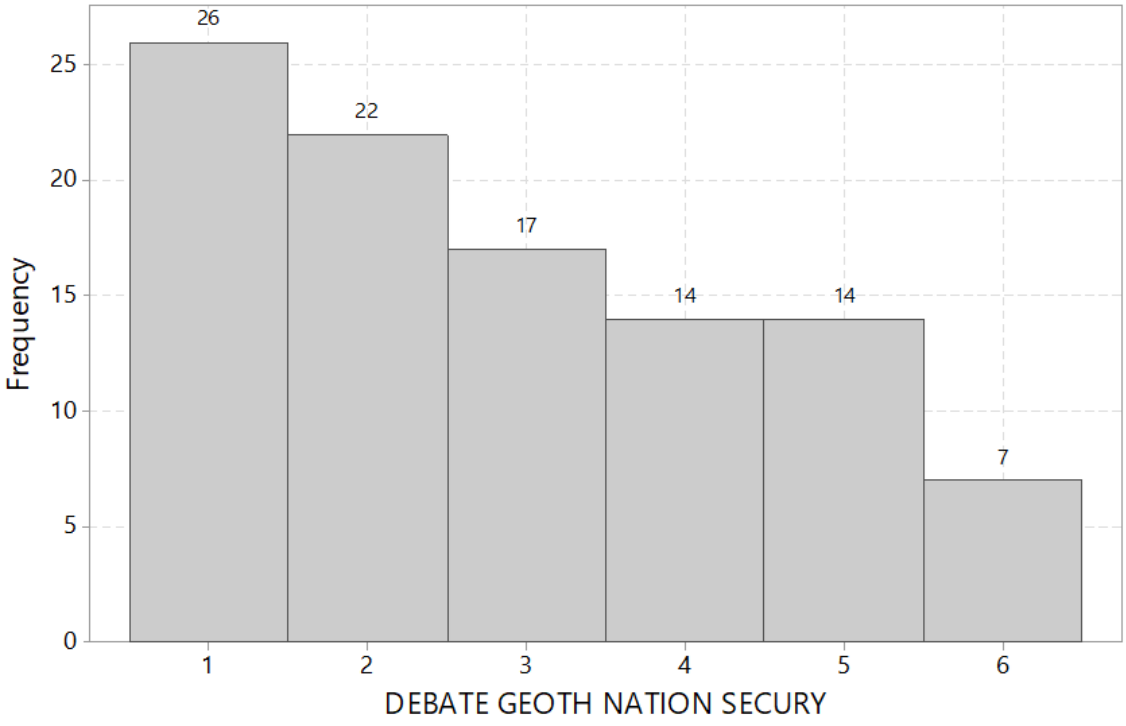

Figure B.102. In your opinion, how often is national security in geothermal energy debates in the media of your country?

Turning to another group of questions, Figure B.103 shows that respondents felt very positively about geothermal energy being used to generate electricity in their country.

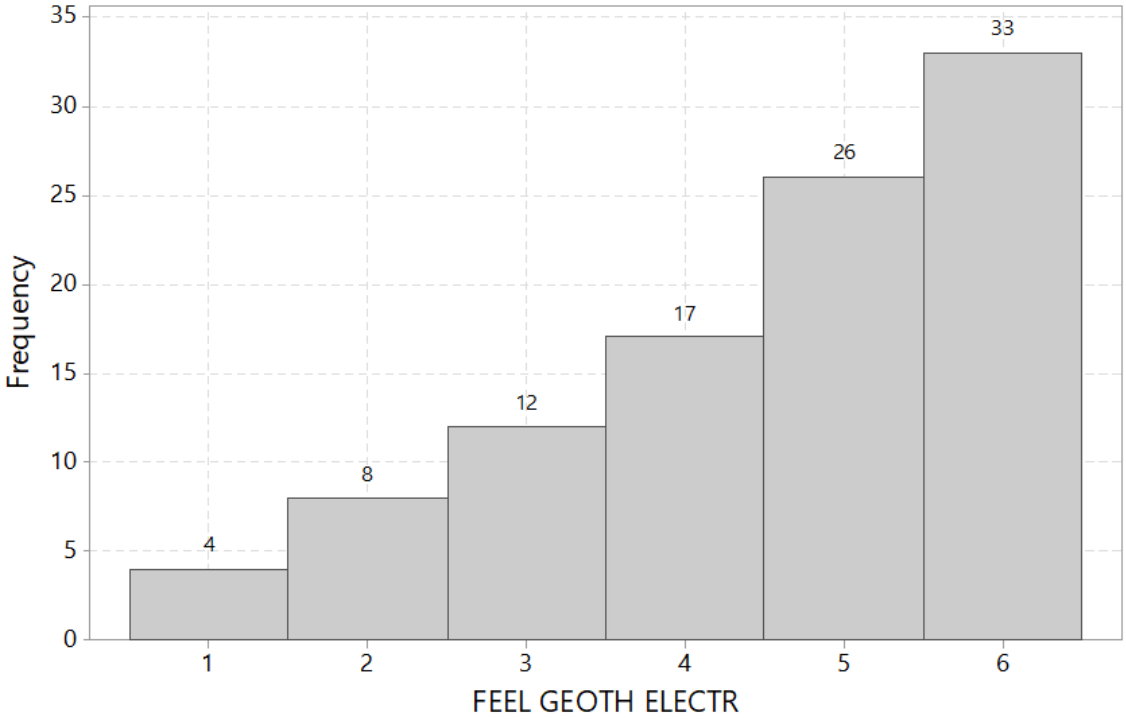

Figure B.103. How do you feel about geothermal energy being used to generate electricity in your country?

Similarly, Figure B.104 shows that respondents felt even more positively about geothermal energy being used for heating in their country.

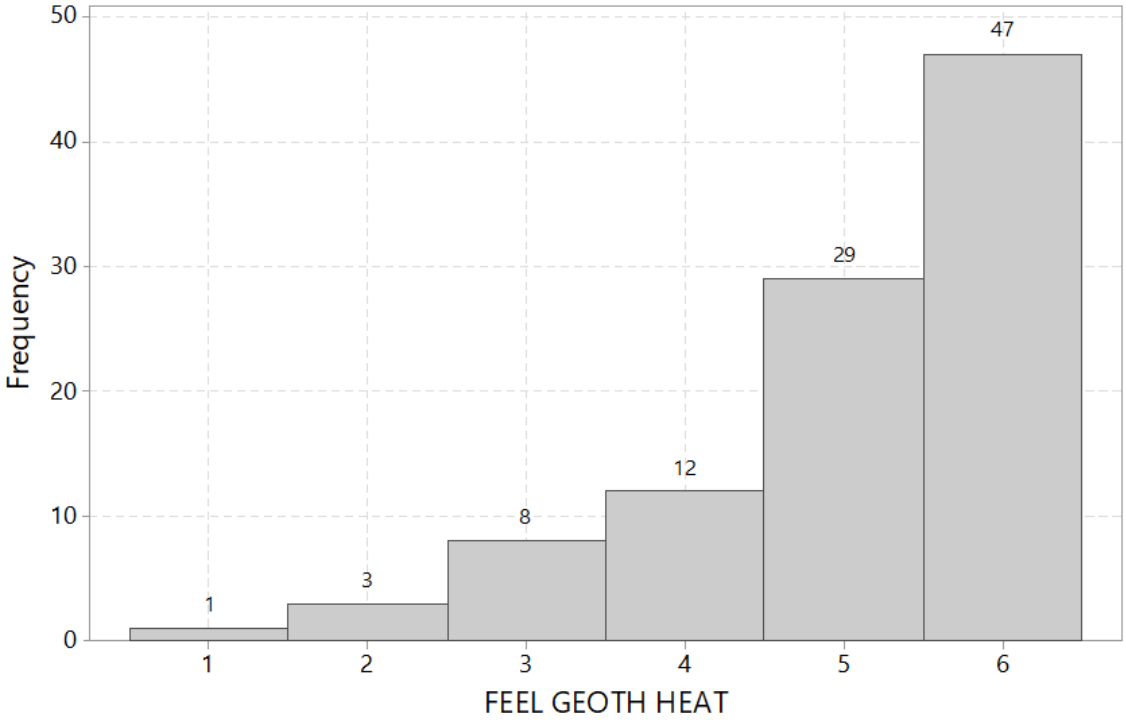

Figure B.104. How do you feel about geothermal energy being used to generate heating in your country?

The multimodal distribution of Figure B.105 shows that the opinion of respondents on developing geothermal exploration projects if hydraulic stimulation is required may be divided into three main groups, indicating the possible presence of three clusters in the sample.

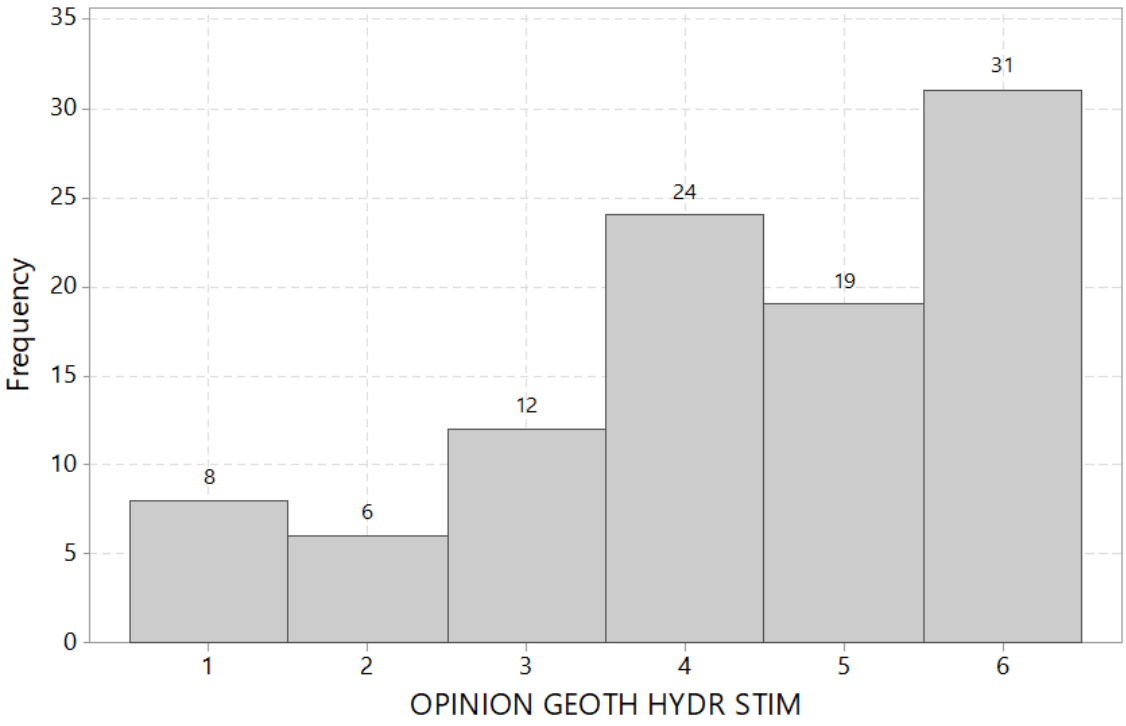

Figure B.105. What is your opinion on developing a pilot geothermal energy project in your country, if (underground) hydraulic stimulation is required?

B.4. Community acceptance variables (Section 4)

Figures 4.106 shows that respondents felt that they understood geothermal energy rather well.

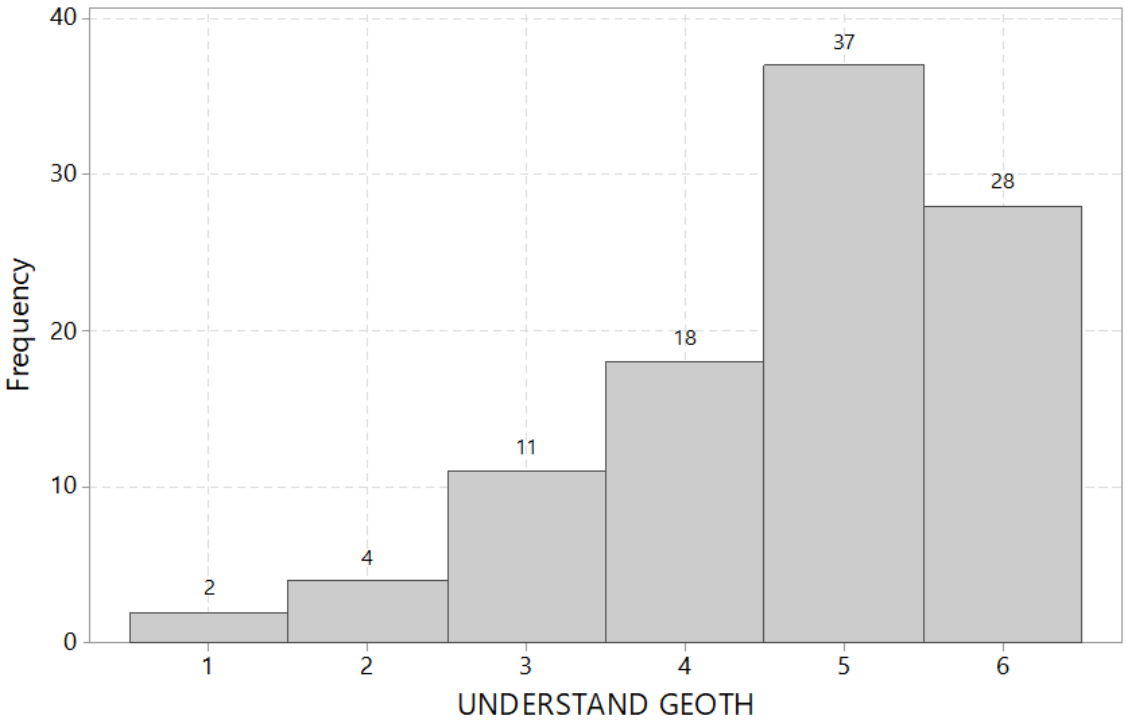

Figure B.106. Do you understand what geothermal energy is and how it works?

Grouping this understanding of geothermal energy per country, shown in Figure B.107, potentially outlines three ranking groups, countries with very good understanding (Albania and Australia, although the size of each group may be a misleading factor), countries with good understanding (China, Lithuania, the UK, Ukraine, France, the US and Greece), and countries with mediocre understanding (Finland, Montenegro, and Poland).

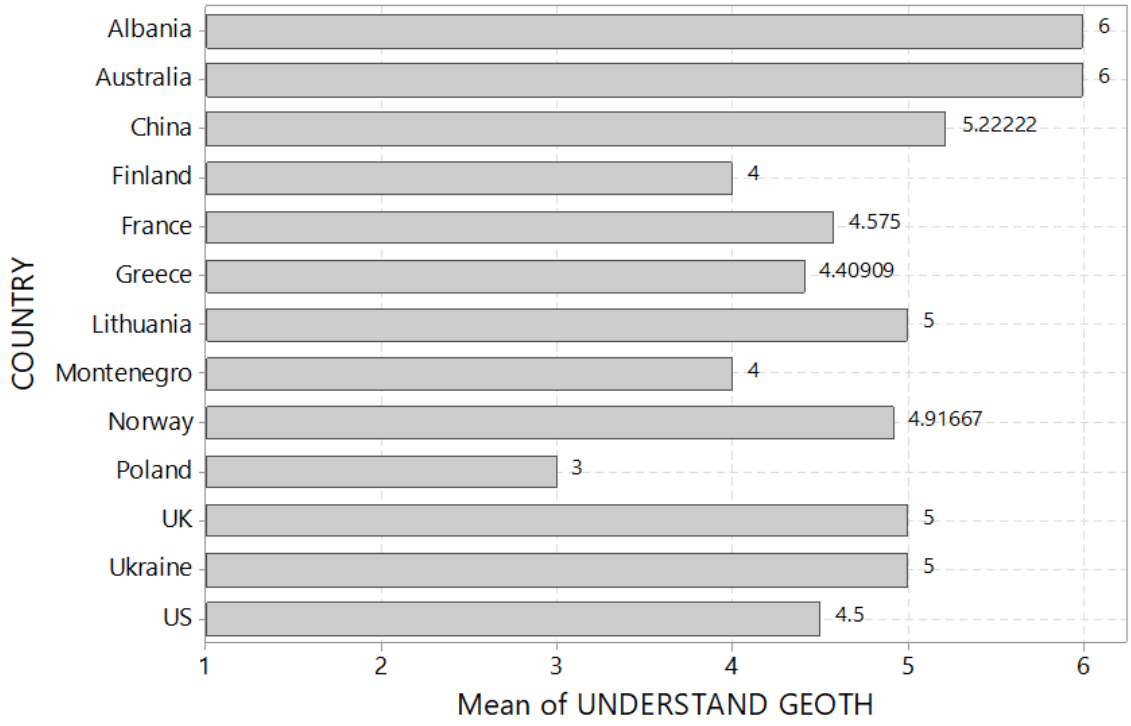

Figure B.107. Mean of "Do you understand what geothermal energy is and how it works?" per country

Figure B.108 shows that respondents considered concerns about facility location to be an important factor in involving local communities in geothermal energy exploration.

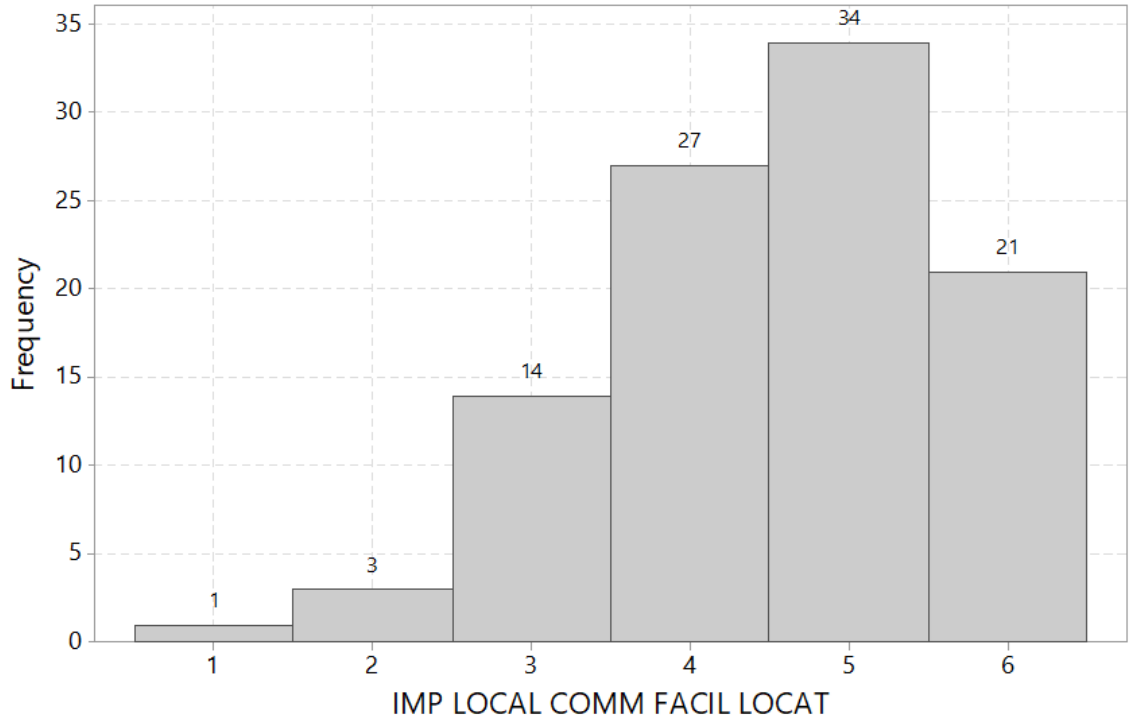

Figure B.108. How important are concerns about facility location in involving local communities in geothermal energy exploration?

As shown by Figure B.109, risks and benefits to society were considered a very important factor in involving local communities in geothermal energy exploration, with almost all respondents assigning them a rating equal to or greater than 4 (out of a maximum of 6).

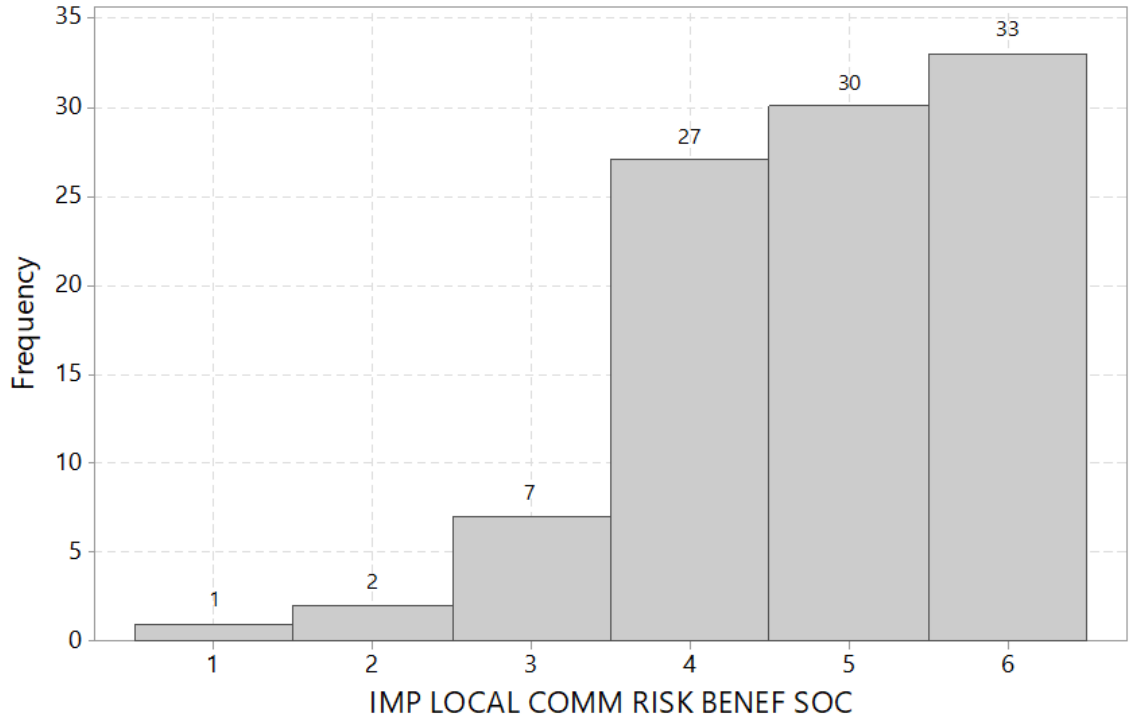

Figure B.109. How important are risks and benefits to society in involving local communities in geothermal energy exploration?

Similarly, respondents considered environmental impacts (Figures 4.110) and concerns about public health and safety (Figures 4.111) to be very important in involving local communities in geothermal energy exploration.

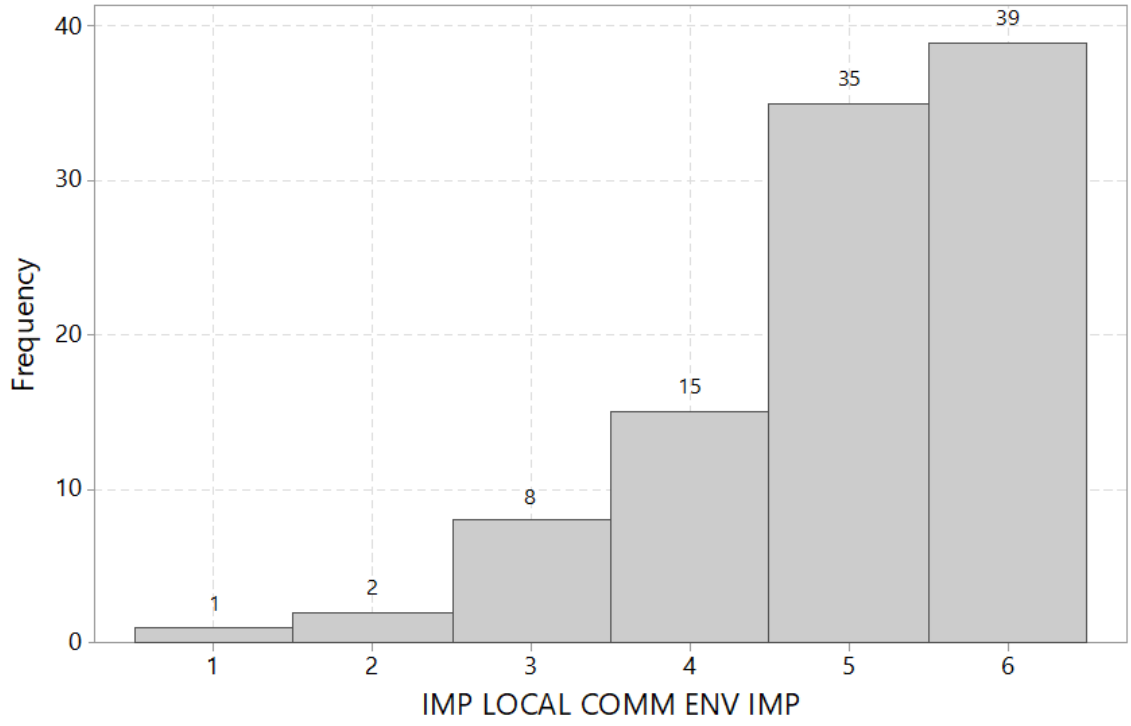

Figure B.110. How important are environmental impacts in involving local communities in geothermal energy exploration?

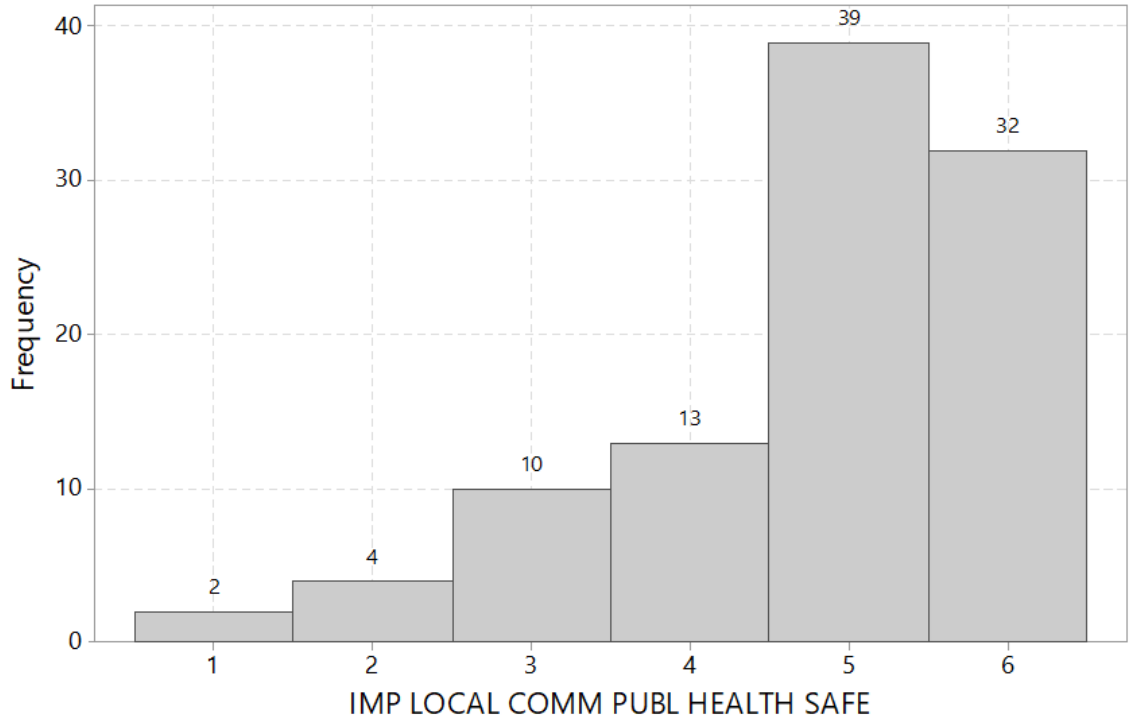

Figure B.111. How important are concerns about public health and safety in involving local communities in geothermal energy exploration?

Figure B.112 shows that respondents ranked insufficient service maturity as a factor of medium to high significance as to whether it would deter them from switching to a geothermal-only energy supply.

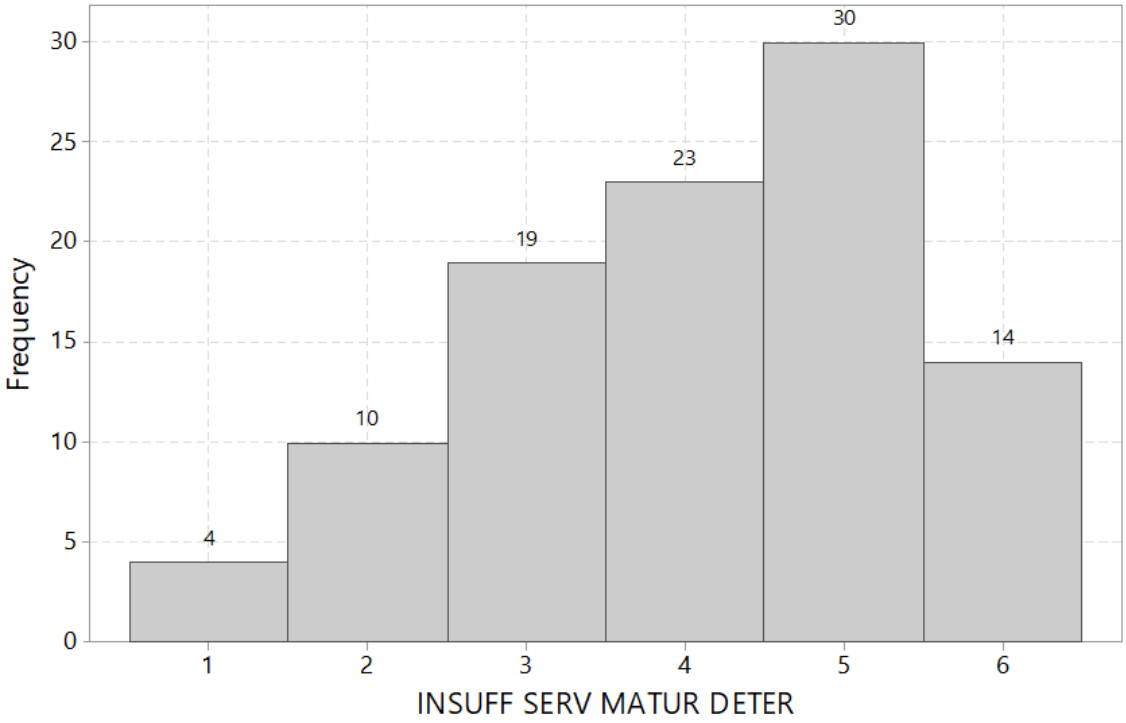

Figure B.112. How much would insufficient service maturity deter you from switching to a geothermal-only energy supply?

Figure B.113 shows that respondents thought that hidden/unknown costs would be a significant factor in deterring them from switching to a geothermal-only energy supply.

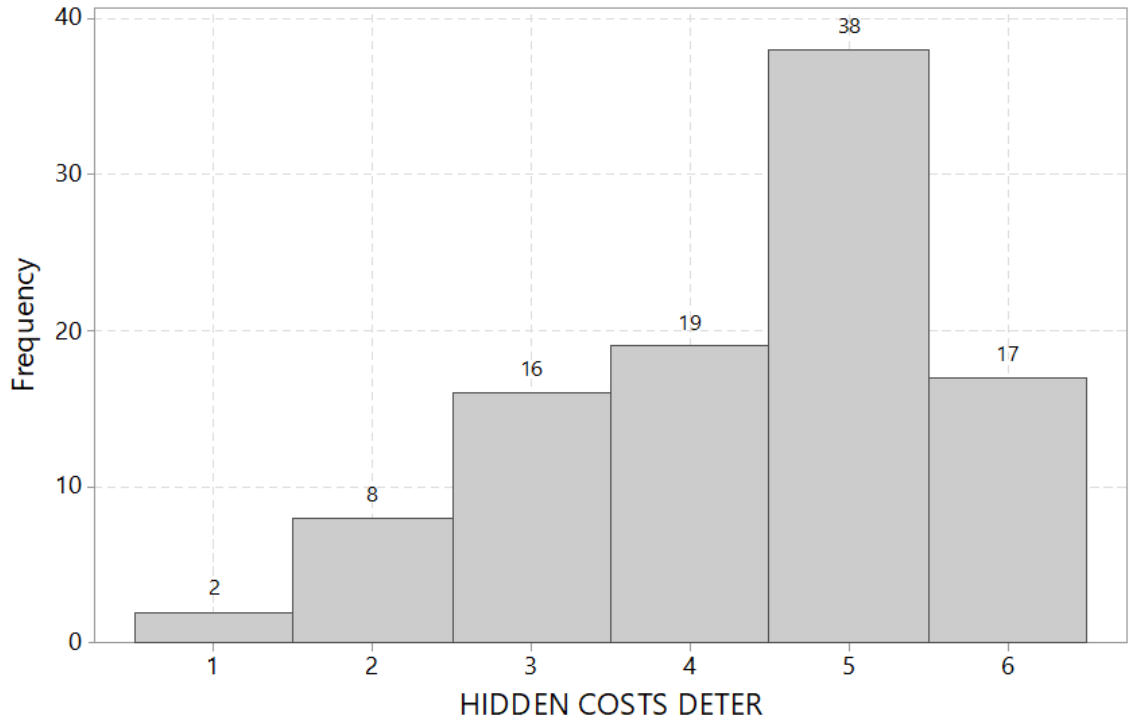

Figure B.113. How much would hidden/unknown costs deter you from switching to a geothermal-only energy supply?

Figure B.114 shows that inconvenience would be a factor of medium importance in deterring respondents from switching to a geothermal-only energy supply.

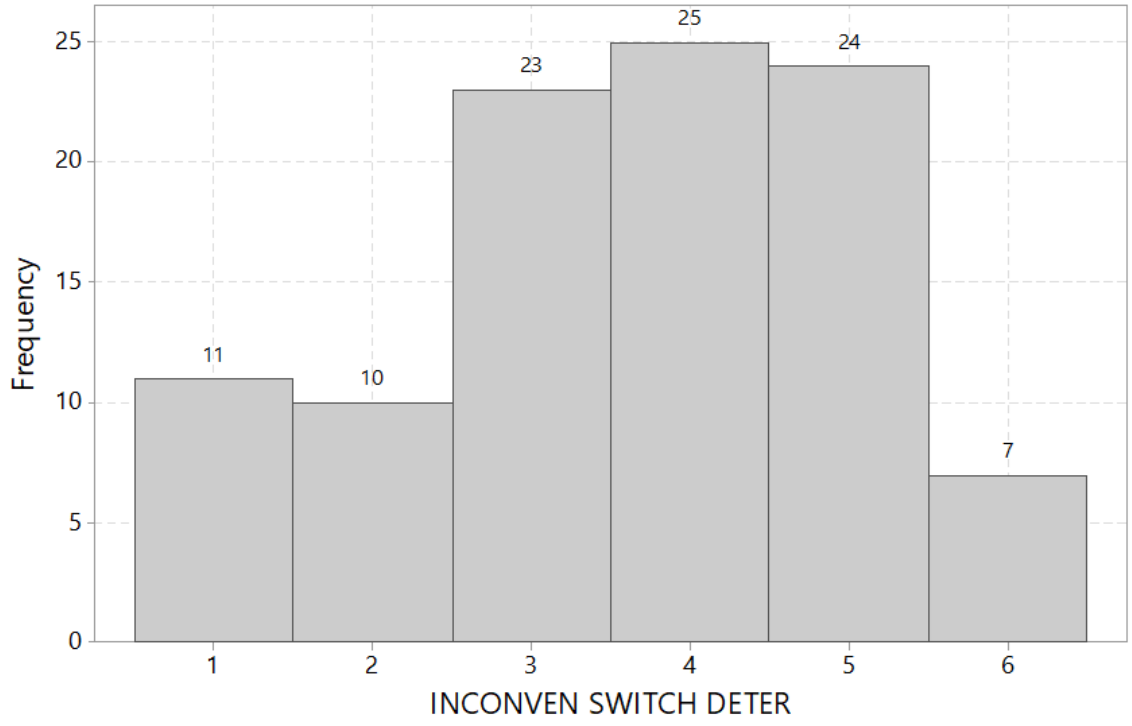

Figure B.114. How much would inconvenience of switching deter you from switching to a geothermal-only energy supply?

Figure B.115 shows that issues of credibility, transparency, and trust would somewhat deter respondents from switching to a geothermal-only energy supply.

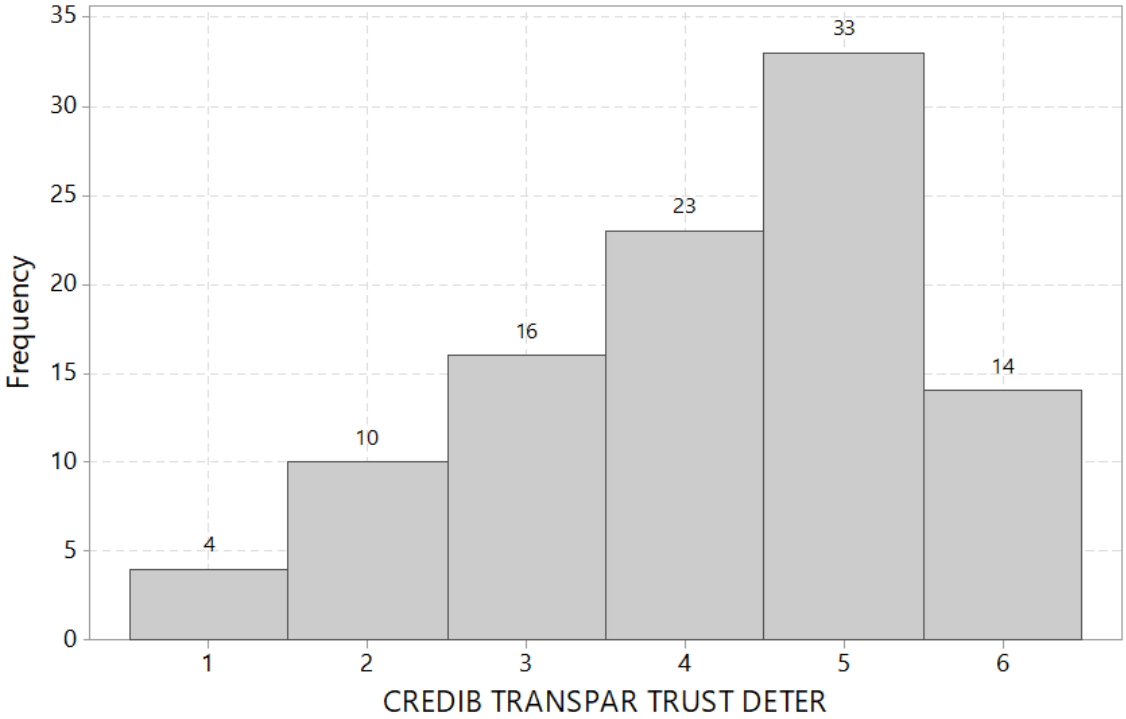

Figure B.115. How much would issues of credibility, transparency, and trust deter you from switching to a geothermal-only energy supply?

Turning to various NIMBY related issues, Figure B.116 shows that environmental impacts related to geothermal drilling near the respondent's property would be of significant concern to most respondents.

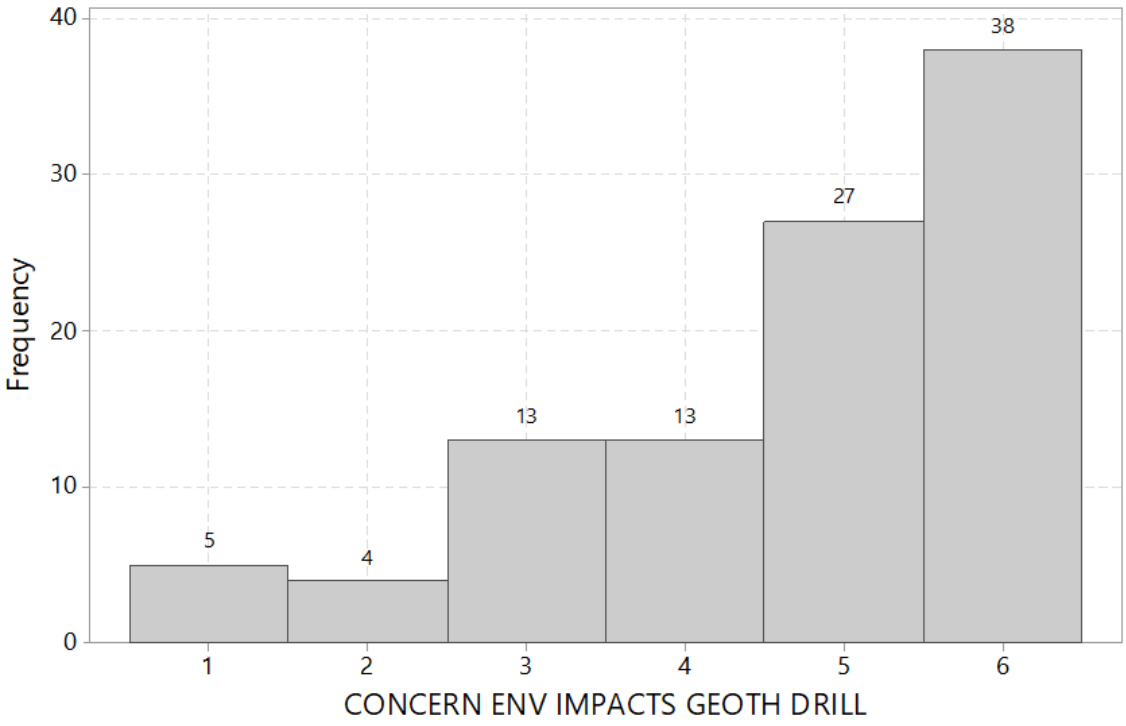

Figure B.116. How concerned would you be about environmental impacts regarding geothermal drilling near your property?

Figure B.117 shows that concern about aesthetic issues regarding geothermal drilling near the respondent's property was ranked as mediocre, with two thirds of the respondent's (67 out of 100) assigning it a ranking of 3, 4 or 5.

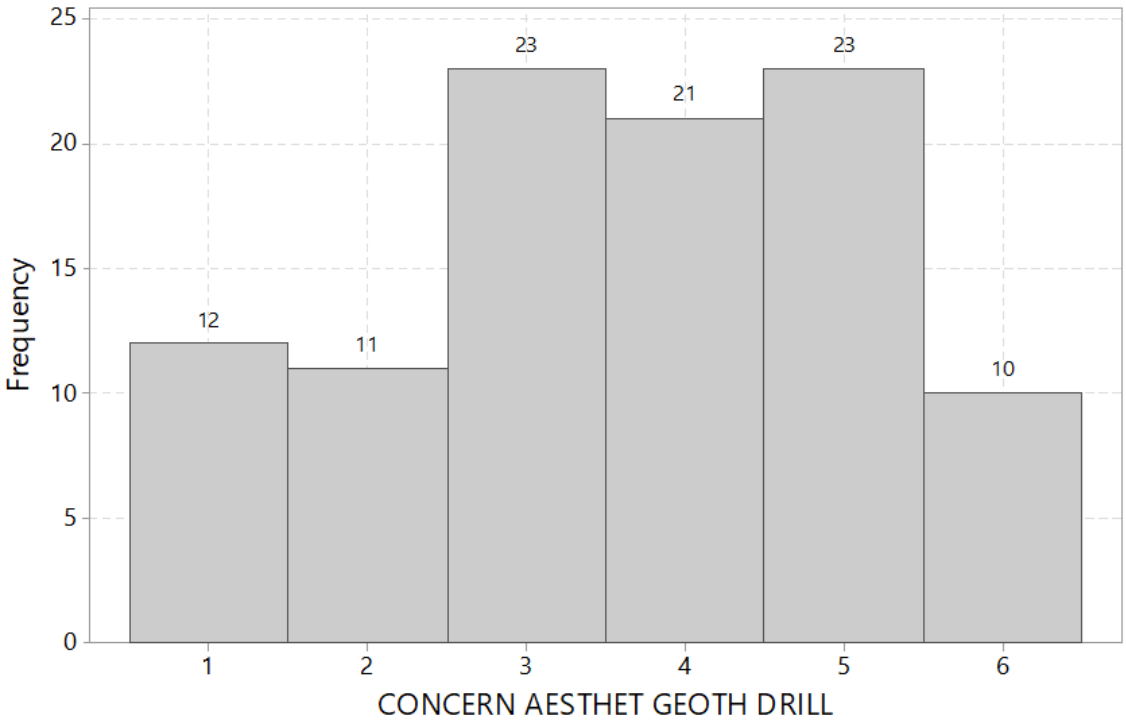

Figure B.117. How concerned would you be about aesthetic issues regarding geothermal drilling near your property?

Figure B.118 shows that concern about safety regarding geothermal drilling near the respondent's property was mostly high or average.

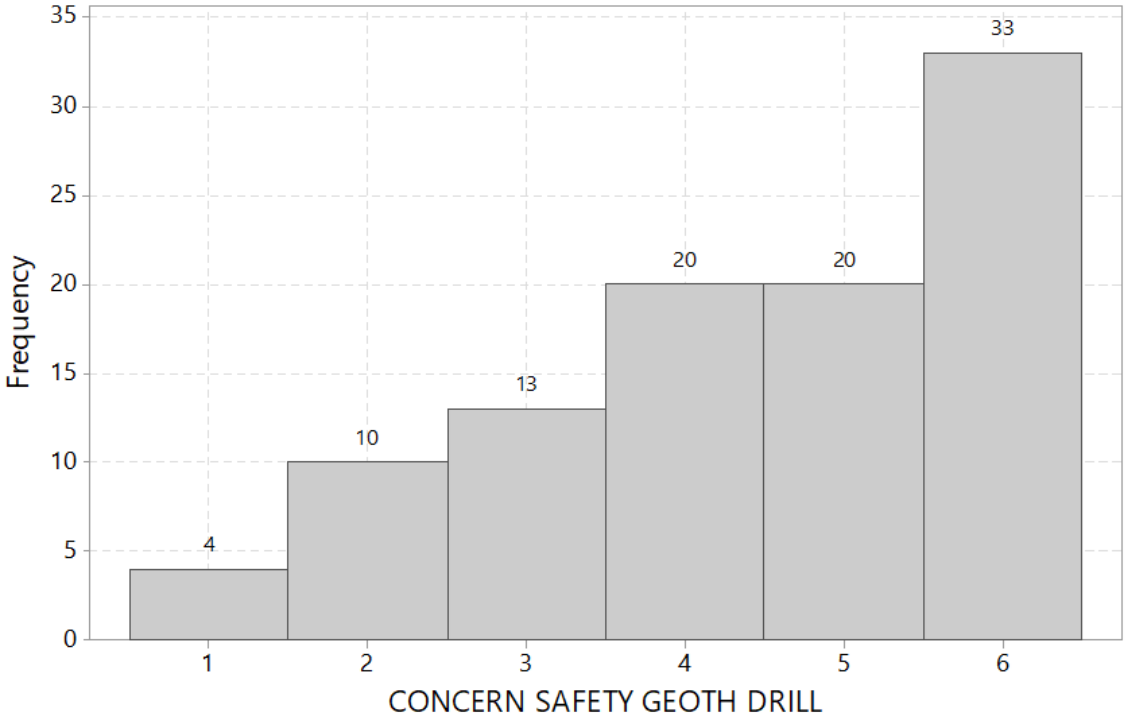

Figure B.118. How concerned would you be about safety regarding geothermal drilling near your property?

Figure B.119 shows that concern about public health regarding geothermal drilling near the respondent's property was distributed bimodally, indicating the presence of two clusters in the sample, with almost two thirds (64) of the respondents ranking it as either 6 or 5.

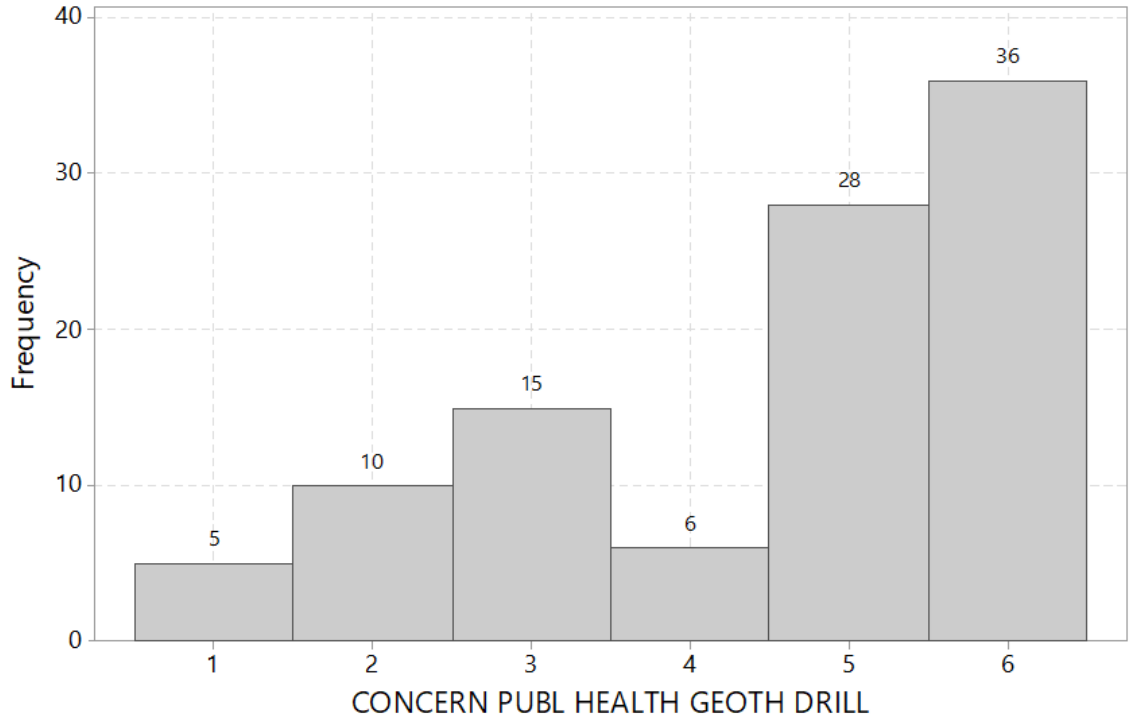

Figure B.119. How concerned would you be about public health regarding geothermal drilling near your property?

According to Figure B.120, concern about transparency regarding geothermal drilling near the respondent's property ranked mostly from 2 to 6, with the ranking of 5 being most frequent.

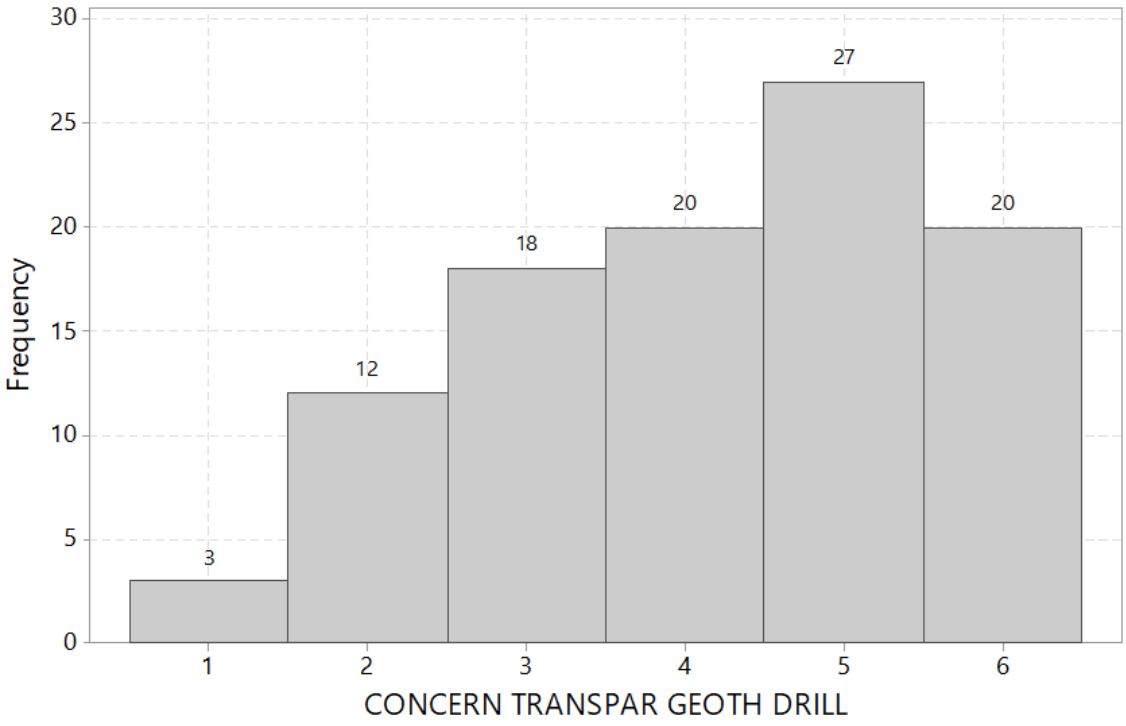

Figure B.120. How concerned would you be about transparency regarding geothermal drilling near your property?

Figure B.121 shows that concern about depreciation of property values regarding geothermal drilling near the respondent's property was relatively high, with 58 rankings equal to either 5 or 4.

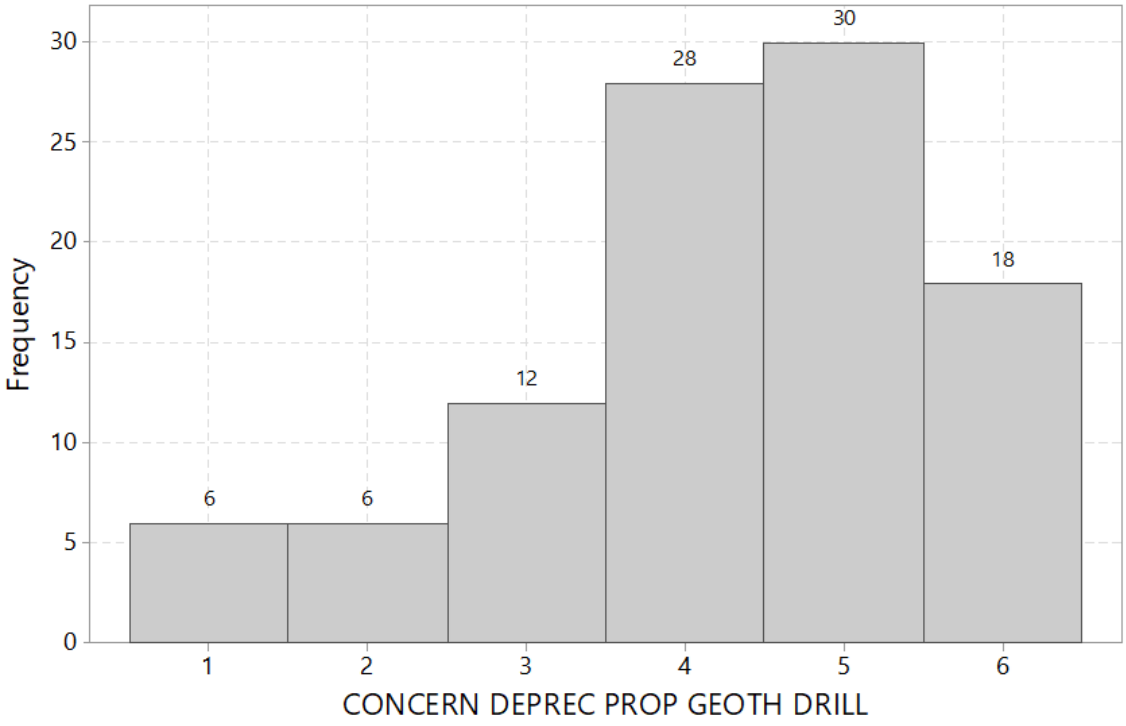

Figure B.121. How concerned would you be about depreciation of property values regarding geothermal drilling near your property?

Figure B.122 shows that reliability of energy supply would be convincing or very convincing to over three fourths (76) of the respondents, if they were considering purchasing energy supplied by deep geothermal sources in their area.

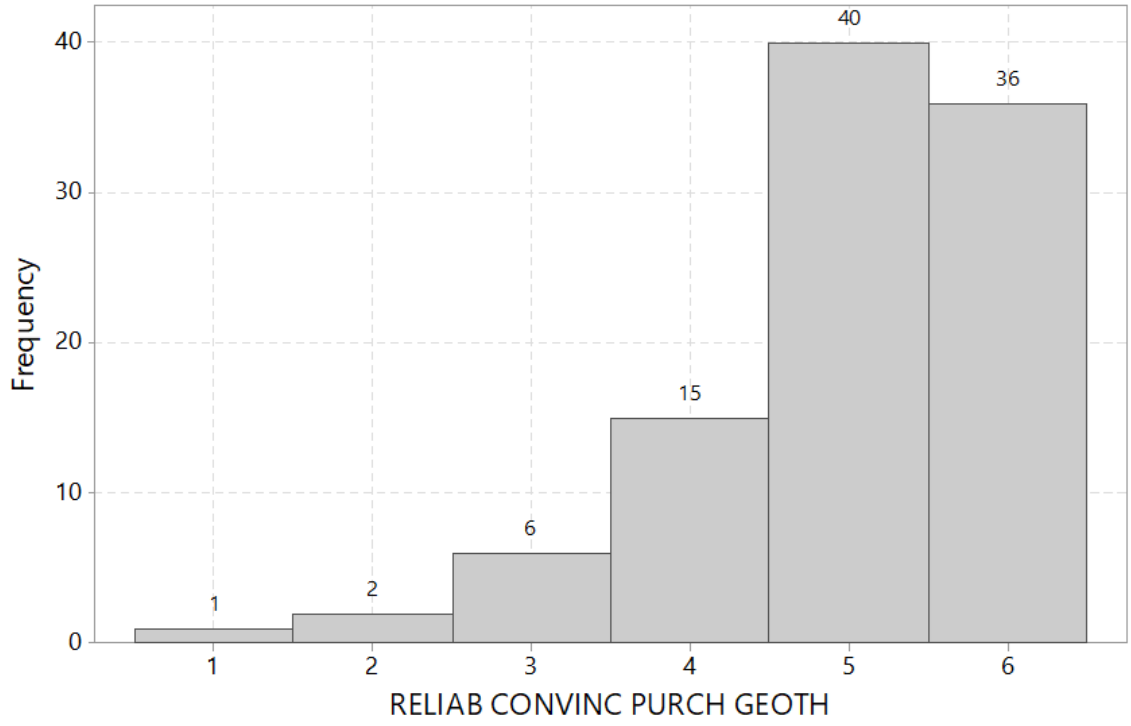

Figure B.122. How convincing would reliability of energy supply be to you if you were considering purchasing energy supplied by deep geothermal sources in your area?

Similarly, Figure B.123 shows that economic benefits would be very convincing if one was considering purchasing energy supplied by deep geothermal in their area.

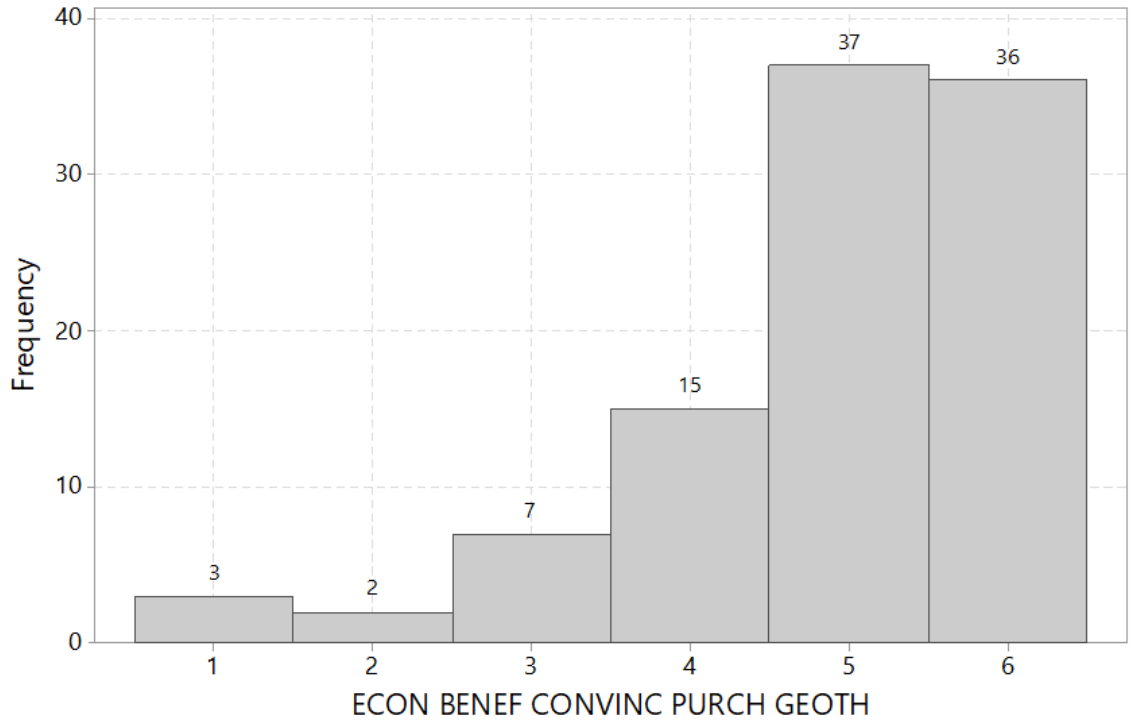

Figure B.123. How convincing would economic benefits be to you if you were considering purchasing energy supplied by deep geothermal sources in your area?

Figure B.124 shows that social benefits would be rather convincing to respondents, if they were considering purchasing energy supplied by deep geothermal sources in their area.

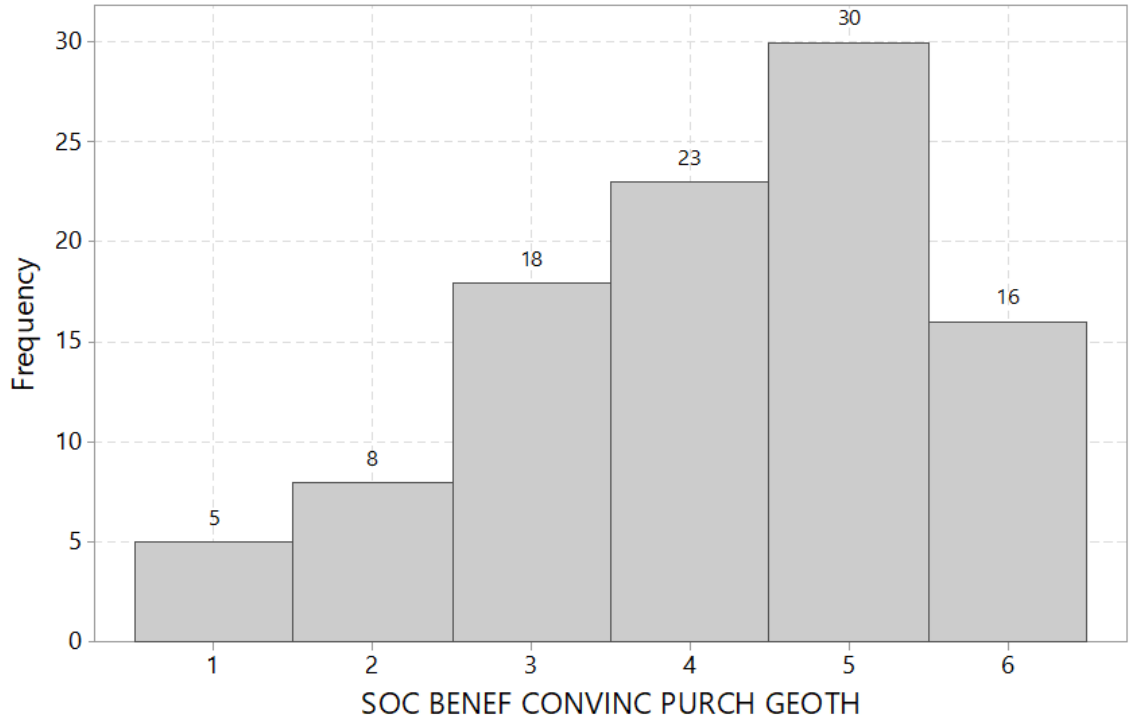

Figure B.124. How convincing would social benefits be to you if you were considering purchasing energy supplied by deep geothermal sources in your area?

Figure B.125 shows that environmental benefits would seem convincing or very convincing to respondents, if they were considering purchasing energy supplied by deep geothermal sources in their area.

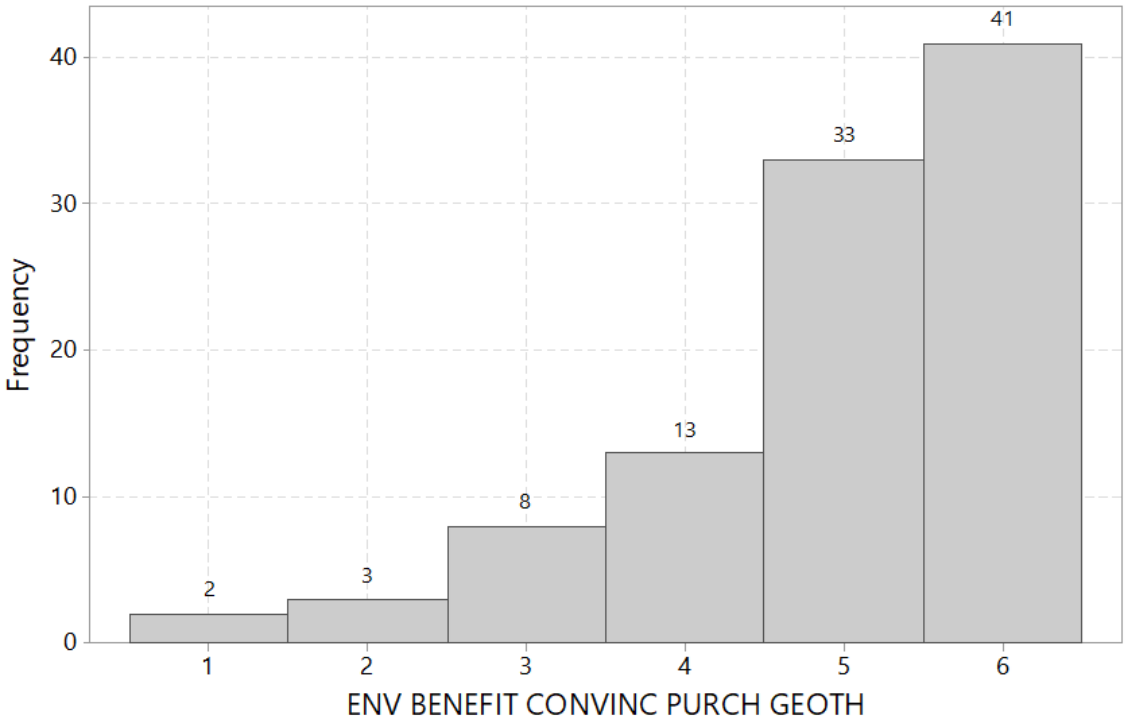

Figure B.125. How convincing would environmental benefits be to you if you were considering purchasing energy supplied by deep geothermal sources in your area?

Turning to questions related to trust, Figure B.126 shows that respondents would display an average trust towards the national public administration in helping make an informed decision about switching energy suppliers.

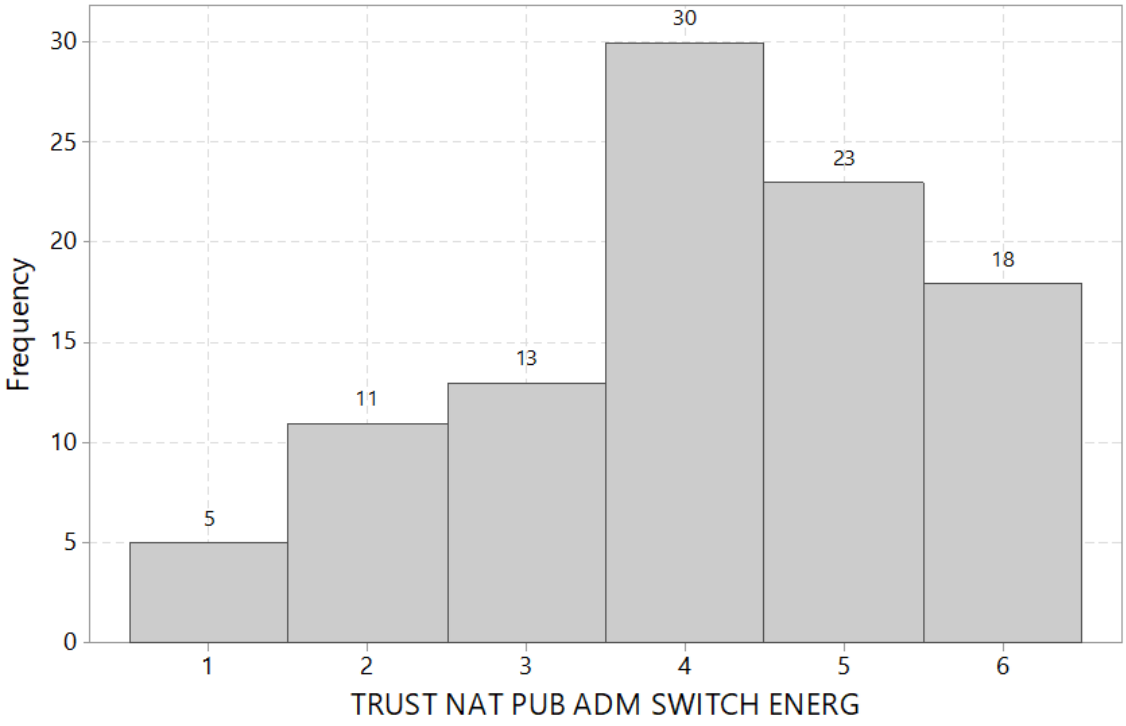

Figure B.126. How much would you trust the national public administration to help you make an informed decision about switching energy suppliers?

Figure B.127 shows respondents feel mediocre trust towards regional/local administration in helping them make an informed decision about switching energy suppliers.

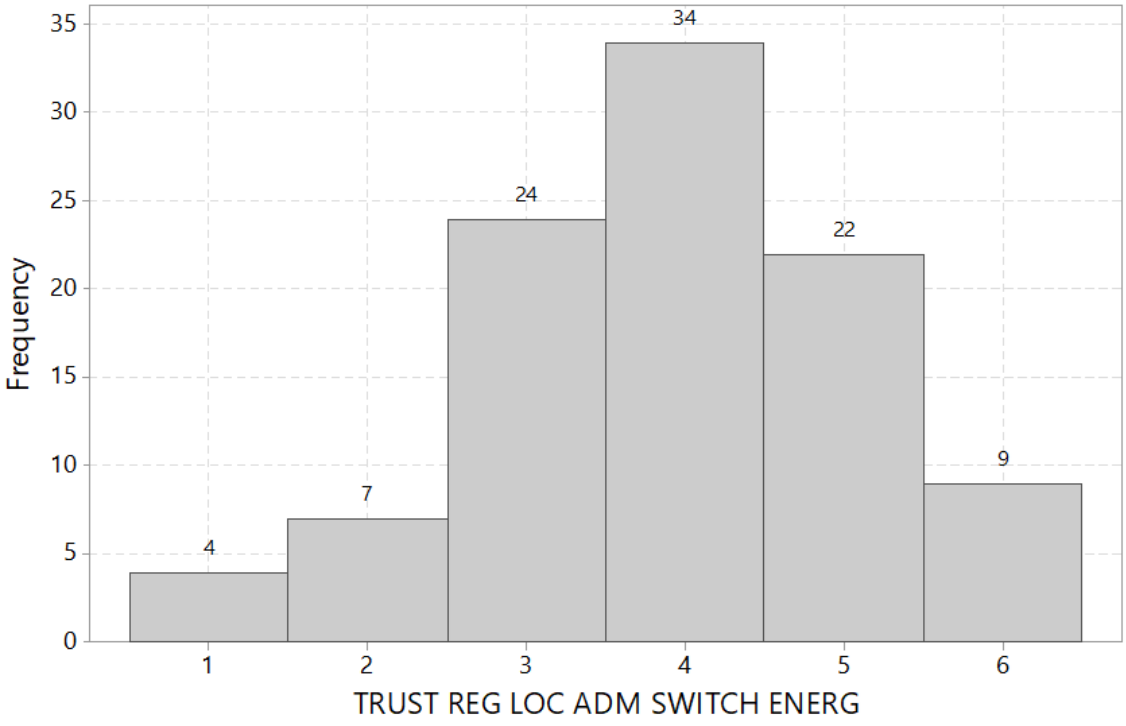

Figure B.127. How much would you trust regional/local administration to help you make an informed decision about switching energy suppliers?

Figure B.128 displays a bimodal distribution of the trust of respondents towards print and broadcast media helping them make an informed decision about switching energy suppliers, which indicates the possible presence of two clusters in the sample.

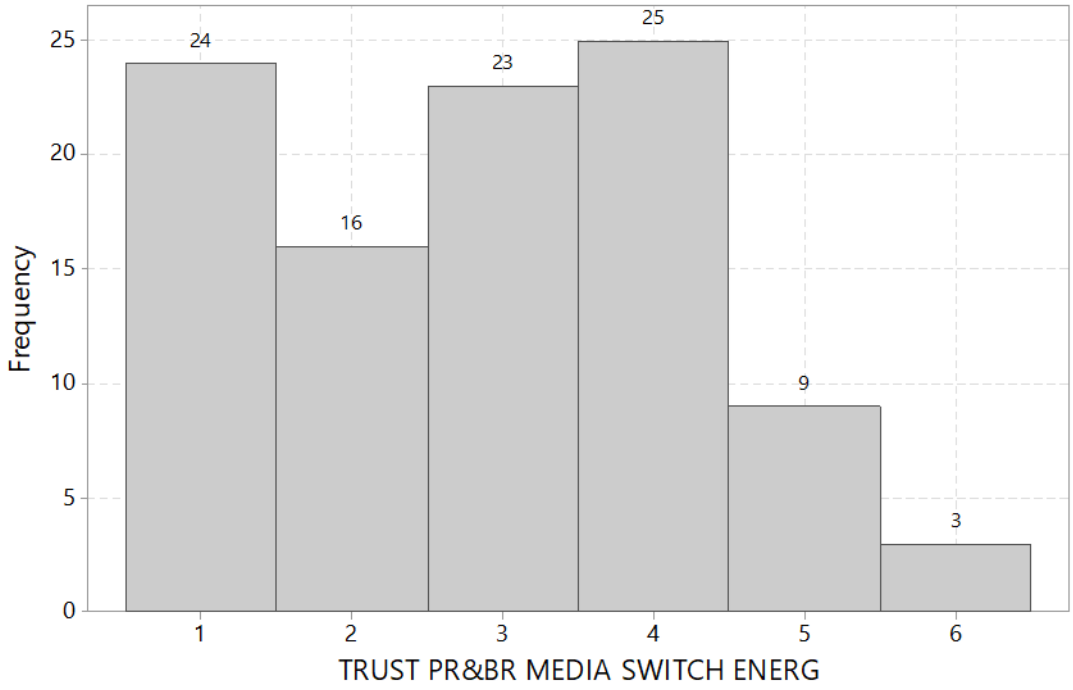

Figure B.128. How much would you trust print and broadcast media to help you make an informed decision about switching energy suppliers?

Figure B.129 shows a rather low trust of respondents towards the internet and social media helping them make an informed decision about switching energy suppliers.

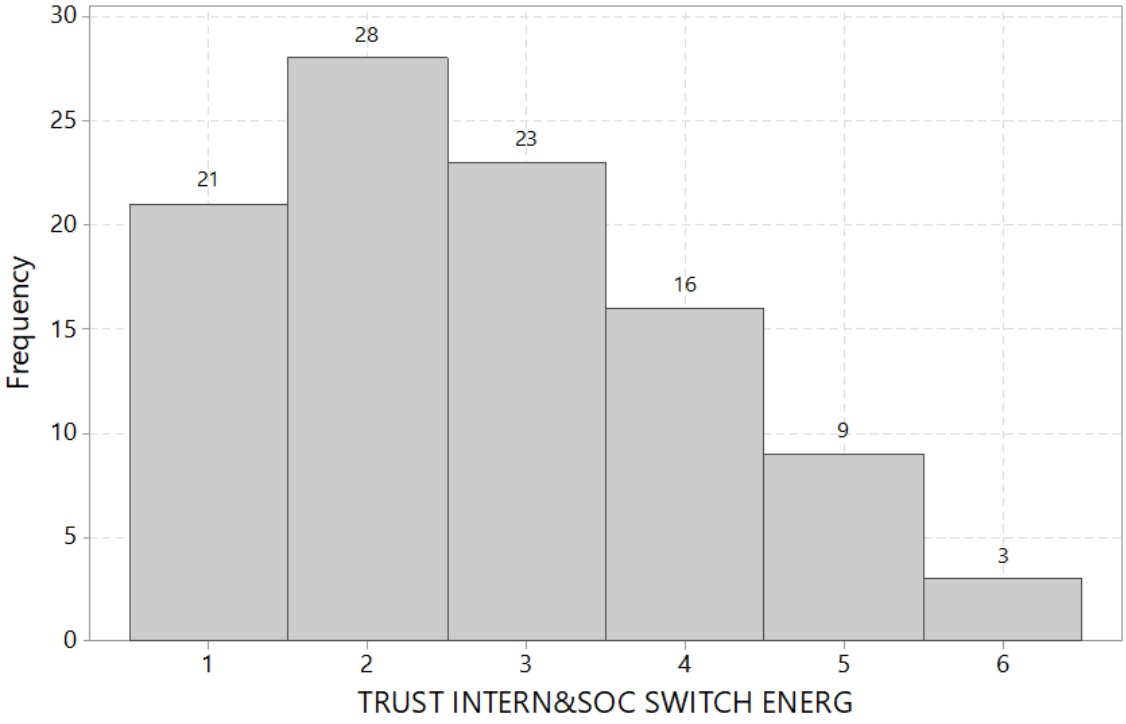

Figure B.129. How much would you trust the internet and social media to help you make an informed decision about switching energy suppliers?

Figure B.130 shows a mediocre trust of respondents towards energy suppliers helping them make an informed decision about switching energy suppliers.

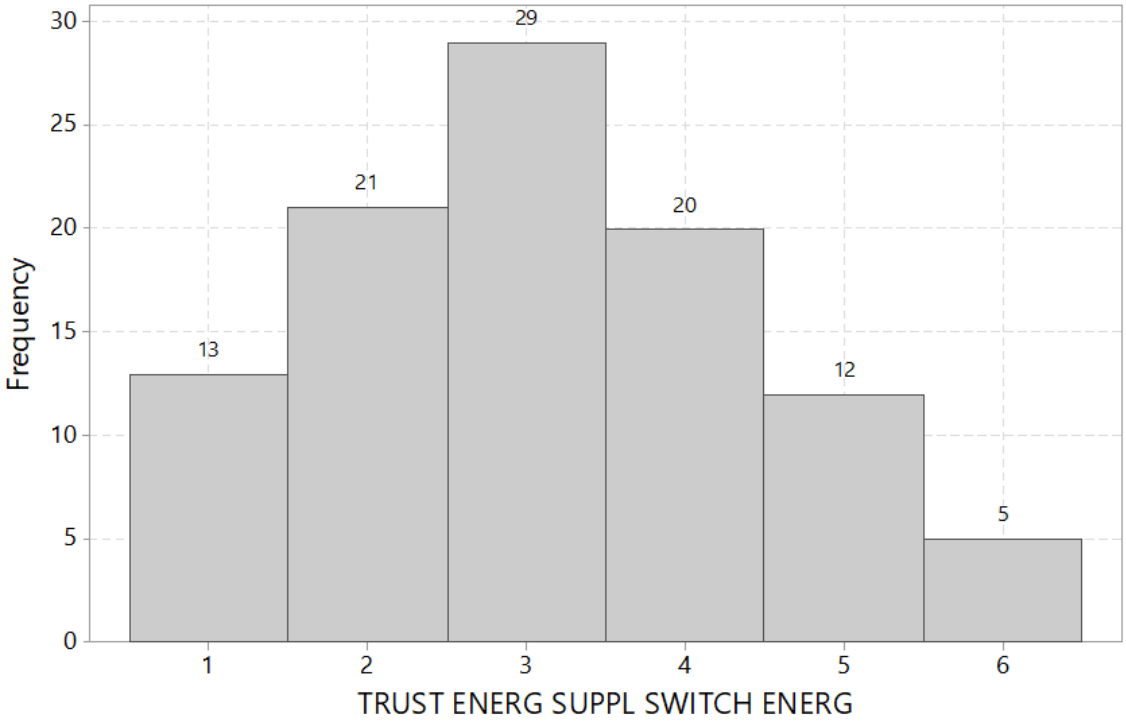

Figure B.130. How much would you trust energy suppliers to help you make an informed decision about switching energy suppliers?

Figure B.131 shows a slightly over average trust of respondents towards environmental associations helping them make an informed decision about switching energy suppliers.

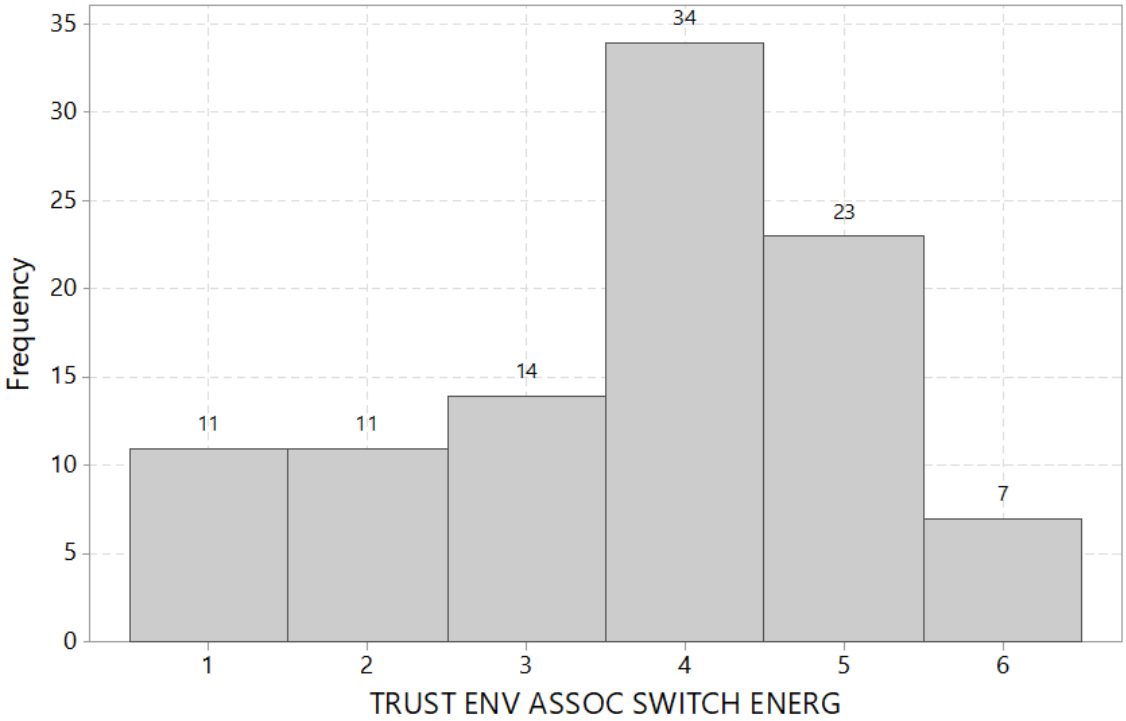

Figure B.131. How much would you trust environmental associations to help you make an informed decision about switching energy suppliers?

Figure B.132 shows that respondents trusted academic/research journals and expert publications to help them make an informed decision about switching energy suppliers, with 86 (of the 100 respondents) assigning them a trust equal or greater than 4.

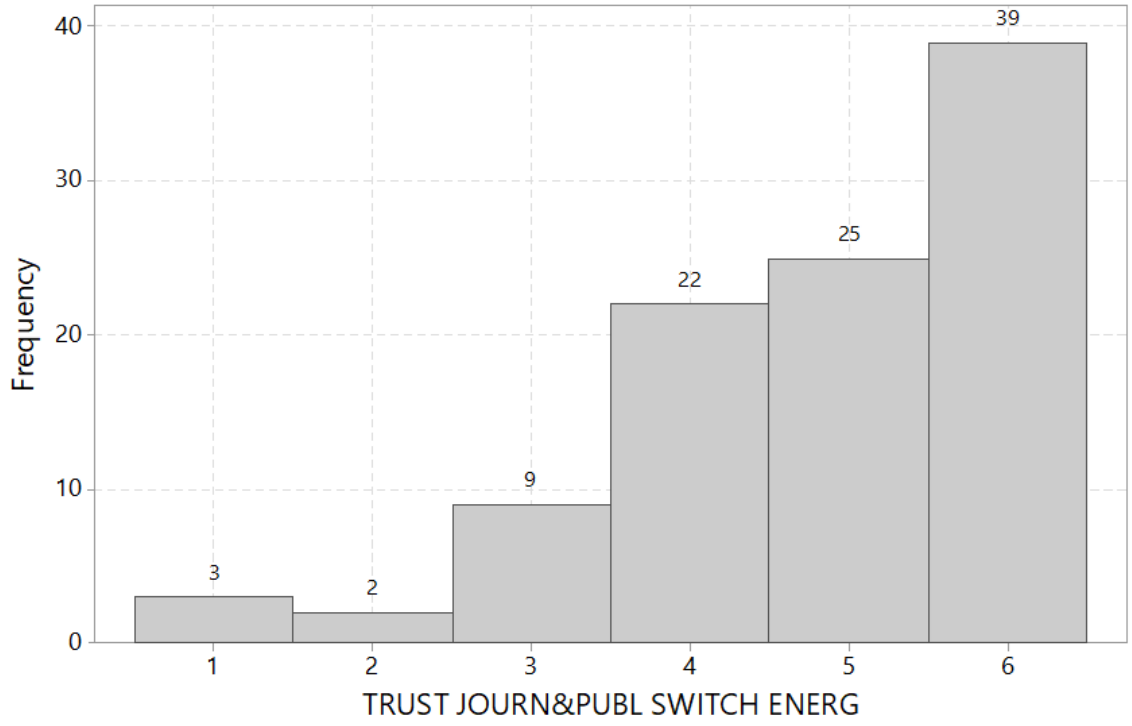

Figure B.132. How much would you trust academic/research journals and expert publications to help you make an informed decision about switching energy suppliers?

Figure B.133 shows that respondents trusted friends and colleagues to help them make an informed decision about switching energy suppliers, to an average degree.

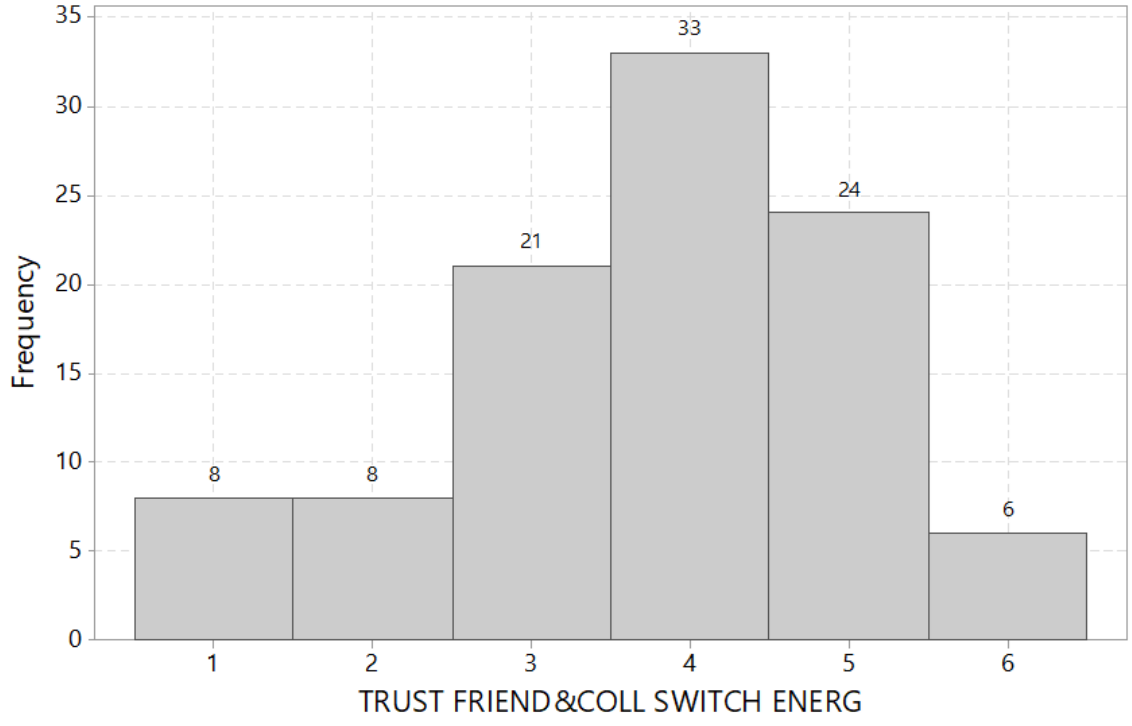

Figure B.133. How much would you trust friends and colleagues to help you make an informed decision about switching energy suppliers?

Figure B.134 shows that respondents would be very concerned if fossil fuel plants/installations were built in their area.

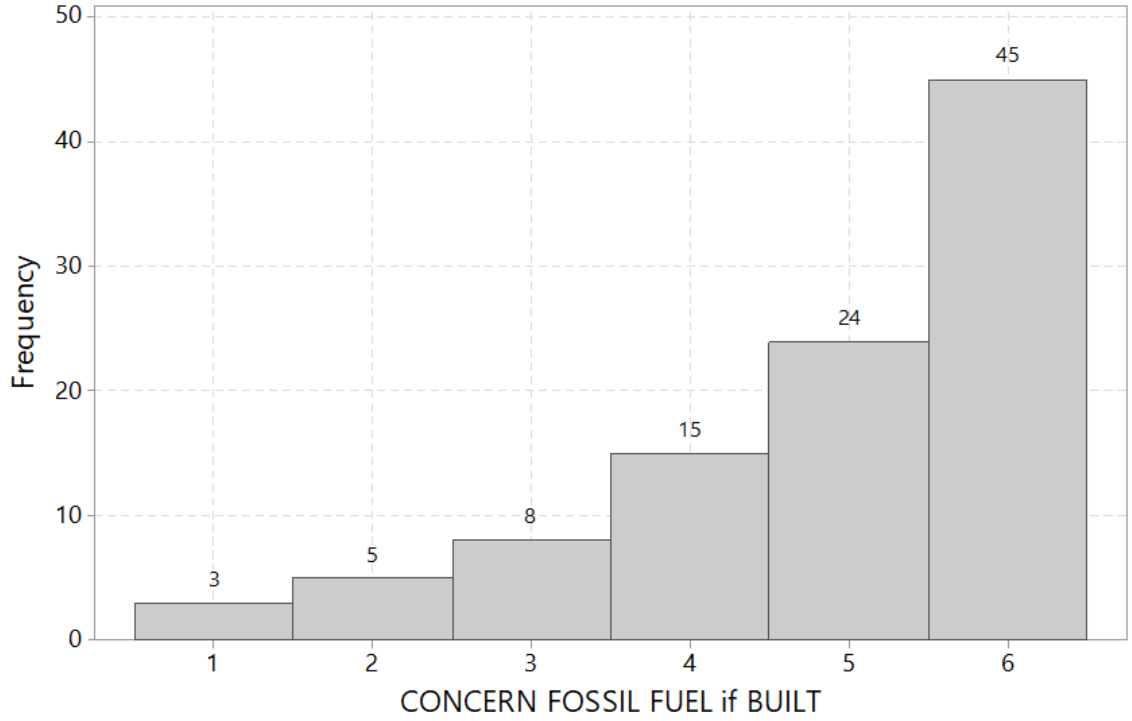

Figure B.134. How concerned would you be if fossil fuel plants/installations were built in your area?

Figure B.135 shows that rankings on how concerned responses would be if nuclear energy plants/installations were built in their area, follow a bimodal distribution, indicating the presence of two clusters in the sample.

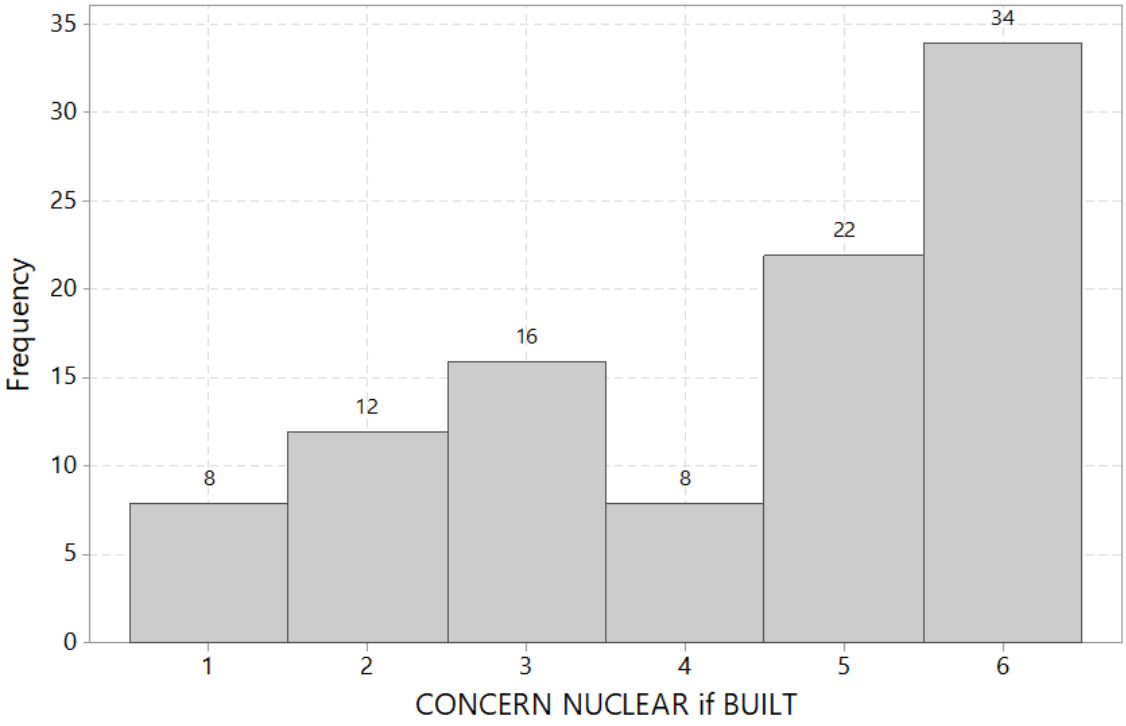

Figure B.135. How concerned would you be if nuclear energy plants/installations were built in your area?

A similar bimodal distribution is shown in Figure B.136, on how concerned would respondents be if hydropower plants or installations were built in their area, although the overall level of concern is lower.

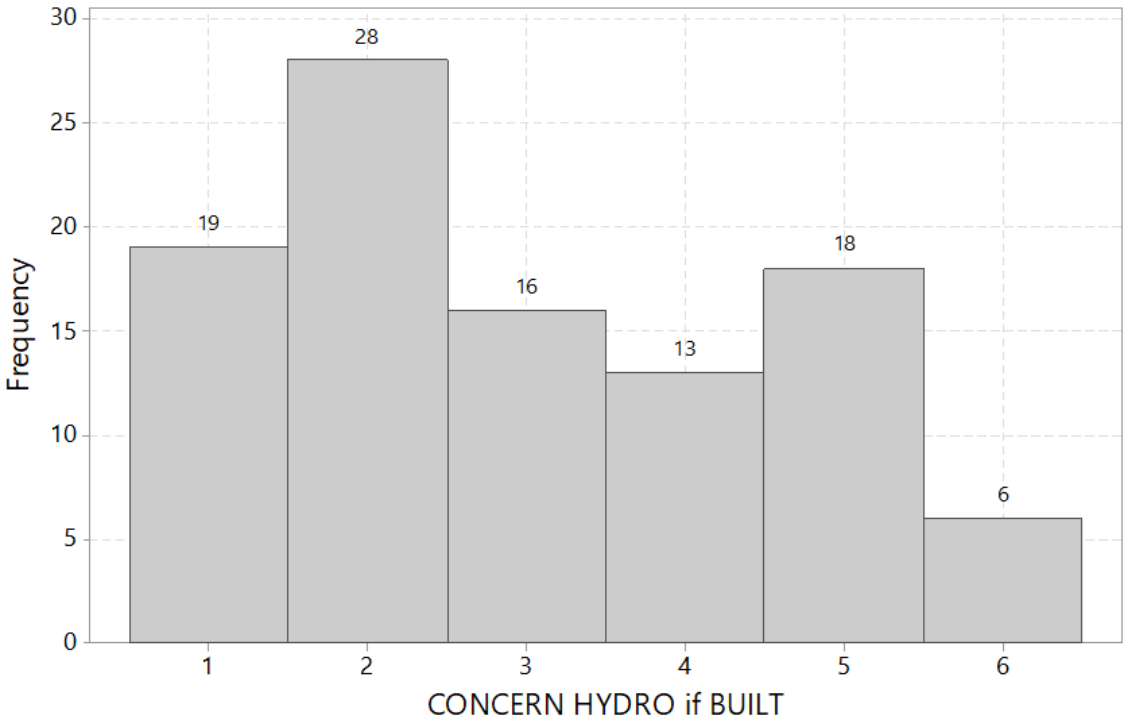

Figure B.136. How concerned would you be if hydropower plants/installations were built in your area?

Figure B.137 also shows the concern of respondents if wind energy plants/installations were built in their area, to be distributed bimodally and across all ranking values, with more responses in the lower range.

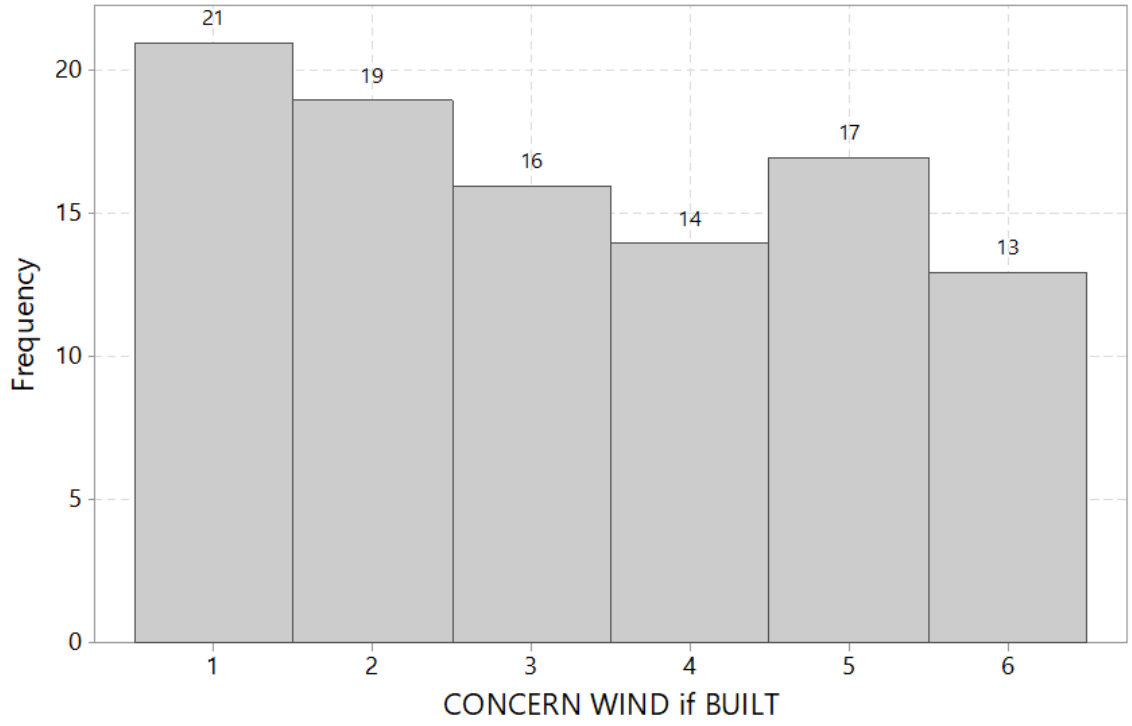

Figure B.137. How concerned would you be if wind energy plants/installations were built in your area?

Figure B.138, on the concern of respondents if solar panel (PV) plants or installations were built in their area, is also bimodally distributed and shows lower levels of concern.

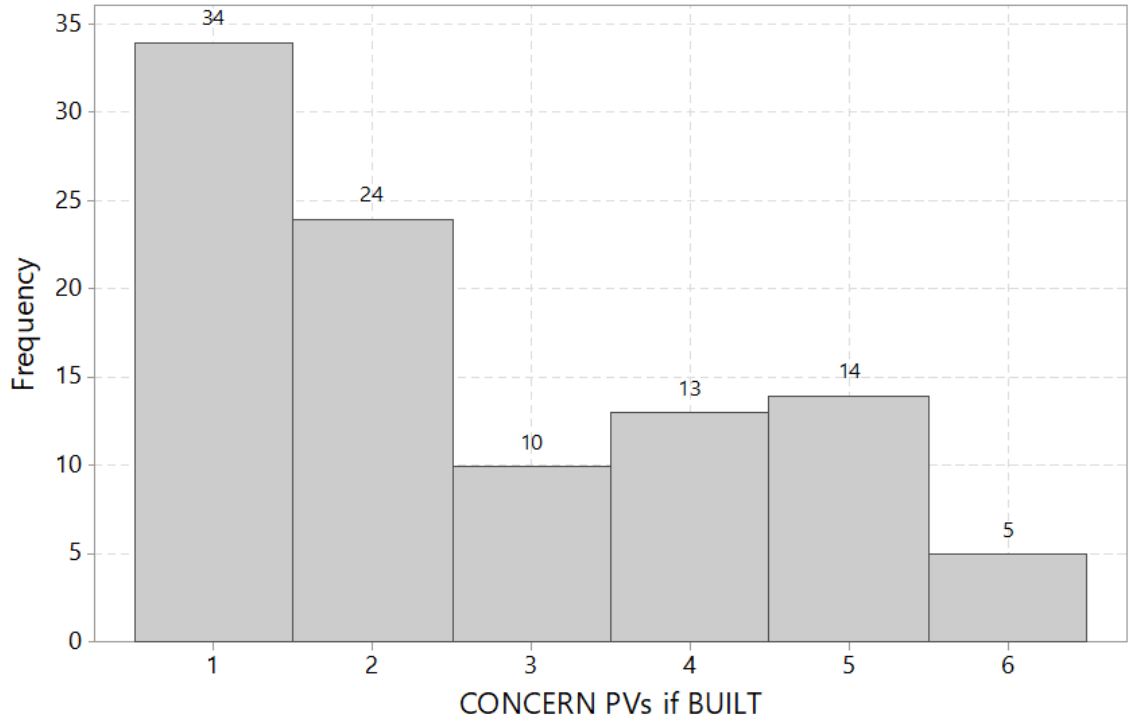

Figure B.138. How concerned would you be if solar panel (PV) plants/installations were built in your area?

Figure B.139 shows that the concern of respondents if geothermal energy plants/installations were built in their area, was at middle and lower ranking levels.

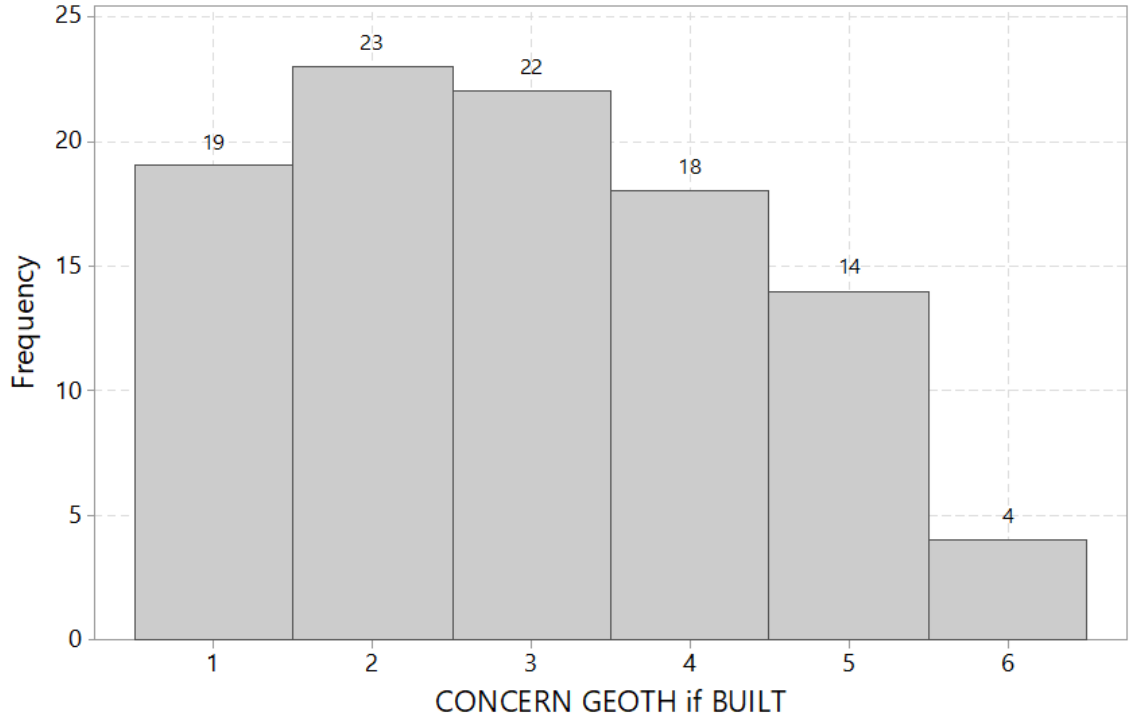

Figure B.139. How concerned would you be if geothermal energy plants/installations were built in your area?

Figure B.140 shows that respondents' concern on biomass plants/installations being built in your area received all ranking values and was distributed bimodally.

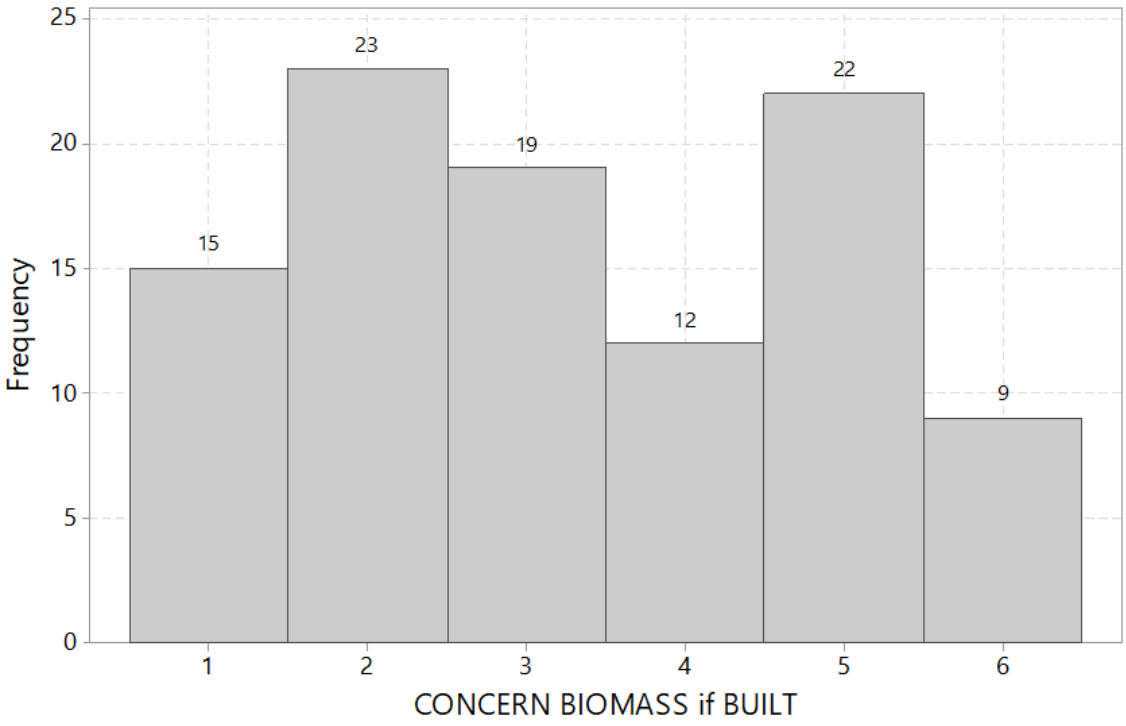

Figure B.140. How concerned would you be if biomass plants/installations were built in your area?

Regarding the concern of respondents about greenhouse gas emissions of geothermal drilling. Figure B.141 shows a uniform distribution of ranking values, with some indications of more than one modes.

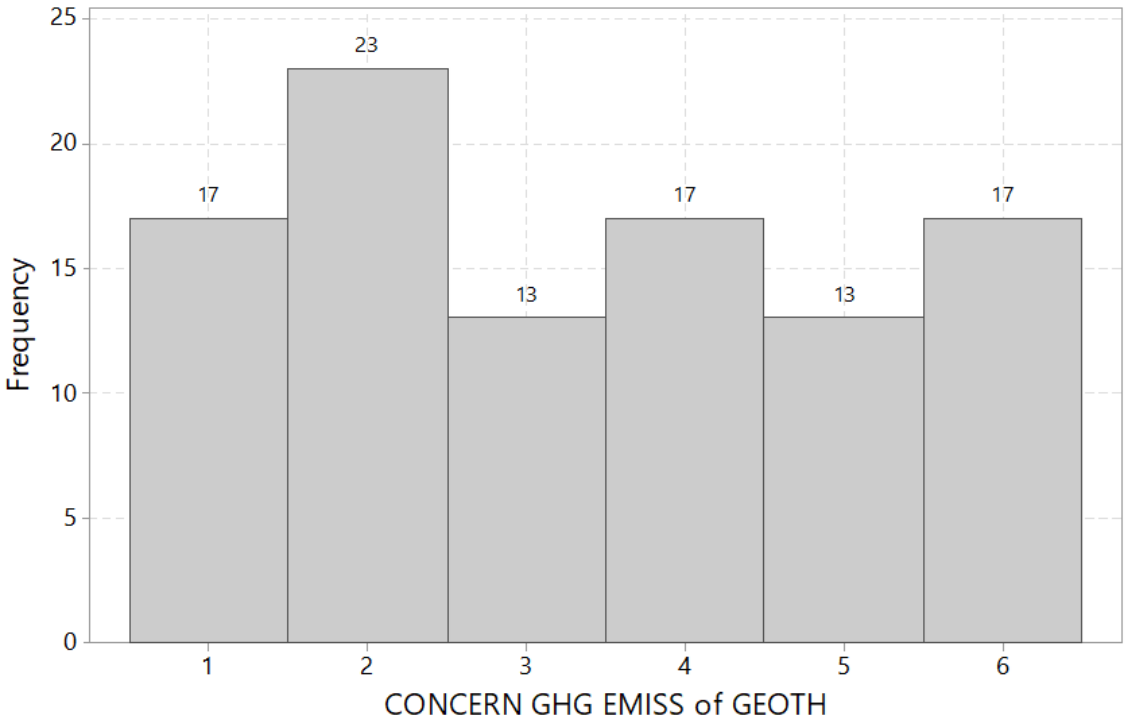

Figure B.141. How concerned would you be about greenhouse gas emissions of geothermal drilling?

Respondent concern about the landscape (Figure B.142) and infrastructure impacts (Figure B.143) of geothermal drilling was distributed almost normally among rankings, with most values being in the middle in both cases.

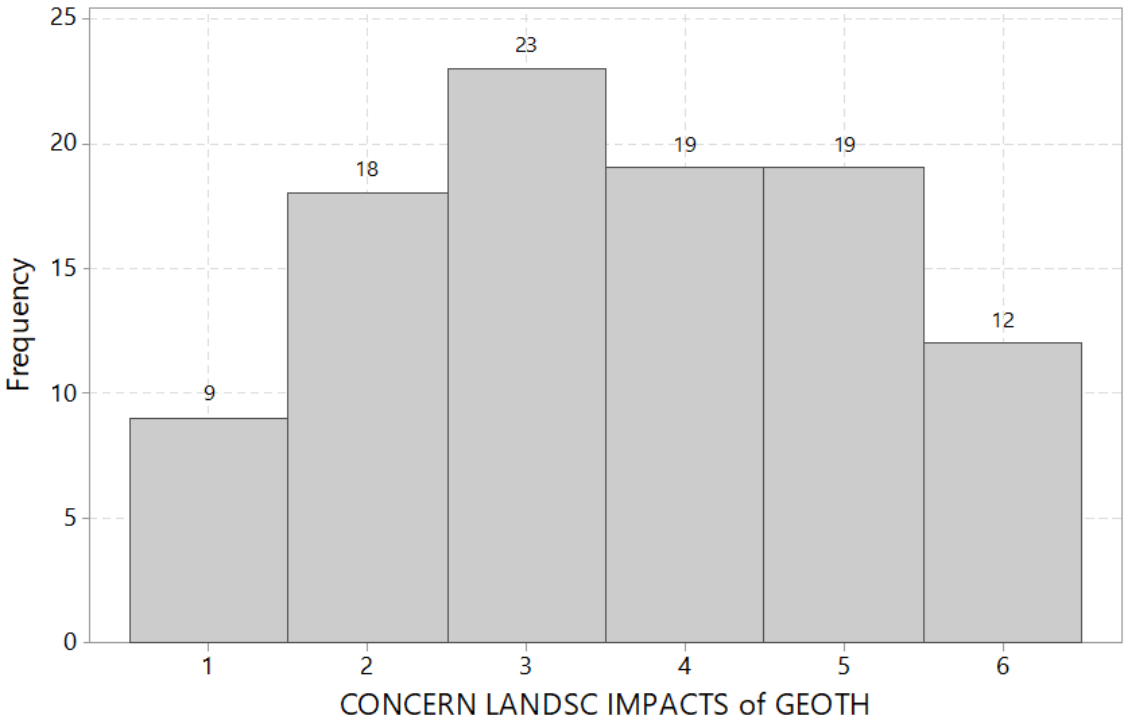

Figure B.142. How concerned would you be about landscape impacts of geothermal drilling?

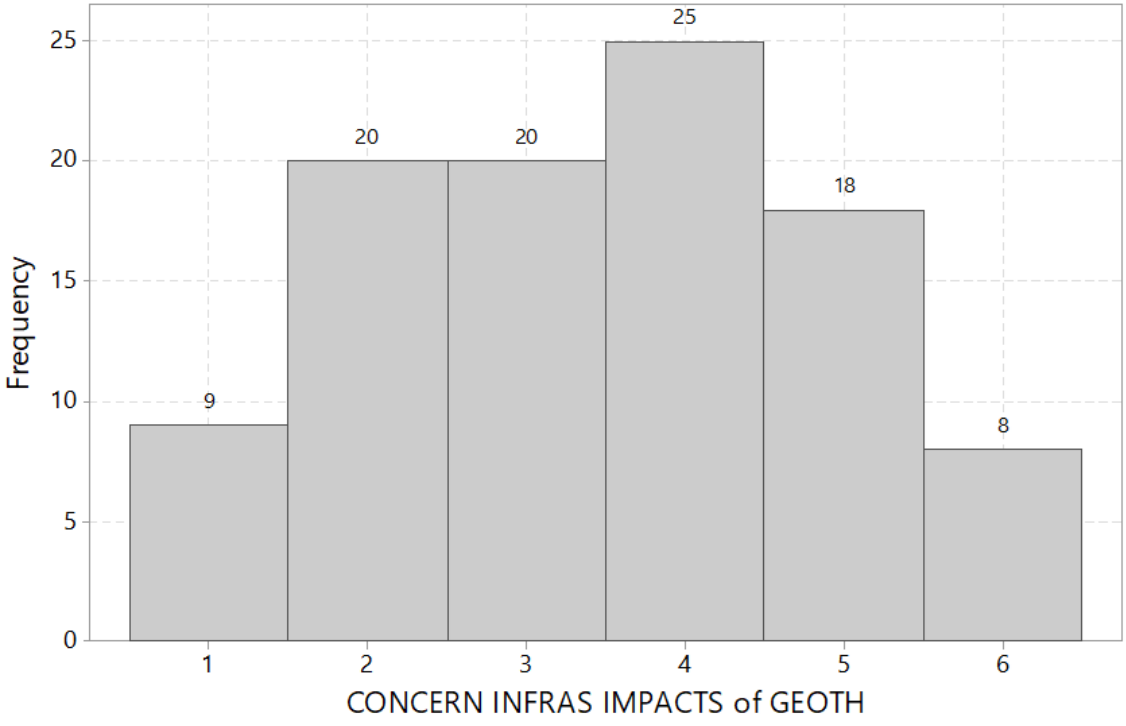

Figure B.143. How concerned would you be about infrastructure impacts of geothermal drilling?

Figure B.144 shows that respondent concern about induced (micro)seismicity of geothermal drilling was also distributed among all rankings, but with more values being greater than average and a mode of 25 responses at a ranking of 5.

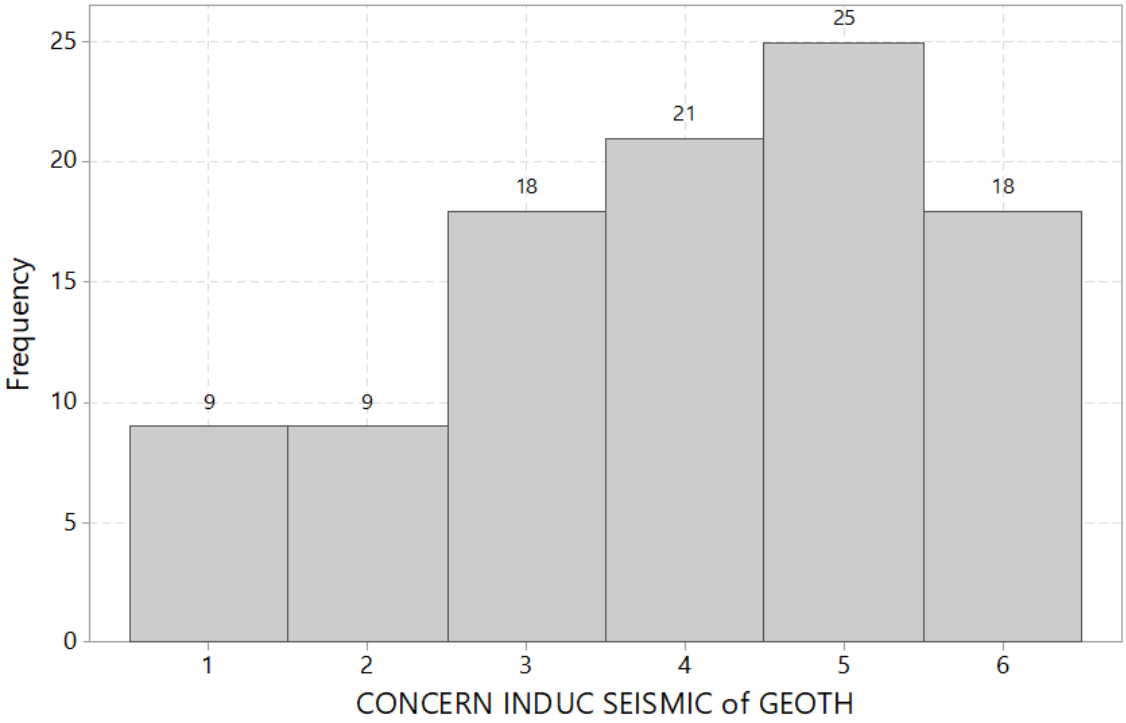

Figure B.144. How concerned would you be about induced (micro)seismicity of geothermal drilling?

Figure B.145 shows that concern about water aquifer-related risks of geothermal drilling was high, certainly more than that for seismicity.

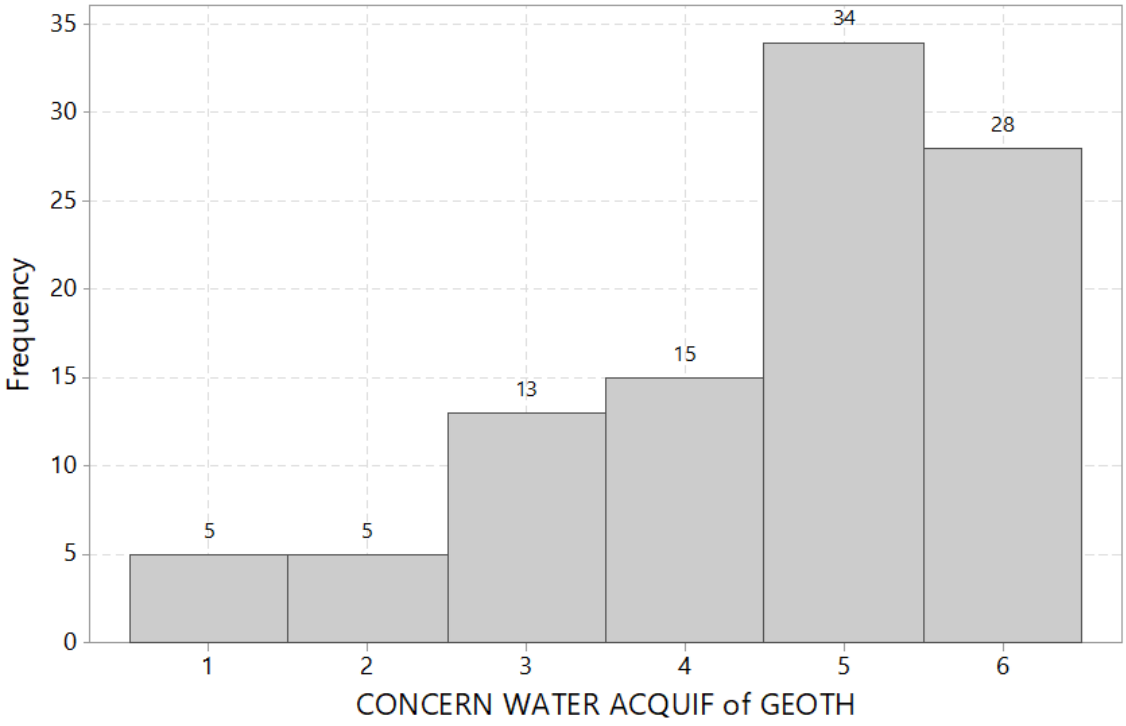

Figure B.145. How concerned would you be about water aquifer-related risks of geothermal drilling?

On how concerned responses were about the legal transparency of geothermal drilling, Figure B.146 shows that rankings were more or less normally distributed along their range, with more values being equal to 3 or bigger.

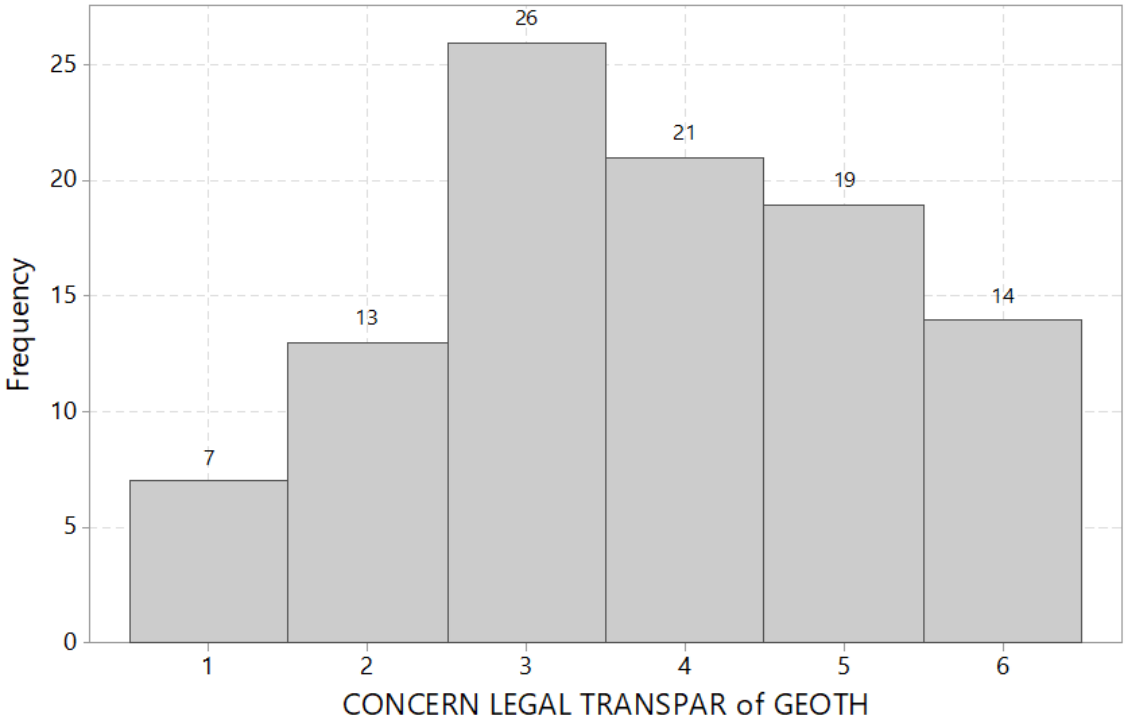

Figure B.146. How concerned would you be about legal transparency of geothermal drilling?

Figure B.147 shows that respondents (very) receptive to geothermal drilling in their area, if monitoring offering safety assurance was provided.

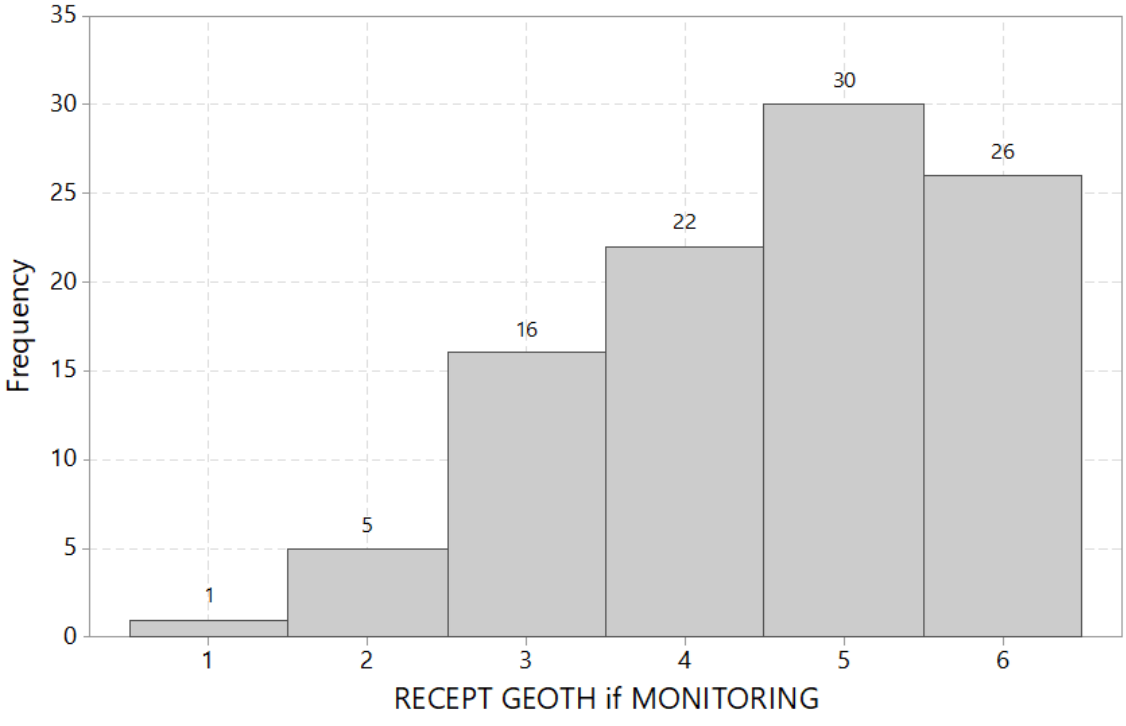

Figure B.147. How receptive would you be to geothermal drilling in your area if monitoring offering safety assurance was provided?

Figure B.148 also shows that respondents were (very) receptive to geothermal drilling in their area, if electricity cost reductions occurred.

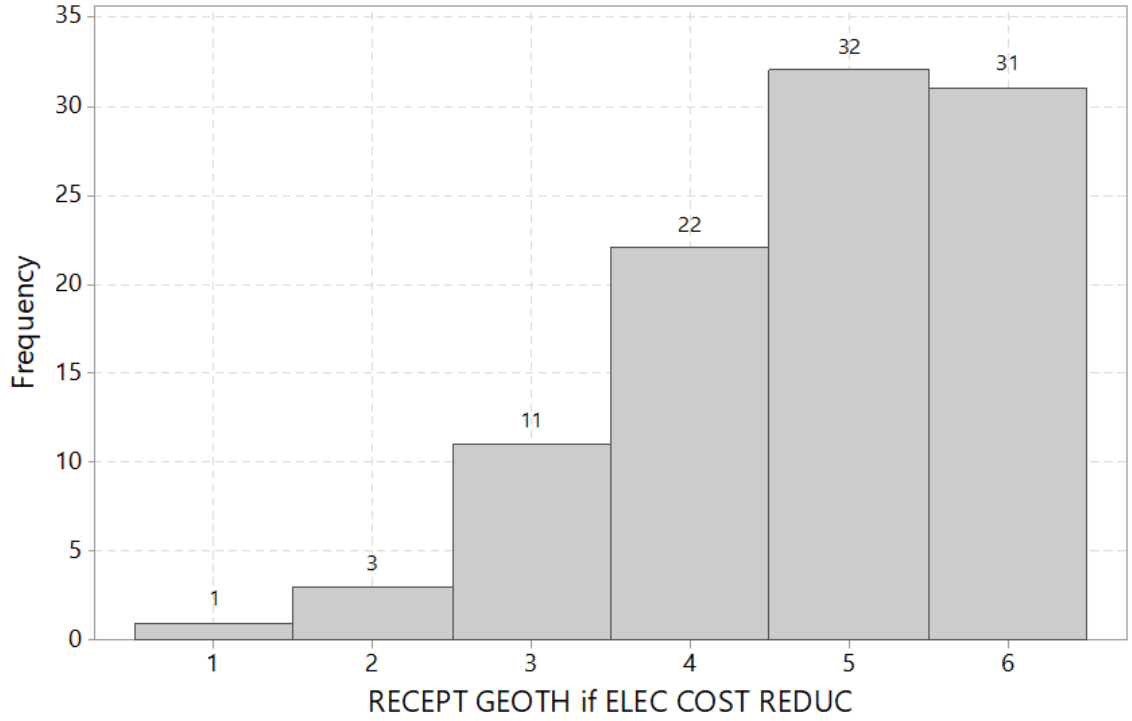

Figure B.148. How receptive would you be to geothermal drilling in your area if electricity cost reductions occurred?

Figure B.149 shows that respondents would be receptive to geothermal drilling in their area, if an increase in employment occured.

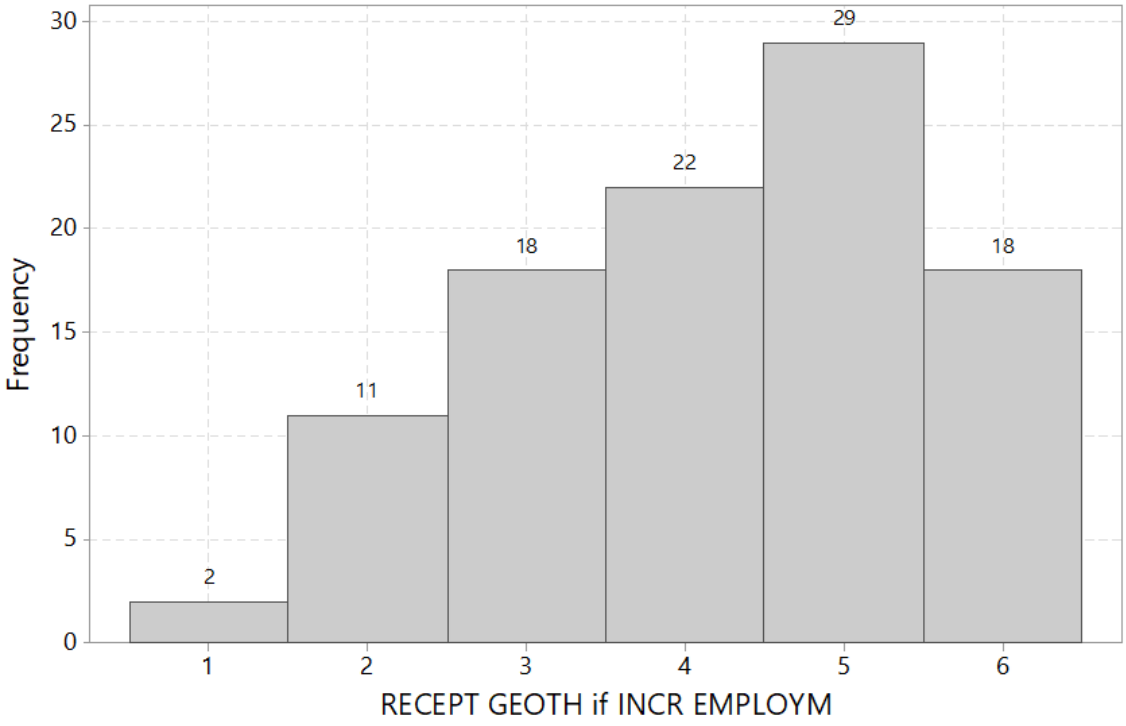

Figure B.149. How receptive would you be to geothermal drilling in your area if an increase in employment occured?

Respondents felt they were receptive to an average degree to geothermal drilling in their area, if control by public institutions took place (Figures 4.150) or compensation for local residents were offered (Figures 4.151).

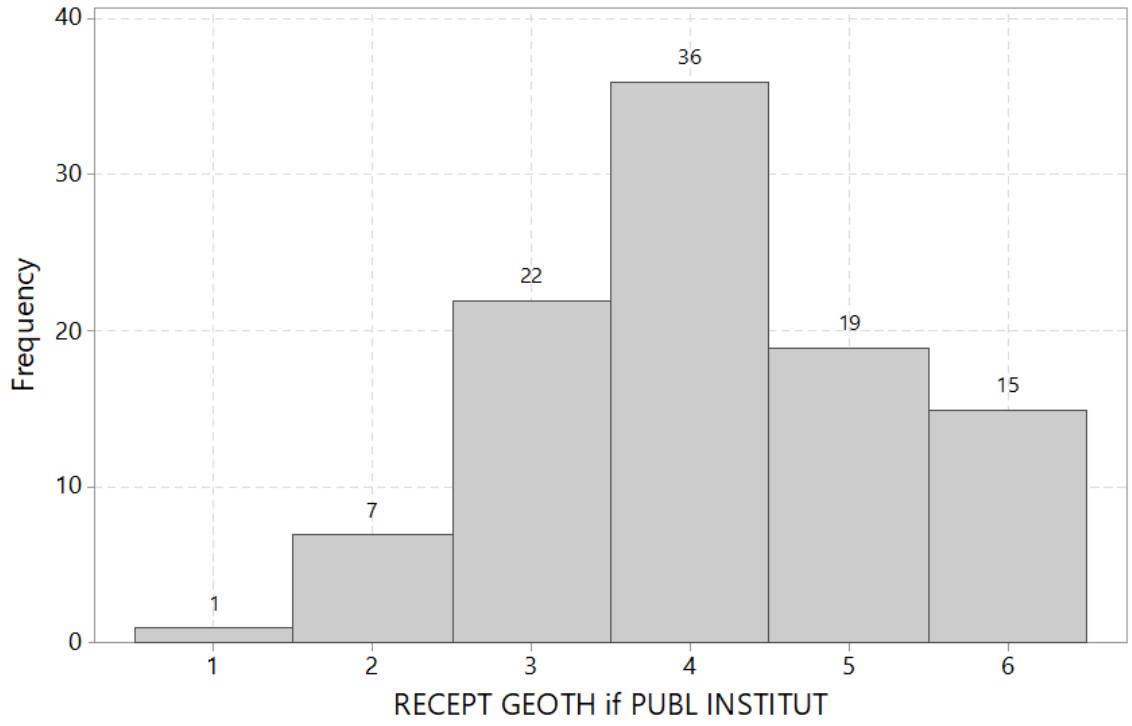

Figure B.150. How receptive would you be to geothermal drilling in your area if control by public institutions took place?

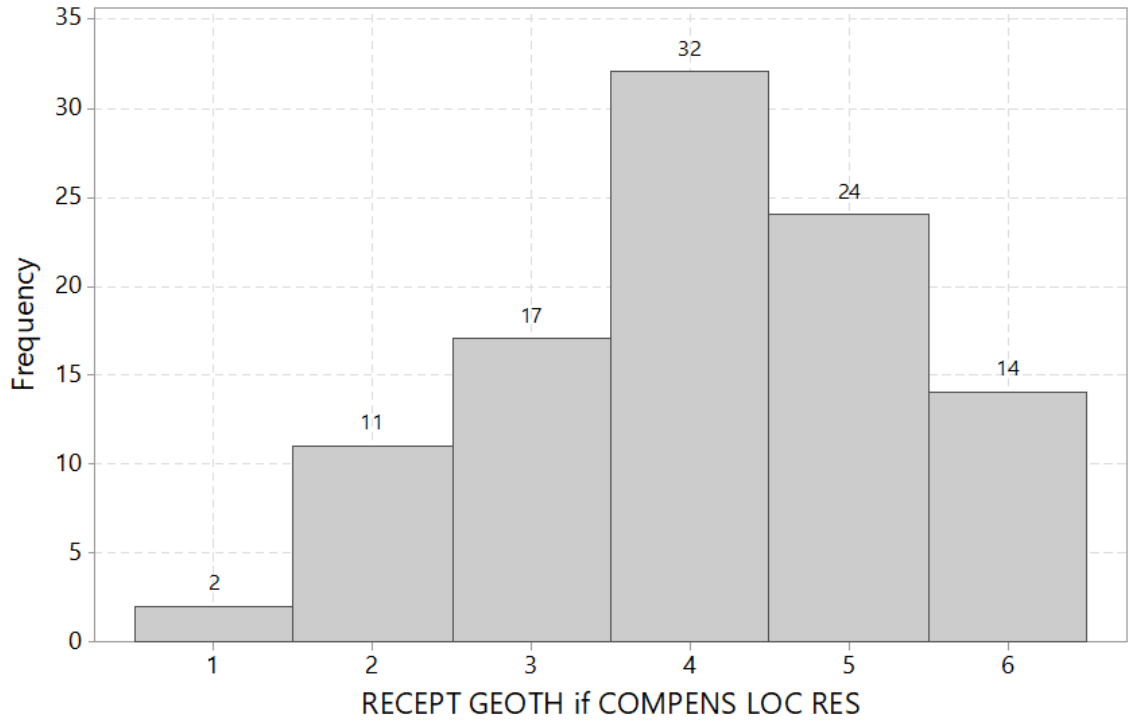

Figure B.151. How receptive would you be to geothermal drilling in your area if compensation for local residents were offered?

Figure B.152 shows that respondents felt that groundwater contamination contributed significantly to public concern about deep geothermal drilling in their region.

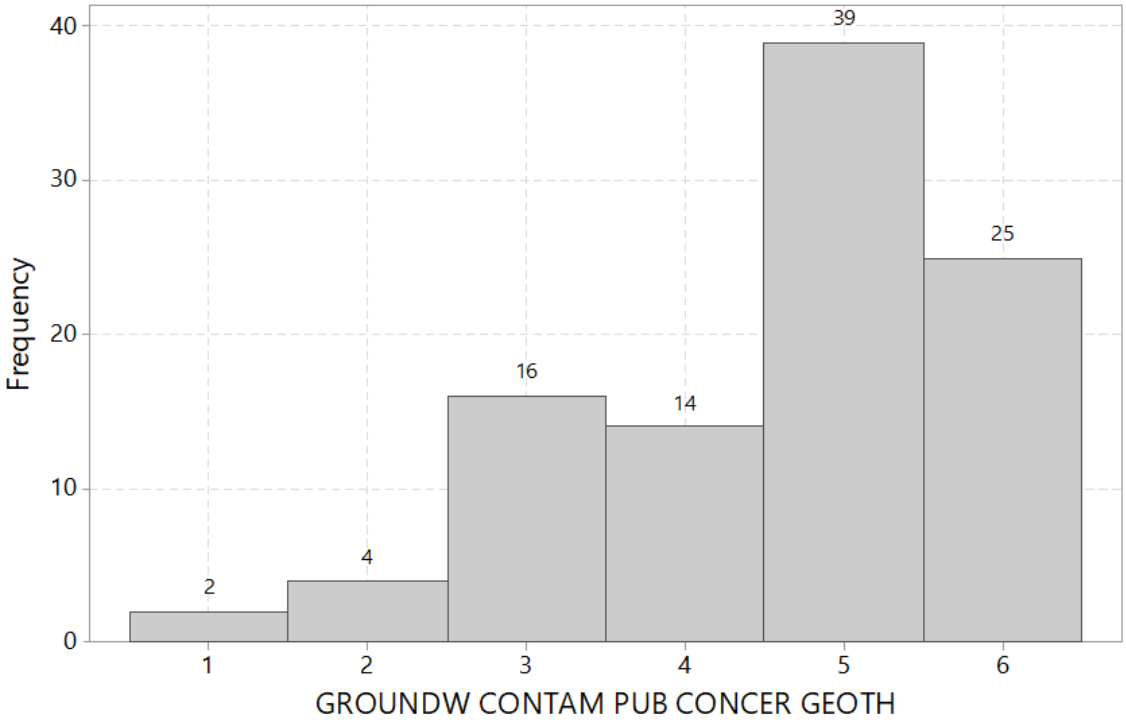

Figure B.152. How much does groundwater contamination, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.153 shows that respondents felt that soil contamination contributed to public concern about deep geothermal drilling in their region, with most rankings (91 out of 100) being distributed from 3 to 6.

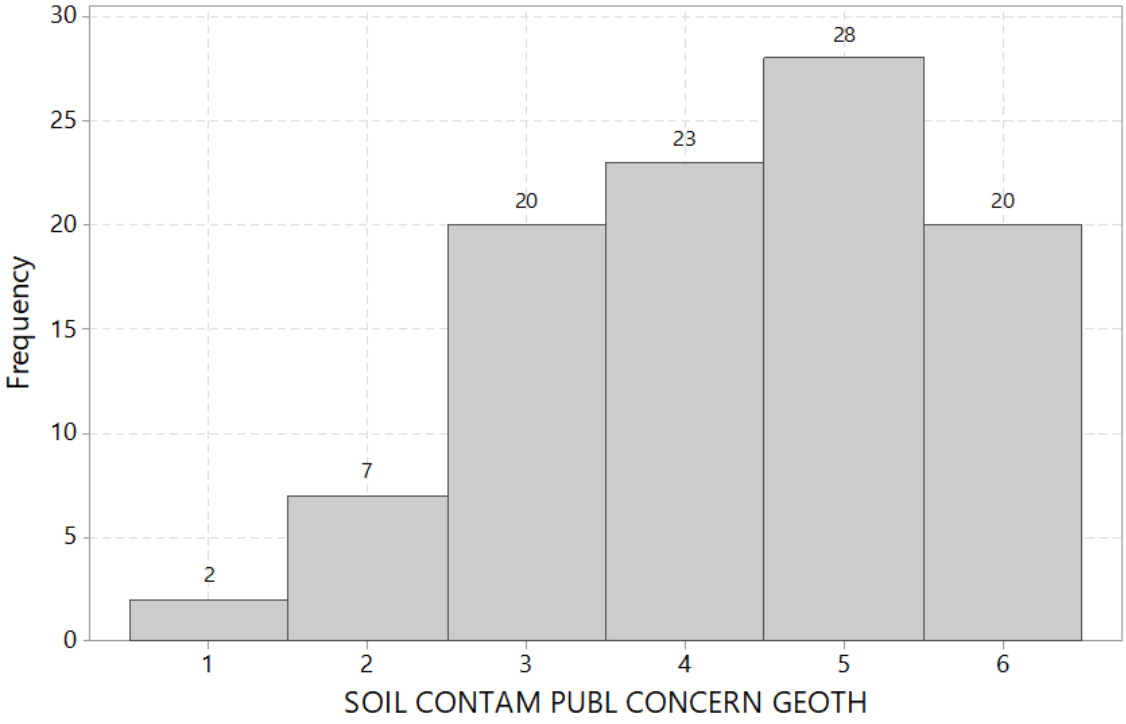

Figure B.153. How much does soil contamination, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.154 shows that respondents felt that radioactive wastes contributed to a mediocre degree to public concern about deep geothermal drilling in their region, with rankings being distributed along all values and a bimodal distribution possibly hinting at the presence of two clusters in the sample.

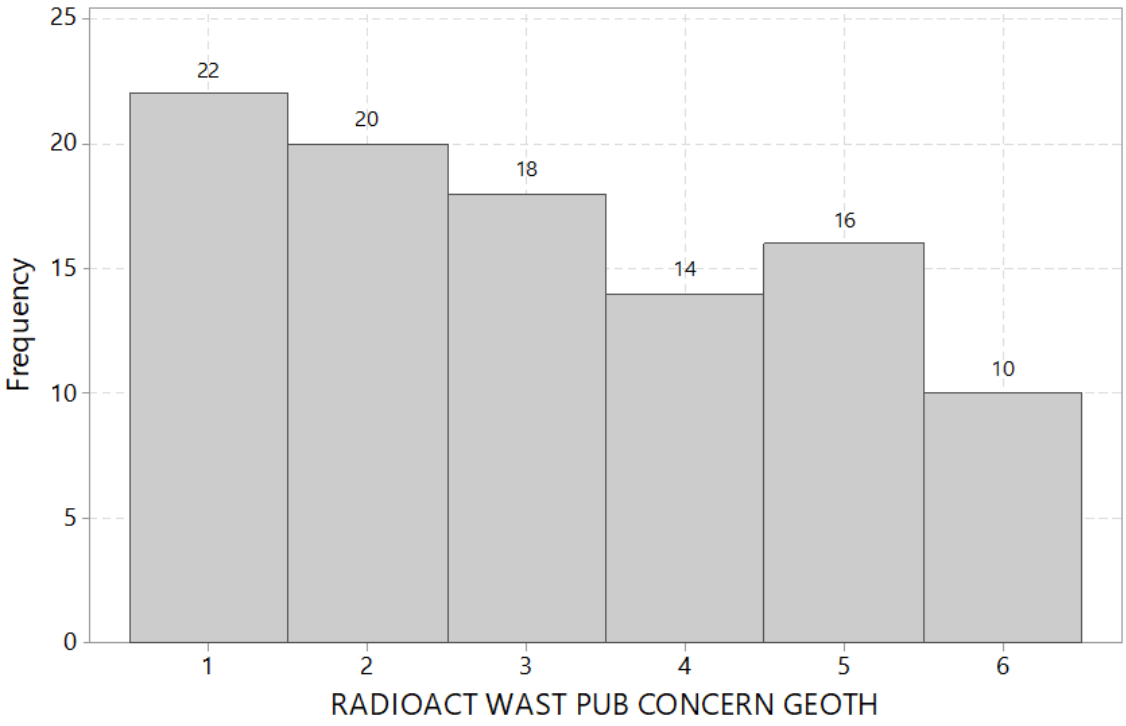

Figure B.154. How much do radioactive wastes, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.155 shows that respondents felt that induced (micro)seismicity contributed rather significantly to public concern about deep geothermal drilling in their region.

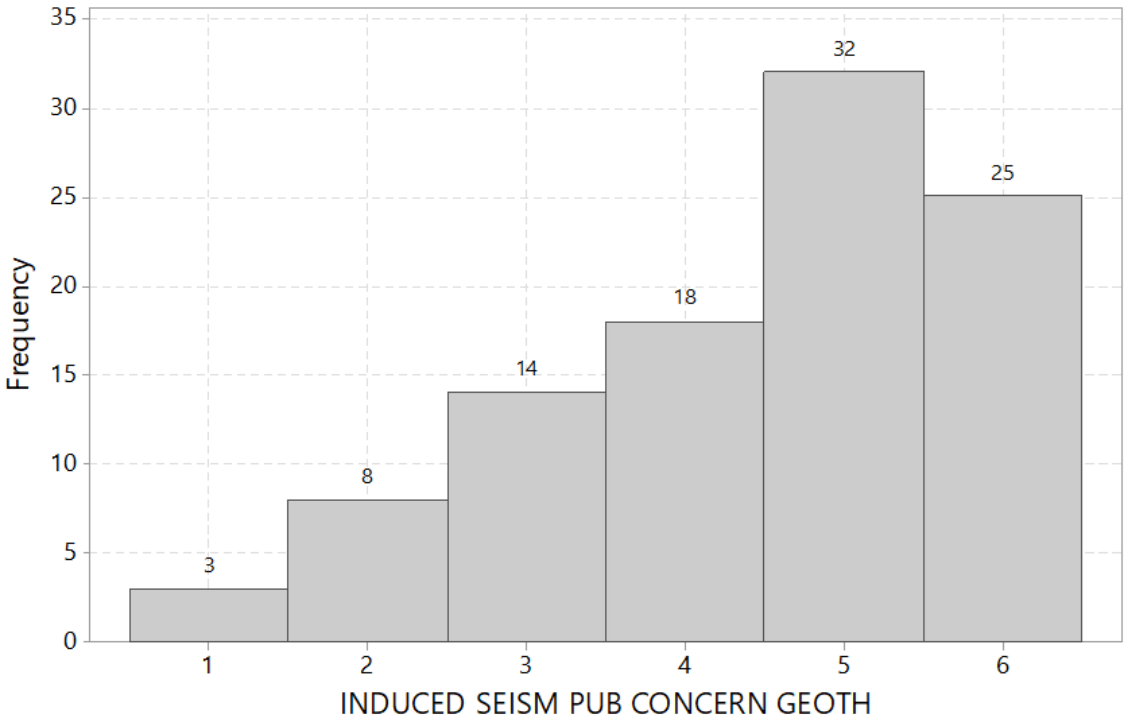

Figure B.155. How much does induced (micro)seismicity, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.156 shows that respondents felt that air pollution contributed to a mediocre degree to public concern about deep geothermal drilling in their region.

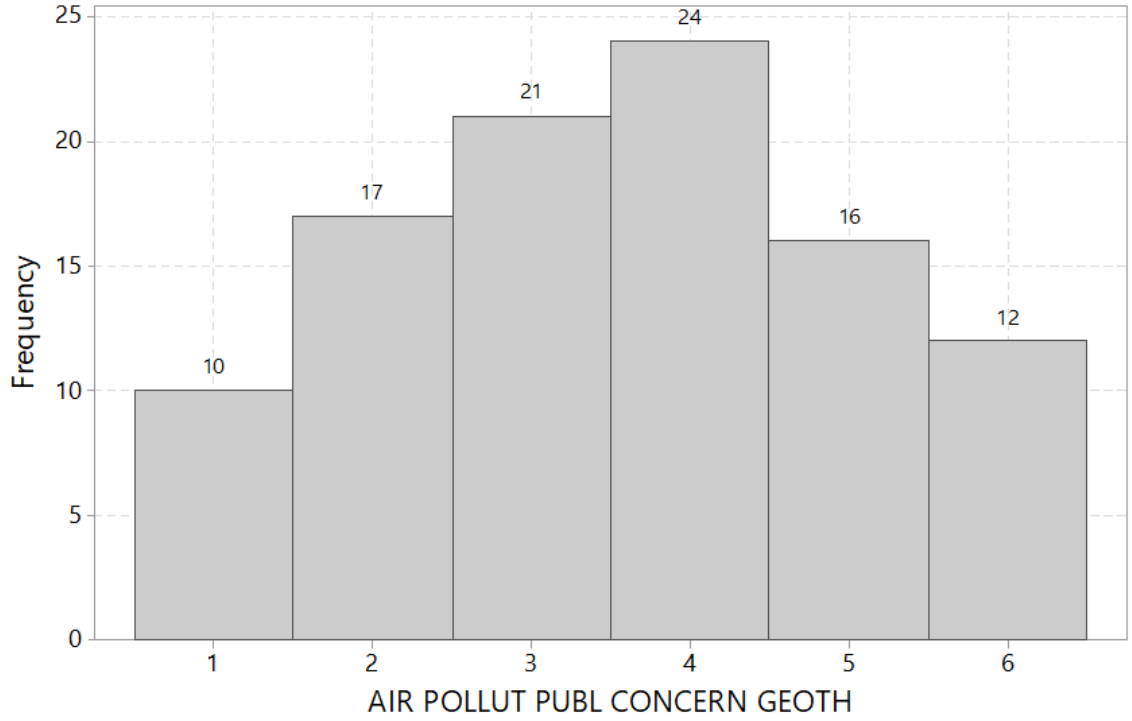

Figure B.156. How much does air pollution, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.157 shows that respondents felt that water use contributed rather significantly to public concern about deep geothermal drilling in their region.

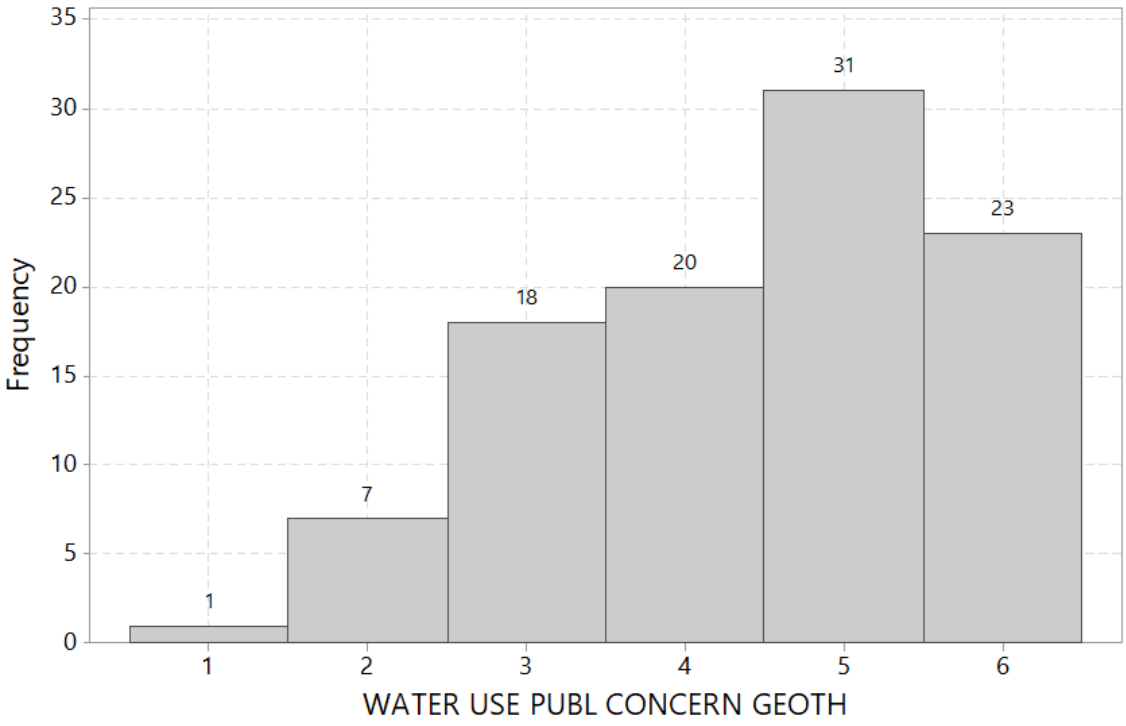

Figure B.157. How much does water use, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.158 shows respondent rankings on whether visual impacts contributed to public concern about deep geothermal drilling in their region, to be normally distributed with a mode equal to 4.

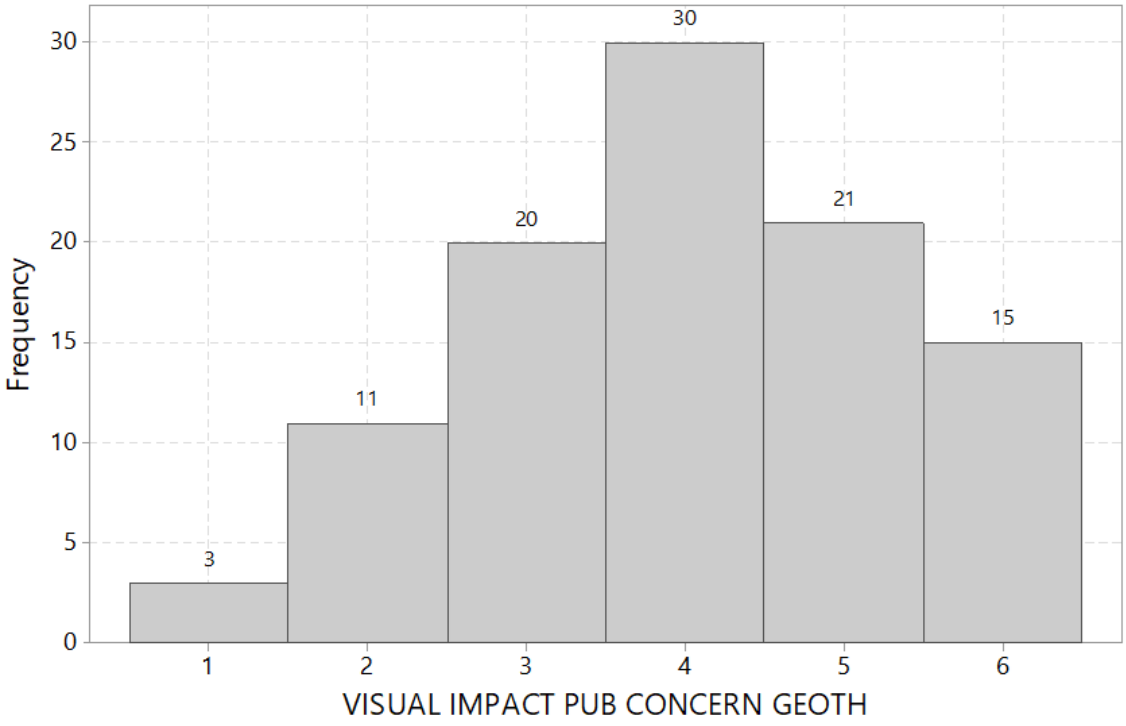

Figure B.158. How much do visual impacts, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Figure B.159 shows that respondents felt that noise contributed rather significantly to public concern about deep geothermal drilling in their region.

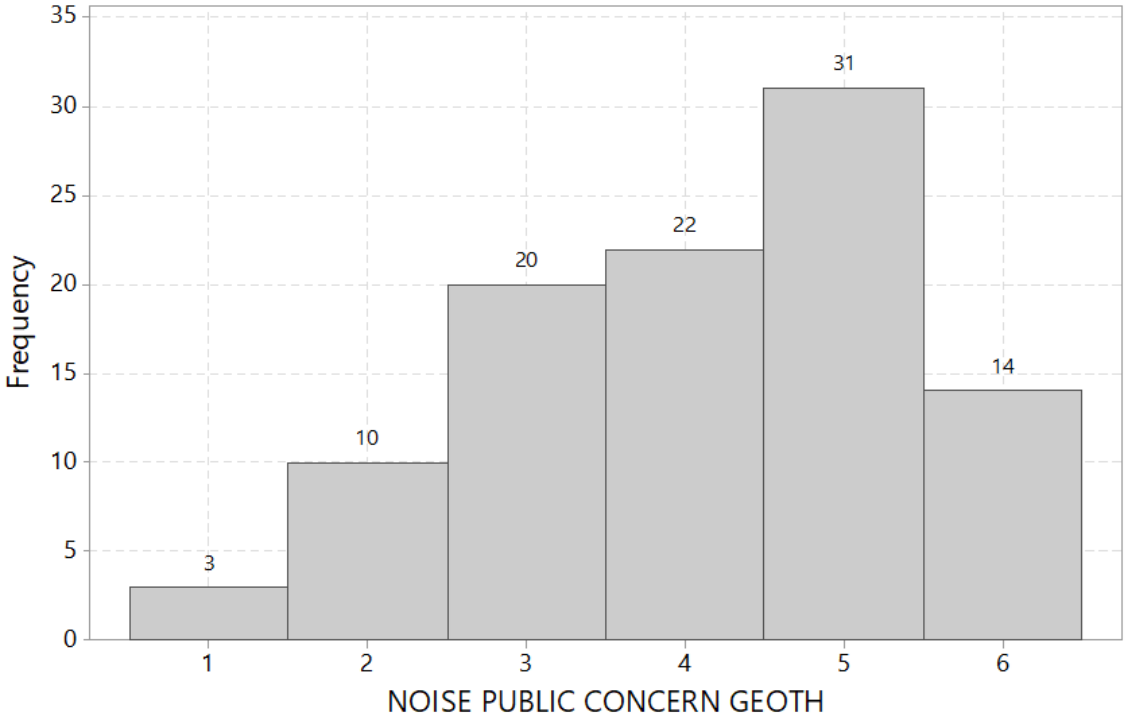

Figure B.159. How much does noise, in your opinion, contribute to public concern about deep geothermal drilling in your region?

Turning to a barchart, Figure B.160 shows that about half of the respondents had not experienced an earthquake in their area of residence.

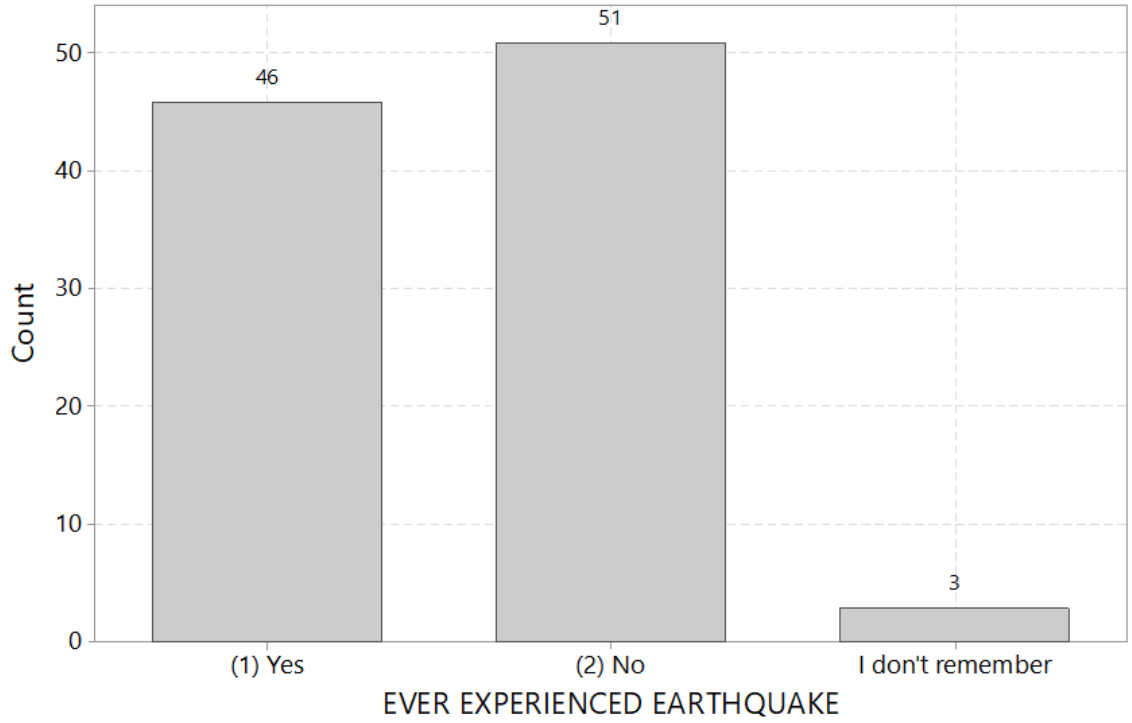

Figure B.160. Have you ever experienced an earthquake in the area of your residence?

The 47 respondents that had experienced an earthquake, Figure B.161 shows that they considered the experience to be somewhat unpleasant, although there are ratings all over the range of values.

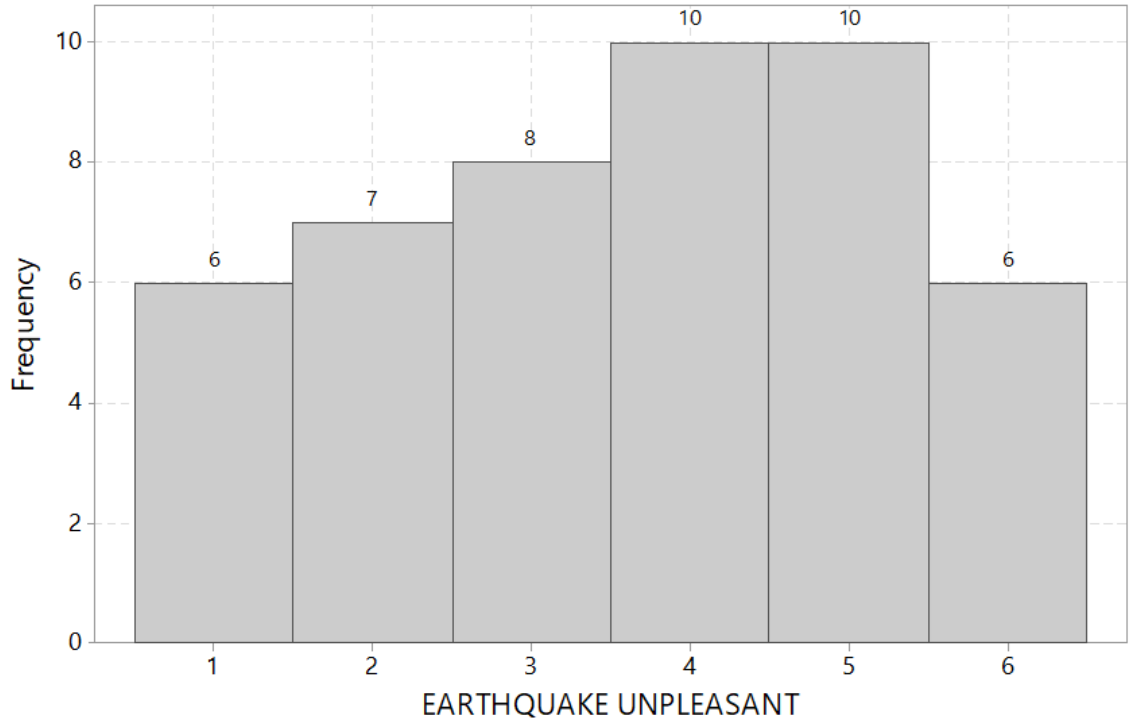

Figure B.161. If you have experienced an earthquake, how unpleasant was your experience?

The barchart of Figure B.162 shows that almost half of the respondents thought that their area was not prone to natural earthquakes - this is something that will be related to objective facts further along in this report.

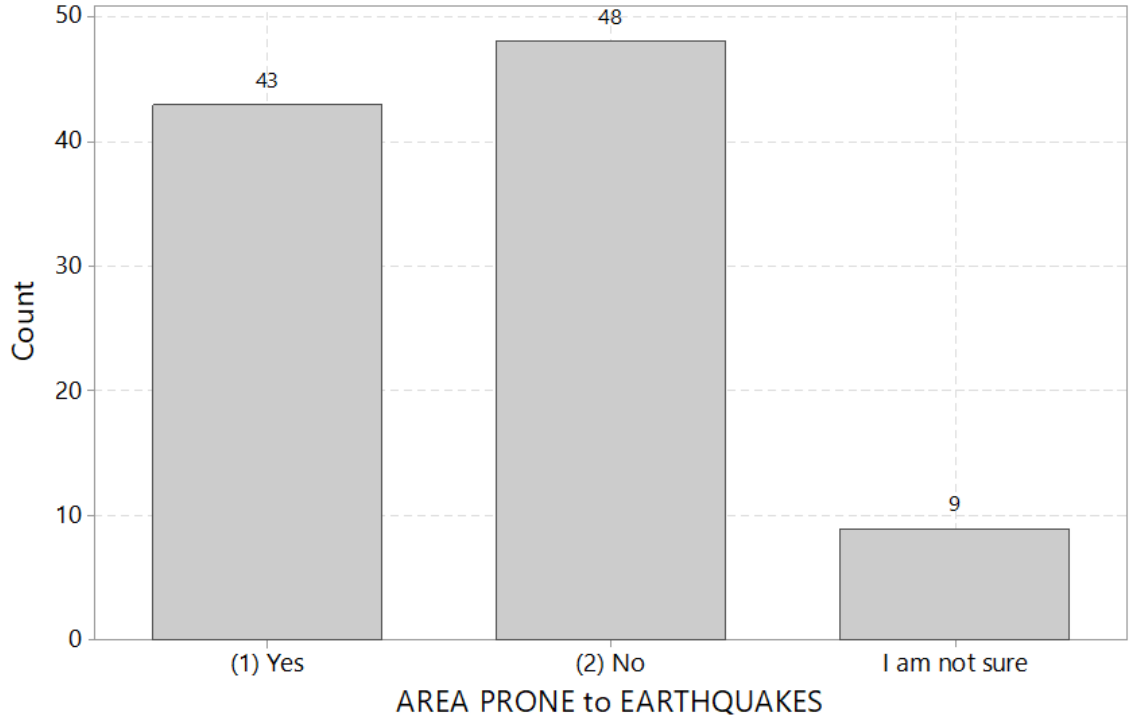

Figure B.162. Is your area prone to natural earthquakes?

Figure B.163 shows that respondents were somewhat split on whether the prospect of induced seismicity altered their perspective on geothermal development in their area. While most thought that it did, providing ratings of 4 or more, a smaller group provided ratings around the value of 2, indicating the presence of two clusters in the sample.

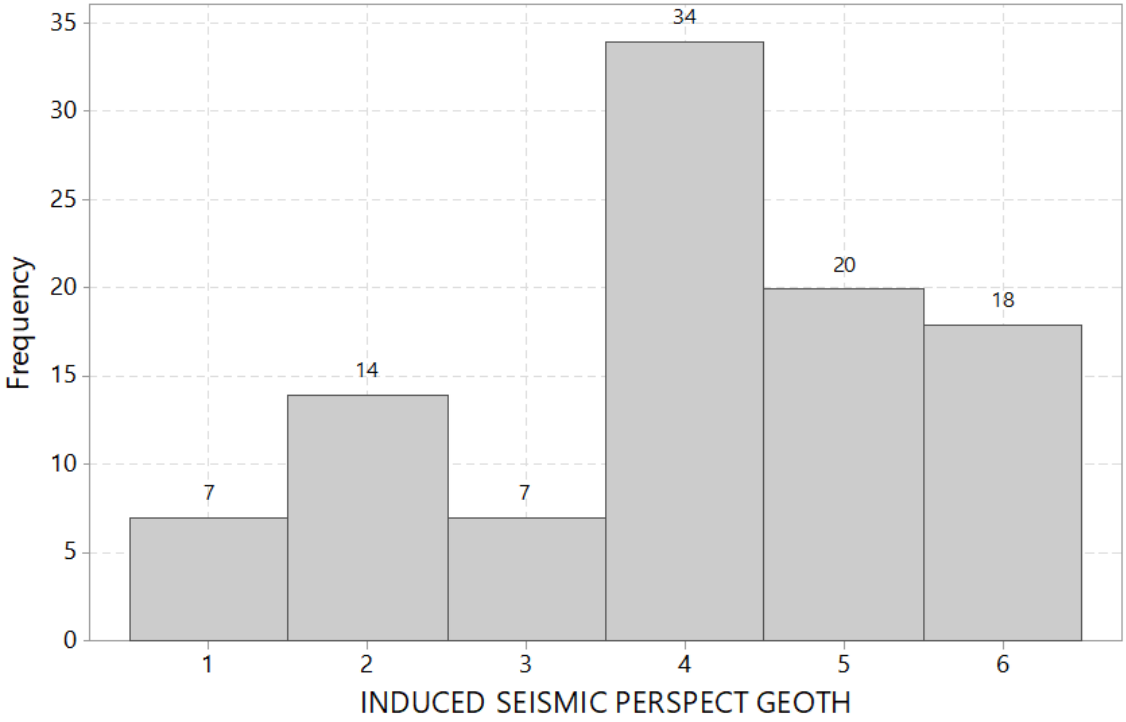

Figure B.163. How might the prospect of induced seismicity alter your perspective on geothermal development in your area?

The barchart of Figure B.164 shows that only 8 respondents would actively oppose geothermal drilling operations in their area.

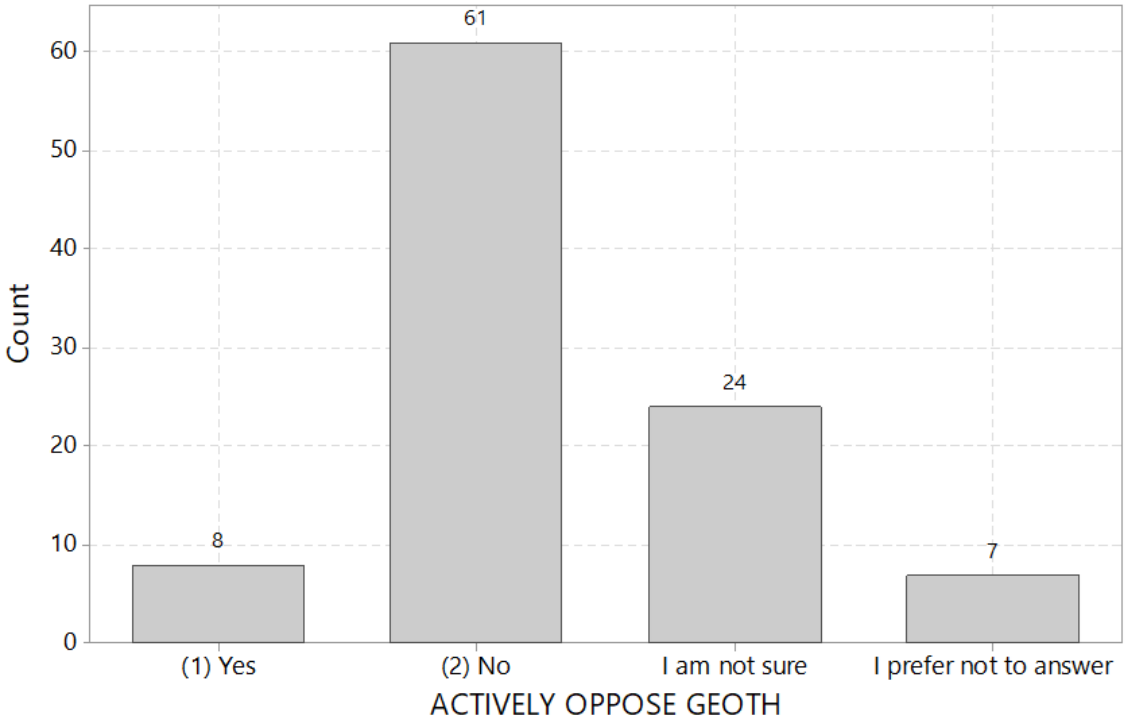

Figure B.164. Would you actively oppose geothermal drilling operations in your area?

B.5. Market acceptance variables (Section 5)

Turning to questions in the last section of the questionnaire on market acceptance, the barchart of Figure B.165 shows that about three fourth (74) of respondents were not aware or unsure of any public incentives or facilitating measures to assist consumers in making the transition to geothermal energy.

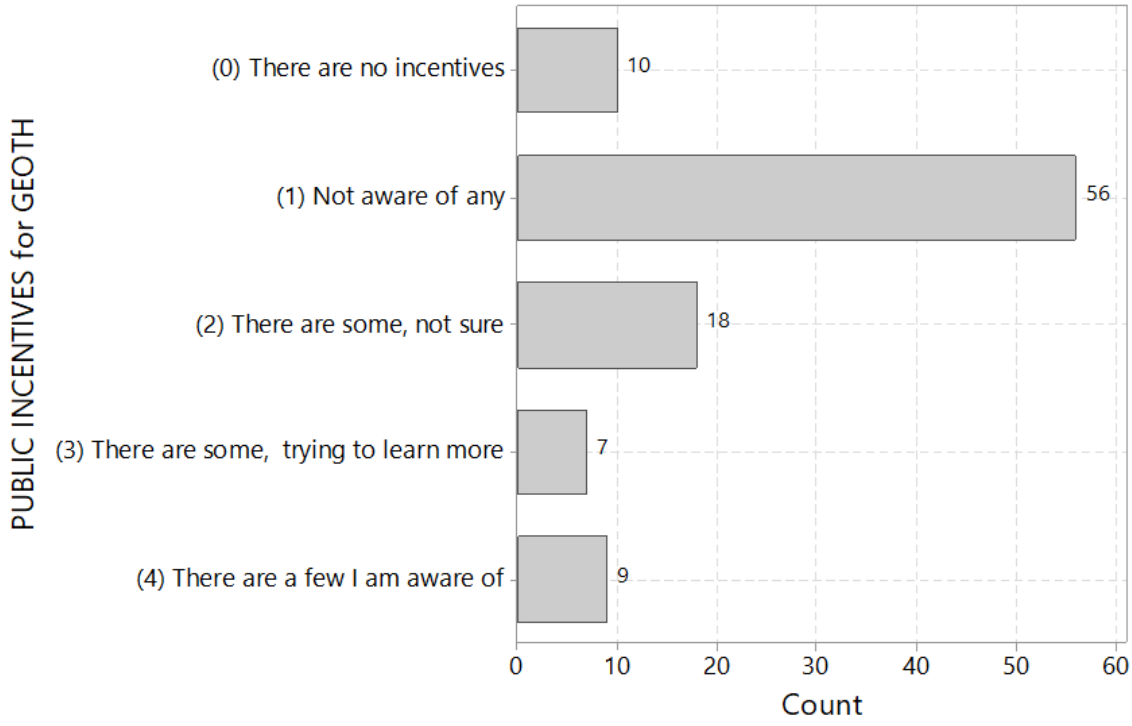

Figure B.165. Is your country offering any public incentives or facilitating measures to assist consumers in making the transition to geothermal energy?

Figure B.166 shows that respondents characterized negatively the quantity of incentives or facilitating measures available in their country to help customers transition to geothermal energy.

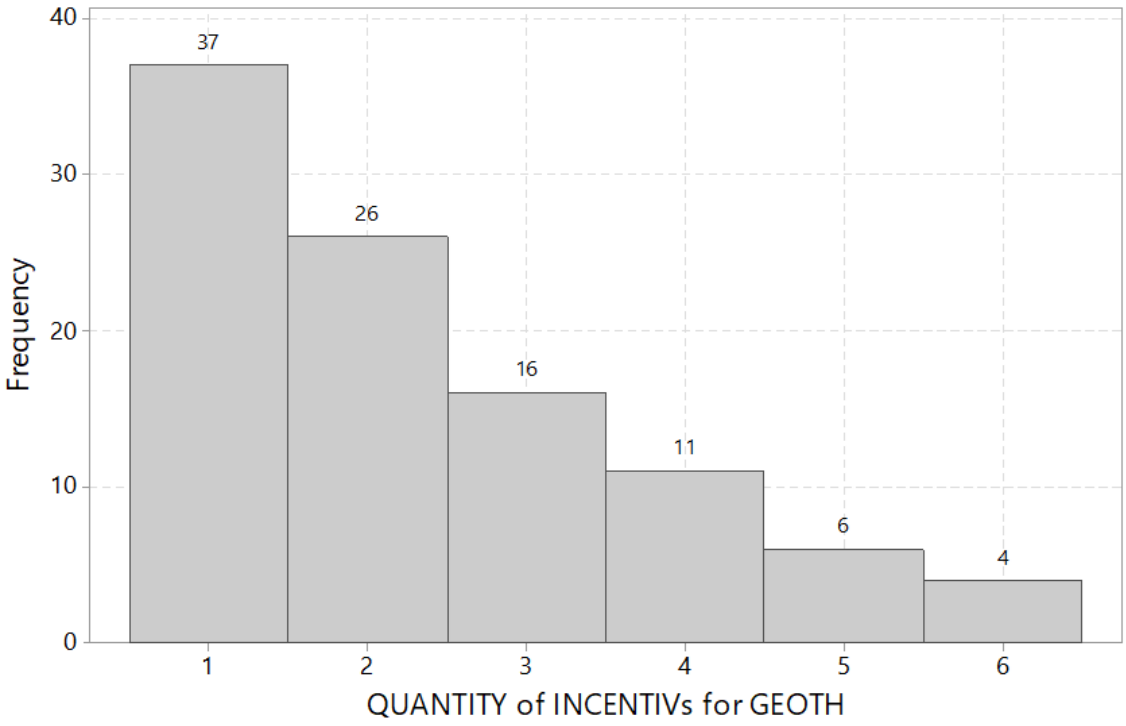

Figure B.166. How would you characterize the quantity of incentives or facilitating measures available in your country to help customers transition to geothermal energy?

Figure B.167 showed that respondents considered economic benefits very influential in helping them switch to a geothermal-only energy provider.

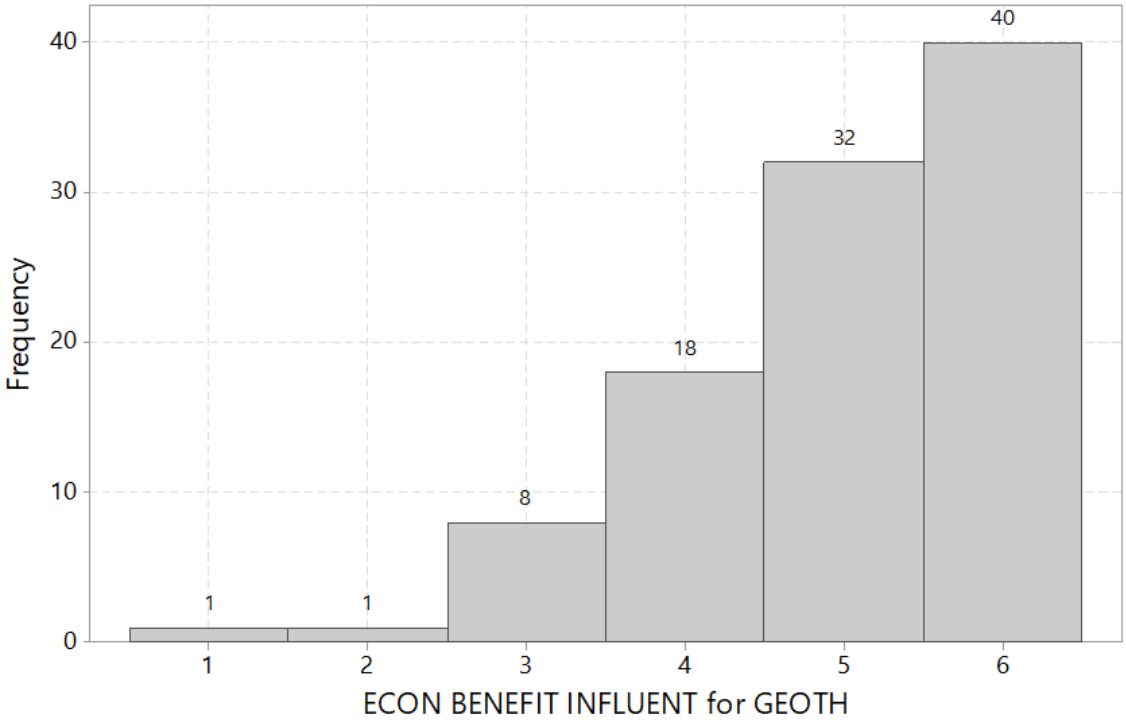

Figure B.167. How influential do you think economic benefits would be in switching to a geothermal-only energy provider?

On the other hand, respondents considered social benefits (Figures 4.168) and community awareness (Figure B.169) to have a mediocre influence in helping them switch to a geothermal-only energy provider.

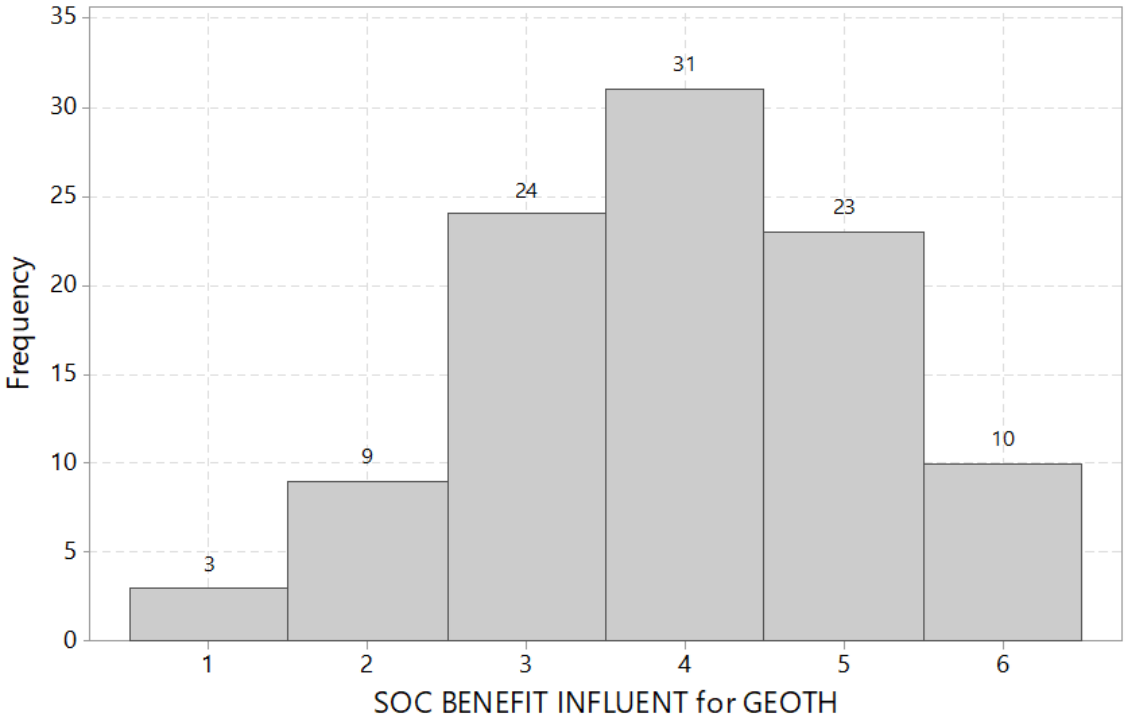

Figure B.168. How influential do you think social benefits would be in switching to a geothermal-only energy provider?

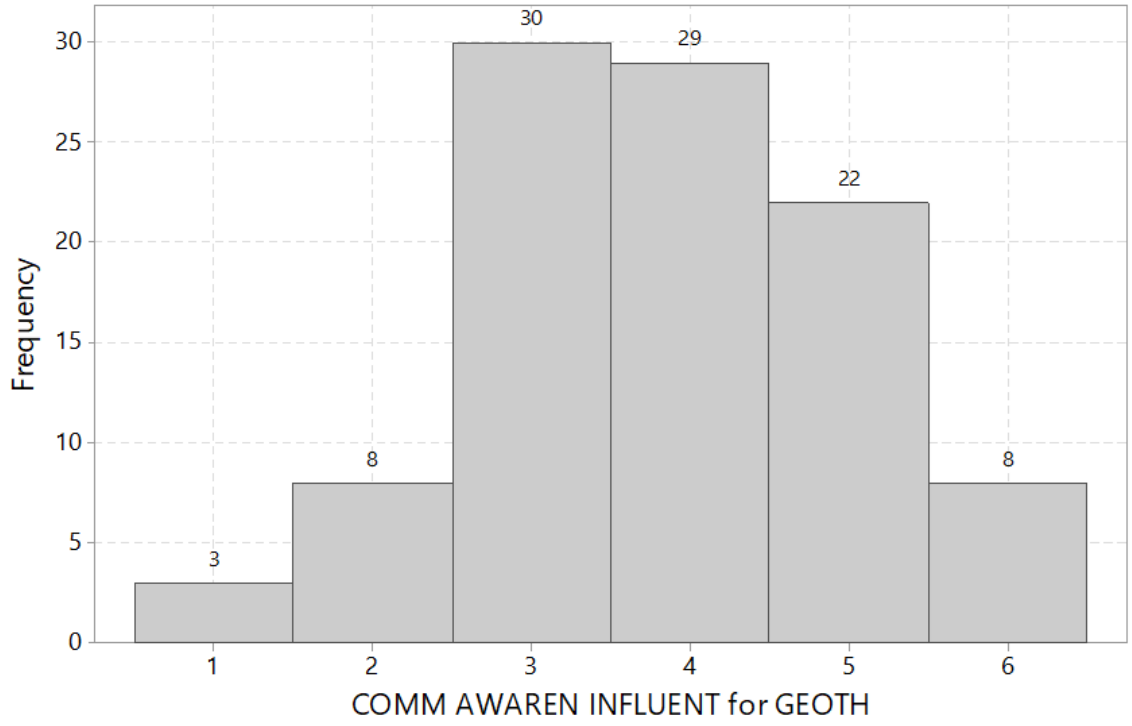

Figure B.169. How influential do you think community awareness would be in switching to a geothermal-only energy provider?

Figure B.170 shows that respondents considered environmental benefits to be quite important in helping them switch to a geothermal-only energy provider.

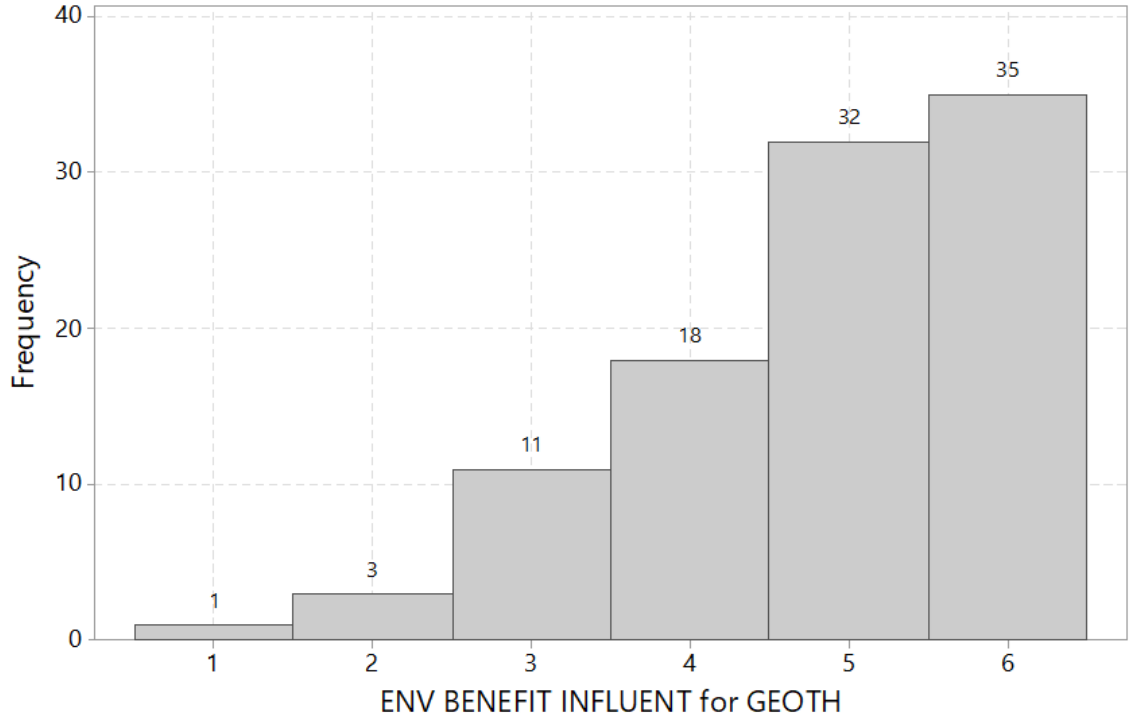

Figure B.170. How influential do you think environmental benefits would be in switching to a geothermal-only energy provider?

Finally, Figure B.171 shows that respondents considered the lower cost of geothermal energy (compared to traditional energy sources) to affect their overall attitude toward geothermal drilling significantly.

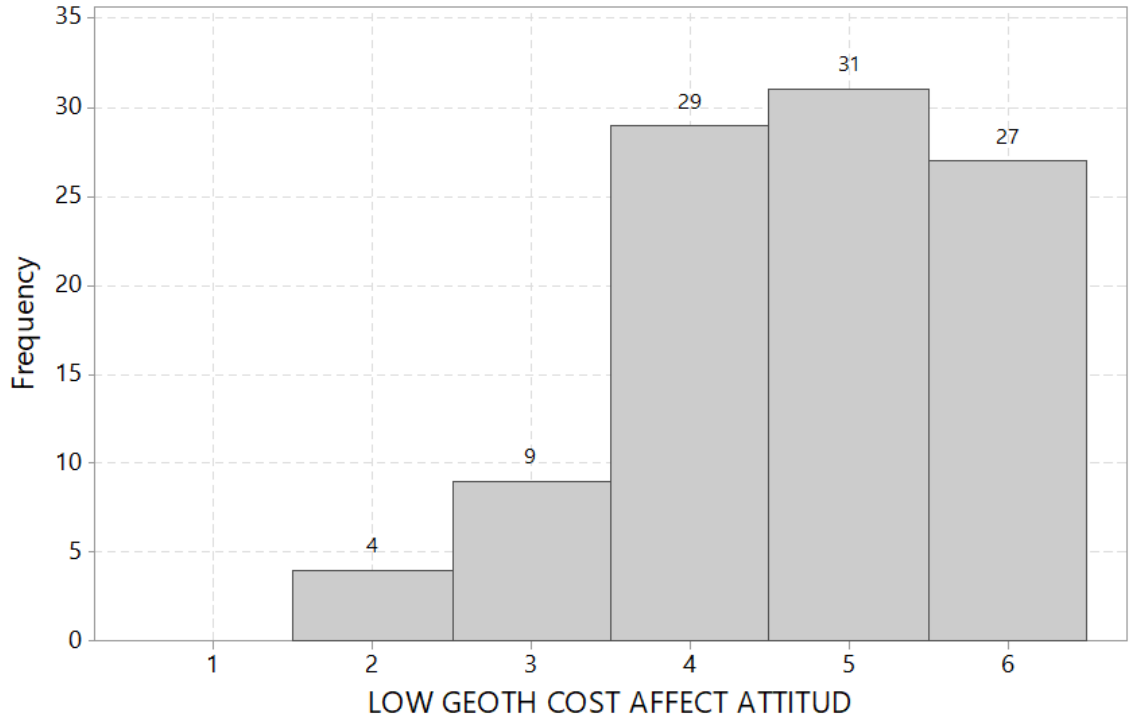

Figure B.171. How does the fact that geothermal energy costs less than traditional energy sources affect your overall attitude toward geothermal drilling?

APPENDIX C: Principal Component Analysis within subjective groups of ranking variables

This appendix presents details of PCA on the six variable groups that were mentioned in Section 4.3.4: dissemination (15 variables), economic (15), environmental (27), geopolitical (21), NIMBY (27), and public acceptance (38).

The variables included in each PC group, along with some basic statistics (mean and standard deviation), are displayed in the tables that follow, beginning with Table C.1, which lists the 15 ranking variables included in the dissemination group.

Table C.1. The 15 ranking variables in the dissemination group

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	How important do you consider the following actors in the energy selection process? Media (IMPORT SELECT MEDIA)	(3) Sociopolitical	100	3.66	1.584
2	How much do you trust the following sources? Print/broadcast and online media (TRUST MEDIA)	(3) Sociopolitical	100	2.52	1.243
3	How frequently do you hear about geothermal energy in the news in your country? (FREQ GEOTH NEWS)	(3) Sociopolitical	100	2.67	1.378
4	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Geothermal potential (DEBATE GEOTH POTENTIAL)	(3) Sociopolitical	100	2.89	1.399
5	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Economy (DEBATE GEOTH ECON)	(3) Sociopolitical	100	3.31	1.568
6	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Climate change (DEBATE GEOTH CLIM CHANGE)	(3) Sociopolitical	100	3.86	1.477
7	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Ecological security (DEBATE GEOTH ECOL SECUR)	(3) Sociopolitical	100	3.13	1.454
8	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? Energy security (DEBATE GEOTH ENER SECUR)	(3) Sociopolitical	100	3.33	1.531

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
9	In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? National security (DEBATE GEOTH NATION SECUR)	(3) Sociopolitical	100	2.89	1.614
10	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Print and broadcast media (TRUST PR&BR MEDIA SWITCH ENERG)	(4) Community acceptance	100	2.88	1.416
11	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Internet and social media (TRUST INTERN&SOC SWITCH ENERG)	(4) Community acceptance	100	2.73	1.362
12	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Energy suppliers (TRUST ENERG SUPPL SWITCH ENERG)	(4) Community acceptance	100	3.12	1.365
13	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Environmental associations (TRUST ENV ASSOC SWITCH ENERG)	(4) Community acceptance	100	3.68	1.413
14	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Academic/research journals and expert publications (TRUST JOURN&PUBL SWITCH ENERG)	(4) Community acceptance	100	4.81	1.269
15	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Friends and colleagues (TRUST FRIEND&COLL SWITCH ENERG)	(4) Community acceptance	100	3.75	1.298

There are no missing cases for any variable in the dissemination group, so they can all be used in statistical analyses without affecting the sample size (as cases with missing data are not taken into account listwise).

Table C.2 lists the 15 ranking variables in the economic group, including both micro and macro variables. Since there are only 79 nonmissing cases for the first variable (energy utility bill too high), it will not be used in subsequent statistical analyses.

Table C.2. The 15 ranking variables in the economic group
(amber highlight indicates variables with missing data)

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	Do you think your energy utility bill is too high? (ELEC BILL TOO HIGH)	(1) Background	79	4.24	1.313
2	In your opinion, how urgent are the following global issues? Economic crises and unemployment (URGENT ECON CRISES UNEMPL)	(3) Sociopolitical	100	4.27	1.024
3	How important do you think the following are? Energy price stability (IMPORT ENERGY PRICE STABILITY)	(3) Sociopolitical	100	4.76	1.084
4	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Jobs/employment (IMPORT GEOTH JOBS)	(3) Sociopolitical	100	4.21	1.192
5	How much would the following deter you from switching to a geothermal-only energy supply? Insufficient service maturity (INSUFF SERV MATUR DETER)	(4) Community acceptance	100	4.07	1.350
6	How much would the following deter you from switching to a geothermal-only energy supply? Hidden/unknown costs (HIDDEN COSTS DETER)	(4) Community acceptance	100	4.34	1.273
7	How much would the following deter you from switching to a geothermal-only energy supply? Inconvenience of switching (INCONVEN SWITCH DETER)	(4) Community acceptance	100	3.62	1.420
8	How much would the following deter you from switching to a geothermal-only energy supply? Issues of credibility, transparency, and trust (CREDIB TRANSPAR TRUST DETER)	(4) Community acceptance	100	4.13	1.346
9	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Reliability of energy supply (RELIAB CONVINC PURCH GEOTH)	(4) Community acceptance	100	4.99	1.049
10	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Economic benefits (ECON BENEF CONVINC PURCH GEOTH)	(4) Community acceptance	100	4.89	1.205

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
11	How receptive would you be to geothermal drilling in your area if the following were true? Electricity cost reductions (RECEPT GEOTH if ELEC COST REDUC)	(4) Community acceptance	100	4.74	1.160
12	How would you characterize the quantity of incentives or facilitating measures available in your country to help customers transition to geothermal energy? (QUANTITY of INCENTIVs for GEOTH)	(5) Market acceptance	100	2.35	1.431
13	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Economic benefits (ECON BENEFIT INFLUENT for GEOTH)	(5) Market acceptance	100	4.99	1.078
14	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Social benefits (SOC BENEFIT INFLUENT for GEOTH)	(5) Market acceptance	100	3.92	1.228
15	How does the fact that geothermal energy costs less than traditional energy sources affect your overall attitude toward geothermal drilling? (LOW GEOTH COST AFFECT ATTITUD)	(5) Market acceptance	100	4.68	1.091

Table C.3 lists the 27 ranking variables in the environmental group. Urgency of noise (number 11 in the table) has 3 missing cases (therefore 97 nonmissing cases), and will be omitted from further consideration. In addition, variables 19 and 21 both refer to the significance of the development of renewable energy and can therefore be used as an additional means of confirming the questionnaire's internal consistency.

Table C.3. The 27 ranking variables in the environmental group (amber highlight indicates variables with missing data)

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	How urgent, in your opinion, are the following environmental concerns? Decline of biodiversity (URGENT DECL BIODIVERS)	(2) Environmental	100	4.57	1.358
2	How urgent, in your opinion, are the following environmental concerns? River and seawater pollution (URGENT RIVER WATER POLLUTION)	(2) Environmental	100	4.79	1.225

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
3	How urgent, in your opinion, are the following environmental concerns? Air pollution (URGENT AIR POLLUTION)	(2) Environmental	100	4.72	1.326
4	How urgent, in your opinion, are the following environmental concerns? Acid rain (URGENT ACID RAIN)	(2) Environmental	100	3.84	1.398
5	How urgent, in your opinion, are the following environmental concerns? Soil pollution/contamination (URGENT SOIL CONTAMINATION)	(2) Environmental	100	4.34	1.281
6	How urgent, in your opinion, are the following environmental concerns? Waste disposal (1~6, URGENT WASTE DISPOSAL)	(2) Environmental	100	4.47	1.275
7	How urgent, in your opinion, are the following environmental concerns? Temperature increase (URGENT TEMP INCREASE)	(2) Environmental	100	4.59	1.609
8	How urgent, in your opinion, are the following environmental concerns? Extreme weather conditions (URGENT EXTREME WEATHER)	(2) Environmental	100	4.44	1.472
9	How urgent, in your opinion, are the following environmental concerns? Exploitation of natural resources (URGENT EXPLOIT NATURAL RESOURCE)	(2) Environmental	100	4.29	1.486
10	How urgent, in your opinion, are the following environmental concerns? Traffic congestion (URGENT TRAFFIC CONGESTION)	(2) Environmental	100	3.66	1.343
11	How urgent, in your opinion, are the following environmental concerns? Noise (URGENT NOISE)	(2) Environmental	97	3.53	1.234
12	In your opinion, how important is the total impact of the existing energy production model on the aforementioned environmental issues? (TOT ENV IMP of ENERGY PROD MOD)	(2) Environmental	100	4.92	1.002
13	In your opinion, how urgent are the following global issues? Climate change (URGENT CLIMATE CHANGE)	(3) Sociopolitical	100	4.84	1.522
14	In your opinion, how urgent are the following global issues? Water shortages (URGENT WATER SHORTAGES)	(3) Sociopolitical	100	4.89	1.230

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
15	How important do you think environmental regulations are in developing effective strategies for sustainable energy systems? (IMPORT ENV REGUL for SUST ENER)	(3) Sociopolitical	100	4.91	1.120
16	How important do you think the following are? Pollution reduction (IMPORT POLLUT REDUCT)	(3) Sociopolitical	100	4.92	1.041
17	How important do you think the following are? Mitigation of greenhouse gas emissions (IMPORT GHG MITIGATION)	(3) Sociopolitical	100	4.80	1.295
18	How important do you think the following are? Energy conservation (IMPORT ENERGY CONSERVATION)	(3) Sociopolitical	100	4.69	1.228
19	How important do you think the following are? Development of renewable energy (IMPORT DEVEL RENEW ENER_1)	(3) Sociopolitical	100	4.89	1.163
20	How important are the following issues to you? Energy efficiency (IMPORT ENERGY EFFIC)	(3) Sociopolitical	100	5.24	0.922
21	How important are the following issues to you? Development of renewable energy (IMPORT DEVEL RENEW ENER_2)	(3) Sociopolitical	100	4.93	1.249
22	How important are the following issues to you? Environmental impacts of energy systems (IMPORT ENV IMPACTS ENER SYST)	(3) Sociopolitical	100	5.06	1.118
23	How concerned would you be about the following aspects of geothermal drilling? Greenhouse gas emissions (CONCERN GHG EMISS of GEOTH)	(4) Community acceptance	100	3.37	1.739
24	How concerned would you be about the following aspects of geothermal drilling? Landscape impacts (CONCERN LANDSC IMPACTS of GEOTH)	(4) Community acceptance	100	3.57	1.506
25	How concerned would you be about the following aspects of geothermal drilling? Infrastructure impacts (CONCERN INFRAS IMPACTS of GEOTH)	(4) Community acceptance	100	3.47	1.432

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
26	How concerned would you be about the following aspects of geothermal drilling? Water aquifer-related risks (CONCERN WATER ACQUIF of GEOTH)	(4) Community acceptance	100	4.52	1.410
27	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Environmental benefits (ENV BENEFIT INFLUENT for GEOTH)	(5) Market acceptance	100	4.82	1.175

None of the 21 variables in the geopolitical group have missing cases, as shown in Table 4.15.

Table 4.15. The 21 ranking variables in the geopolitical group

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	In your opinion, how urgent are the following global issues? Food shortages and famine (URGENT FOOD SHORTAGES)	(3) Sociopolitical	100	4.80	1.172
2	In your opinion, how urgent are the following global issues? Pandemic crises and their impacts (URGENT PANDEMICS)	(3) Sociopolitical	100	4.19	1.300
3	In your opinion, how urgent are the following global issues? Poverty (URGENT POVERTY)	(3) Sociopolitical	100	4.42	1.257
4	In your opinion, how urgent are the following global issues? Terrorism (URGENT TERRORISM)	(3) Sociopolitical	100	3.84	1.354
5	How important do you think the following are? Energy accessibility (IMPORT ENERGY ACCESSIBILITY)	(3) Sociopolitical	100	4.86	1.025
6	How important do you consider the following actors in the energy selection process? European Union (IMPORT SELECT EU)	(3) Sociopolitical	100	4.55	1.359
7	How important do you consider the following actors in the energy selection process? National governments (IMPORT SELECT NATION GOV)	(3) Sociopolitical	100	4.88	1.233
8	How important do you consider the following actors in the energy selection process? Local authorities (IMPORT SELECT LOCAL AUTH)	(3) Sociopolitical	100	4.20	1.497

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
9	How important do you consider the following actors in the energy selection process? Energy companies (IMPORT SELECT ENER COMPAN)	(3) Sociopolitical	100	4.07	1.444
10	How much do you trust the following sources? European Union (TRUST EU)	(3) Sociopolitical	100	3.75	1.520
11	How much do you trust the following sources? National governments (TRUST NATIONAL GOV)	(3) Sociopolitical	100	3.66	1.327
12	How much do you trust the following sources? Regional/local governments (TRUST REGIONAL)	(3) Sociopolitical	100	3.64	1.150
13	How much do you trust the following sources? Energy companies (TRUST ENERGY COMP)	(3) Sociopolitical	100	2.95	1.274
14	How much do you trust the following sources? Non-Governmental Organizations (NGOs) (TRUST NGOs)	(3) Sociopolitical	100	3.10	1.367
15	How important are the following issues to you? Energy independence (IMPORT ENERGY INDEPEND)	(3) Sociopolitical	100	5.09	0.986
16	How important are the following issues to you? Energy affordability (IMPORT ENERGY AFFORD)	(3) Sociopolitical	100	4.81	1.012
17	How important are the following issues to you? Energy availability (IMPORT ENERGY AVAIL)	(3) Sociopolitical	100	5.10	0.859
18	How important are the following issues to you? Diversification of the energy supply (IMPORT DIVERS ENER SUPPL)	(3) Sociopolitical	100	4.80	1.198
19	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? National public administration (TRUST NAT PUB ADM SWITCH ENERG)	(4) Community acceptance	100	4.09	1.408
20	How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? Regional/local administration (TRUST REG LOC ADM SWITCH ENERG)	(4) Community acceptance	100	3.90	1.210

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
21	How concerned would you be about the following aspects of geothermal drilling? Legal transparency (CONCERN LEGAL TRANSPAR of GEOTH)	(4) Community acceptance	100	3.74	1.454

There are no missing cases for any of the NIMBY variables, listed in Table C.4.

Table C.4. The 27 ranking variables in the NIMBY group

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	How important are the following in involving local communities in geothermal energy exploration? Concerns about facility location (IMP LOCAL COMM FACIL LOCAT)	(4) Community acceptance	100	4.53	1.123
2	How concerned would you be about the following issues regarding geothermal drilling near your property? Environmental impacts (CONCERN ENV IMPACTS GEOTH DRILL)	(4) Community acceptance	100	4.67	1.450
3	How concerned would you be about the following issues regarding geothermal drilling near your property? Aesthetic issues (CONCERN AESTHET GEOTH DRILL)	(4) Community acceptance	100	3.62	1.503
4	How concerned would you be about the following issues regarding geothermal drilling near your property? Safety (CONCERN SAFETY GEOTH DRILL)	(4) Community acceptance	100	4.41	1.505
5	How concerned would you be about the following issues regarding geothermal drilling near your property? Public health (CONCERN PUBL HEALTH GEOTH DRILL)	(4) Community acceptance	100	4.50	1.580
6	How concerned would you be about the following issues regarding geothermal drilling near your property? Transparency (CONCERN TRANSPAR GEOTH DRILL)	(4) Community acceptance	100	4.16	1.412
7	How concerned would you be about the following issues regarding geothermal drilling near your property? Depreciation of property values (CONCERN DEPREC PROP GEOTH DRILL)	(4) Community acceptance	100	4.24	1.372
8	How concerned would you be if one of the following energy plants/installations were built in your area? Fossil fuel (CONCERN FOSSIL FUEL if BUILT)	(4) Community acceptance	100	4.87	1.361
9	How concerned would you be if one of the following energy plants/installations were built in your area? Nuclear (CONCERN NUCLEAR if BUILT)	(4) Community acceptance	100	4.26	1.703

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
10	How concerned would you be if one of the following energy plants/installations were built in your area? Hydropower (CONCERN HYDRO if BUILT)	(4) Community acceptance	100	3.01	1.567
11	How concerned would you be if one of the following energy plants/installations were built in your area? Wind (CONCERN WIND if BUILT)	(4) Community acceptance	100	3.26	1.727
12	How concerned would you be if one of the following energy plants/installations were built in your area? Solar panel (PVs) (CONCERN PVs if BUILT)	(4) Community acceptance	100	2.64	1.624
13	How concerned would you be if one of the following energy plants/installations were built in your area? Geothermal (CONCERN GEOTH if BUILT)	(4) Community acceptance	100	2.97	1.453
14	How concerned would you be if one of the following energy plants/installations were built in your area? Biomass (CONCERN BIOMASS if BUILT)	(4) Community acceptance	100	3.30	1.605
15	How receptive would you be to geothermal drilling in your area if the following were true? Monitoring offering safety assurance (RECEPT GEOTH if MONITORING)	(4) Community acceptance	100	4.53	1.235
16	How receptive would you be to geothermal drilling in your area if the following were true? Increase in employment (RECEPT GEOTH if INCR EMPLOYM)	(4) Community acceptance	100	4.19	1.339
17	How receptive would you be to geothermal drilling in your area if the following were true? Control by public institutions (RECEPT GEOTH if PUBL INSTITUT)	(4) Community acceptance	100	4.10	1.176
18	How receptive would you be to geothermal drilling in your area if the following were true? Compensation for local residents (RECEPT GEOTH if COMPENS LOC RES)	(4) Community acceptance	100	4.07	1.265
19	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Groundwater contamination (GROUNDW CONTAM PUB CONCER GEOTH)	(4) Community acceptance	100	4.59	1.248

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
20	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Soil contamination (SOIL CONTAM PUBL CONCERN GEOTH)	(4) Community acceptance	100	4.28	1.296
21	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Radioactive wastes (RADIOACT WAST PUB CONCERN GEOTH)	(4) Community acceptance	100	3.12	1.665
22	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Induced (micro)seismicity (INDUCED SEISM PUB CONCERN GEOTH)	(4) Community acceptance	100	4.43	1.373
23	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Air pollution (AIR POLLUT PUBL CONCERN GEOTH)	(4) Community acceptance	100	3.55	1.500
24	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Water use (WATER USE PUBL CONCERN GEOTH)	(4) Community acceptance	100	4.42	1.273
25	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Visual impacts (VISUAL IMPACT PUB CONCERN GEOTH)	(4) Community acceptance	100	4.00	1.318
26	How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? Noise (NOISE PUBLIC CONCERN GEOTH)	(4) Community acceptance	100	4.10	1.322
27	How might the prospect of induced seismicity alter your perspective on geothermal development in your area? (INDUCED SEISMIC PERSPECT GEOTH)	(4) Community acceptance	100	4.00	1.484

Table C.5 lists the remaining 38 variables in the public acceptance group. Some variables have missing cases and will not be used in subsequent analyses:

1. Four variables had 79 nonmissing cases: Significance of impact of coal on our way of life (7), significance of impact of oil on our way of life (8), significance of impact of

natural gas on our way of life (9), and significance of impact of nuclear on our way of life (16).

2. The “Community awareness important for acceptance and support of geothermal project” (24) variable had 88 nommissing cases.
3. Finally, the "unpleasantness of experiencing an earthquake" variable (37) contained only 47 nonmissing cases, as it was not included in the initial data collection.

Two other variables, familiarity with geothermal operations (1) and the “do you understand geothermal” variable (30) were conceptually related, and may be used as an additional means of confirming the questionnaire’s internal consistency.

Table C.5. The 38 ranking variables in the public acceptance group (amber highlight indicates variables with missing data)

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
1	How familiar are you with geothermal energy exploration and development (including drilling)? (FAMILIAR with GEOTHERMAL)	(1) Background	100	3.86	1.538
2	What is the significance of public acceptance of geothermal energy development, in your opinion? (SIGNIF of PUBL ACCEPT of GEOTH)	(1) Background	100	4.35	1.290
3	How much would air pollution affect your attitude toward geothermal development in your area? (AIR POLL AFFECT ATTITUDE GEOTH)	(2) Environmental	100	4.21	1.282
4	How much would noise pollution affect your perception of geothermal development in your community? (NOISE AFFECT PERCEPT GEOTH)	(2) Environmental	100	3.54	1.388
5	How much would aesthetic degradation and visual intrusion affect your attitude toward geothermal development in your area? (VISUAL AFFECT ATTITUDE GEOTH)	(2) Environmental	100	3.46	1.396
6	How much would degradation and/or depletion of water resources affect your attitude towards geothermal development in your area? (DEGR WATER AFFECT ATTITUD GEOTH)	(2) Environmental	100	4.55	1.184
7	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Coal (IMPACT COAL on WoL)	(3) Sociopolitical	79	3.35	1.687

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
8	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Oil (IMPACT OIL on WoL)	(3) Sociopolitical	79	4.25	1.255
9	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Natural gas (IMPACT NATURAL GAS on WoL)	(3) Sociopolitical	79	4.54	1.249
10	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Solar (IMPACT SOLAR on WoL)	(3) Sociopolitical	100	4.42	1.350
11	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Wind (IMPACT WIND on WoL)	(3) Sociopolitical	100	4.06	1.448
12	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Hydropower (IMPACT HYDRO on WoL)	(3) Sociopolitical	100	4.35	1.403
13	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Geothermal (IMPACT GEOTHERM on WoL)	(3) Sociopolitical	100	4.18	1.359
14	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Biomass/biofuels (IMPACT BIOMASS on WoL)	(3) Sociopolitical	100	3.73	1.355
15	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Hydrogen (IMPACT HYDROGEN on WoL)	(3) Sociopolitical	100	4.03	1.403
16	How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? Nuclear (IMPACT NUCLEAR on WoL)	(3) Sociopolitical	79	4.73	1.402
17	How important do you consider the following actors in the energy selection process? Scientists and researchers (IMPORT SELECT SCIENT RESEARCH)	(3) Sociopolitical	100	4.47	1.329

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
18	How important do you consider the following actors in the energy selection process? Non-Governmental Organizations (NGOs) (IMPORT SELECT NGOs)	(3) Sociopolitical	100	3.52	1.425
19	How important do you consider the following actors in the energy selection process? Environmental organizations (IMPORT SELECT ENV ORGs)	(3) Sociopolitical	100	3.76	1.372
20	How important do you consider the following actors in the energy selection process? Grassroot movements (IMPORT SELECT GRASSROOT)	(3) Sociopolitical	100	3.47	1.547
21	How important do you consider the following actors in the energy selection process? Individual citizens (IMPORT SELECT CITIZENS)	(3) Sociopolitical	100	3.35	1.714
22	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Public safety (IMPORT GEOTH PUBLIC SAFE)	(3) Sociopolitical	100	5.01	1.150
23	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Environmental protection (IMPORT GEOTH ENV PROTECT)	(3) Sociopolitical	100	5.03	1.087
24	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community awareness (IMPORT GEOTH COMMUN AWARE)	(3) Sociopolitical	88	4.42	1.238
25	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community consultation (IMPORT GEOTH COMMUN CONSULT)	(3) Sociopolitical	100	4.34	1.216
26	How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? Community compensation (IMPORT GEOTH COMMUN COMPENS)	(3) Sociopolitical	100	4.08	1.277

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
27	How do you feel about geothermal energy being used to generate electricity in your country? (FEEL GEOTH ELECTR)	(3) Sociopolitical	100	4.52	1.460
28	How do you feel about geothermal energy being used to generate heating in your country? (1~6, FEEL GEOTH HEAT)	(3) Sociopolitical	100	5.06	1.162
29	What is your opinion on developing a pilot geothermal energy project in your country, if (underground) hydraulic stimulation is required? (OPINION GEOTH HYDR STIM)	(3) Sociopolitical	100	4.33	1.557
30	Do you understand what geothermal energy is and how it works? (UNDERSTAND GEOTH)	(4) Community acceptance	100	4.68	1.222
31	How important are the following in involving local communities in geothermal energy exploration? Risks and benefits to society (IMP LOCAL COMM RISK BENEF SOC)	(4) Community acceptance	100	4.82	1.095
32	How important are the following in involving local communities in geothermal energy exploration? Environmental impacts (IMP LOCAL COMM ENV IMP)	(4) Community acceptance	100	4.98	1.101
33	How important are the following in involving local communities in geothermal energy exploration? Concerns about public health and safety (IMP LOCAL COMM PUBL HEALTH SAFE)	(4) Community acceptance	100	4.79	1.225
34	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Social benefits (SOC BENEF CONVINC PURCH GEOTH)	(4) Community acceptance	100	4.13	1.376
35	How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? Environmental benefits (ENV BENEFIT CONVINC PURCH GEOTH)	(4) Community acceptance	100	4.95	1.209
36	How concerned would you be about the following aspects of geothermal drilling? Induced (micro)seismicity (CONCERN INDUC SEISMIC of GEOTH)	(4) Community acceptance	100	3.98	1.531

	Question (and variable) description	*Section*	*N*	*Mean*	*Standard deviation*
37	If you have experienced an earthquake, how unpleasant was your experience? (EARTHQUAKE UNPLEASANT)	(4) Community acceptance	47	3.62	1.596
38	How influential do you think the following factors would be in switching to a geothermal-only energy provider? Community awareness (COMM AWAREN INFLUENT for GEOTH)	(5) Market acceptance	100	3.83	1.190

Turning to the results of the PC analyses within each of the six ranking groups, only the number of extracted PCs (with some statistics) is displayed. Component weights are not displayed because, as explained in the following section, PCA on all ranking variables was favored.

PCA for the dissemination group was run. There were 100 complete cases in the analysis, variable values were standardized, and a total of 4 PCs were extracted, as shown in Table C.6 (Scree plot not shown).

Table C.6. Principal Components extracted from the 15 variables of the dissemination group

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	5.25192	35.013	35.013
2	2.79815	18.654	53.667
3	1.34892	8.993	62.66
4	1.04252	6.950	69.61

Four PCs were extracted because, as shown in the table, 4 components had eigenvalues greater than or equal to 1. These 4 PCs accounted for 69.61% (just over two-thirds) of the original data's variability.

PCA for the economic group was run next. Again, a total of 100 complete cases were available for analysis, variable values were standardized, and 4 PCs were extracted, as shown in Table C.7.

Table C.7. Principal Components extracted from the 15 variables of the economic group

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	4.20516	30.037	30.037

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
2	1.7634	12.596	42.633
3	1.23676	8.834	51.467
4	1.21588	8.685	60.151

The 4 PCs that were extracted accounted for 60.151% of the variability of the original data.

PCA for the environmental group was run next. Again, there were 100 complete cases in the analysis, variable values were standardized, and 6 PCs were extracted, as shown in Table C.8.

Table C.8. Principal Components extracted from the 27 variables of the environmental group

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	10.7365	41.294	41.294
2	2.81464	10.826	52.120
3	2.2882	8.801	60.920
4	1.16861	4.495	65.415
5	1.09401	4.208	69.623
6	1.0505	4.040	73.663

The 6 PCs that were extracted accounted for 73.663% (almost three fourths) of the variability of the original data.

PCA for the geopolitical group was run next. Again, a total of 100 complete cases were available, variable values were standardized, and 6 PCs were extracted, as shown in Table C.9.

Table C.9. Principal Components extracted from the 21 variables of the geopolitical group

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	5.95625	28.363	28.363
2	2.66847	12.707	41.070
3	2.09044	9.954	51.025

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
4	1.31239	6.249	57.274
5	1.29094	6.147	63.421
6	1.12369	5.351	68.772

The 6 PCs that were extracted accounted for 68.772% (about two-thirds) of the variability of the original data.

PCA for the NIMBY group was run next. Again, a total of 100 complete cases were available, variable values were standardized, and 8 PCs were extracted, as shown in Table C.10.

Table C.10. Principal Components extracted from the 27 variables of the NIMBY group

Component Number	*Eigenvalue*	*Percent of Variance*	*Cumulative Percentage*
1	7.02068	26.003	26.003
2	3.2032	11.864	37.866
3	2.15513	7.982	45.848
4	2.08965	7.739	53.588
5	1.58175	5.858	59.446
6	1.30954	4.850	64.296
7	1.17176	4.340	68.636
8	1.02331	3.790	72.426

The 8 PCs that were extracted accounted for 72.426% of the variability in the original data.

Finally, PCA for the public acceptance group was run. As previously, a total of 100 complete cases were available, variables values were standardized, and 10 PCs were extracted, as shown in Table C.11.

Table C.11. Principal Components extracted from the 38 variables in the public acceptance group

Component	*Eigenvalue*	*% of Variance*	*Cumulative %*
1	8.2235	25.698	25.698

Component	*Eigenvalue*	*% of Variance*	*Cumulative %*
2	3.4837	10.887	36.585
3	2.34171	7.318	43.903
4	2.09944	6.561	50.464
5	1.68219	5.257	55.720
6	1.58109	4.941	60.661
7	1.31782	4.118	64.780
8	1.15806	3.619	68.398
9	1.09193	3.412	71.811
10	1.00961	3.155	74.966

The 10 PCs that were extracted accounted for 74.966% (three fourths) of the variability of the original data.

APPENDIX D: Two cluster solution

This section tabulates and discusses the two cluster solution.

In the following table, the appropriate independent samples t-test was selected (assuming equality of variances in most cases).

Table D.1. Cluster size and centroids or frequencies of variables (2 cluster solution) for cluster analysis on PCs from selected multimodal variables (with independent samples t-test red if significant at 95% confidence level; cells with a green highlight indicate the highest value of the centroid or other measure of the respective variable)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
N	41 (41%)	59 (59%)	
(1) Background information			
Male	22 (53.66%)	50 (84.75%)	
Age (years)	39.9	41.56	−0.622 (0.5356)
Country	France 15 (36.585%) Greece 10 (24.39%) Norway 4 (9.756%) UK 4 (9.756%) etc.	France 25 (42.373%) Greece 12 (30.339%) Norway 8 (13.559%) China 7 (11.864%) etc.	
Annual income (thousand euros)	45.88	46.11	−0.026 (0.9795)
Marital status	Married/with partner 22 (53.66%) Single 14 (34.15%) etc.	Married/with partner 35 (59.32%) Single 20 (33.9%) etc.	
Children	1	1.034	−0.147 (0.8835)
Education	University 15 (36.59%) Postgrad 8 (19.51%) PhD 8 (19.51%) Postdoc 6 (14.63%) etc.	PhD 20 (33.9%) University 16 (27.12%) Postdoc 12 (20.34%) Postgrad 10 (16.95%) etc.	
Experience (years)	14.09	16.02	−0.812 (0.4189)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Professional	Researcher 15 (36.6%) Private employee 9 (21.95%) Student 8 (19.5%) Faculty 7 (17.1%) etc.	Researcher 27 (46.55%) Faculty 14 (24.14%) Private employee 11 (18.97%) Student 6 (10.34%) Business executive 6 (10.34%) State employee 4 (6.9%) etc.	
Area characterization	Other urban 14 (34.15%) Suburban 10 (24.39%) Megacity 10 (24.39%) Rural 3 (7.32%) Densely populated 3 (7.32%) etc.	Other urban 22 (37.29%) Megacity 14 (40.68%) Rural 9 (15.25%) Suburban 6 (10.17%) Densely population 5 (8.47%) etc.	
Consumer type	Householder 26 (63.42%) Tenant 13 (31.7%) etc.	Householder 40 (67.8%) Tenant 15 (25.42%) etc.	
Familiarity with geothermal	3.707	3.966	−0.826 (0.4105)
Distance to geothermal exploration	Don't know 22 (56.41%) Over 50 km 12 (30.77%) 0-25 km 5 (12.82%)	Don't know 27 (47.37%) Over 50 km 12 (21.05%) 0-25 km 9 (15.79%) 25-50 km 8 (14.04%)	
Significance of public acceptance of geothermal	4.22	4.441	−0.842 (0.4019)
(2) Environmental concerns			
Urgency of decline of biodiversity	4.366	4.712	−1.257 (0.2117)
Urgency of river water pollution	4.537	4.966	−1.652 (0.1030)
Urgency of air pollution	4.366	4.996	−2.272 (0.0253)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Urgency of acid rain	3.317	4.203	−3.267 (0.0015)
Urgency of soil contamination	4.024	4.559	−2.089 (0.0393)
Urgency of waste disposal	4.293	4.593	−1.161 (0.2483)
Urgency of temperature increase	4.268	4.814	−1.682 (0.0957)
Urgency of extreme weather	4.244	4.576	−1.112 (0.2691)
Urgency of exploitation of natural resources	3.78	4.644	−2.969 (0.0038)
Urgency of traffic congestion	3.415	3.831	−1.534 (0.1283)
Urgency of noise	3.103	3.81	−2.872 (0.0050)
Total impact of energy production model on the environment	4.61	5.136	−2.433 (0.0180)
Air pollution affects attitude towards geothermal	4.049	4.322	−1.049 (0.2966)
Noise affects perception of geothermal	3.366	3.661	−1.046 (0.2981)
Aesthetic degradation/visual intrusion affects attitude towards geothermal	3.049	3.746	−2.522 (0.0133)
Degradation of water affects attitude towards geothermal	4.61	4.508	0.419 (0.6761)
(3) Sociopolitical issues			

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Urgency of climate change	4.537	5.051	−1.677 (0.0968)
Urgency of water shortages	4.634	5.068	−1.752 (0.0829)
Urgency of food shortages	4.488	5.017	−2.137 (0.0363)
Urgency of pandemics	3.659	4.559	−3.608 (0.0005)
Urgency of economic crises and unemployment	4.024	4.441	−2.032 (0.0449)
Urgency of poverty	3.805	4.847	−4.157 (0.0000)
Urgency of terrorism	3.78	3.881	−0.365 (0.7160)
Who should decide on geothermal exploration	Nation 30 (73.17%) Region 21 (51.22%) EU 17 (41.46%) Local communities 15 (36.59%) Suppliers 8 (19.51%) Environmental groups 7 (17.07%) Citizens 5 (12.2%) Producers 3 (7.32%)	Nation 41 (69.49%) Local communities 31 (52.54%) EU 31 (52.54%) Region 28 (47.46%) Citizens 18 (30.51%) Environmental groups 17 (28.81%) Producers 13 (22.03%) Suppliers 7 (11.86%)	
Are you aware of any recent initiatives to promote more sustainable energy generation and consumption?	Uncertain/Not sure 14 (70.73%) Unaware 9 (21.95%) Aware 3 (7.32%)	Uncertain/Not sure 45 (76.27%) Unaware 12 (20.34%) Aware 2 (3.39%)	
Importance of environmental regulations in developing effective strategies for sustainable energy	4.634	5.102	−1.929 (0.0583)
Importance of pollution reduction in developing effective strategies for sustainable energy	4.683	5.085	−1.817 (0.0737)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Importance of GHG mitigation	4.488	5.017	−1.930 (0.0578)
Importance of energy conservation	4.341	4.932	−2.283 (0.0256)
Importance of developing renewable energy (1)	4.634	5.068	−1.710 (0.0923)
Importance of energy accessibility	4.537	5.085	−2.713 (0.0079)
Importance of energy price stability	4.659	4.831	−0.779 (0.4378)
Impact of coal on way of life	3.188	3.468	−0.723 (0.4717)
Impact of oil on way of life	4.188	4.298	−0.381 (0.7039)
Impact of natural gas on way of life	4.438	4.617	−0.625 (0.5339)
Impact of solar on way of life	3.756	4.881	−4.152 (0.0001)
Impact of wind on way of life	3.366	4.542	−4.128 (0.0001)
Impact of hydro on way of life	4.073	4.542	−1.660 (0.1001)
Impact of geothermal on way of life	3.561	4.61	−4.088 (0.0001)
Impact of biomass on way of life	2.927	4.288	−5.665 (0.0000)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Impact of hydrogen on way of life	4.073	4.542	−2.726 (0.0076)
Impact of nuclear on way of life	4.813	4.681	0.407 (0.6849)
Importance of EU in energy selection	4.293	4.729	−1.591 (0.1148)
Importance of national governments in energy selection	4.634	5.051	−1.677 (0.0967)
Importance of local authorities in energy selection	3.585	4.627	−3.409 (0.0011)
Importance of energy companies in energy selection	3.561	4.424	−3.060 (0.0029)
Importance of scientists and researchers in energy selection	4.39	4.525	−0.471 (0.6397)
Importance of media in energy selection	2.61	4.39	−6.613 (0.0000)
Importance of NGOs in energy selection	2.585	4.169	−6.513 (0.0000)
Importance of environmental organizations in energy selection	2.927	4.339	−5.853 (0.0000)
Importance of grassroot organizations in energy selection	2.488	4.156	−6.219 (0.0000)
Importance of individual citizens in energy selection	2.317	4.068	−5.792 (0.0000)
Trust the EU	3.732	3.763	−0.01 (0.9207)
Trust national governments	3.659	3.661	−0.009 (0.9927)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Trust regional authorities	3.415	3.797	−1.566 (0.1218)
Trust energy companies	2.732	3.102	−1.436 (0.1543)
Trust NGOs	2.463	3.542	−4.195 (0.0001)
Trust the media	1.902	2.949	−4.532 (0.0000)
Importance of energy independence	5.171	5.034	0.681 (0.4975)
Importance of energy efficiency	5.171	5.288	−0.589 (0.5577)
Importance of energy affordability	4.683	4.898	−1.047 (0.2976)
Importance of energy availability	4.951	5.203	−1.351 (0.1814)
Importance of diversification of energy supply	4.585	4.949	−1.503 (0.1359)
Importance of developing renewable energy (2)	4.659	5.119	−1.700 (0.0941)
Importance of environmental impacts of energy systems	4.683	5.322	−2.692 (0.0092)
Public safety important for geothermal to be accepted and supported	4.732	5.203	−1.912 (0.0603)
Environmental protection important for geothermal to be accepted and supported	4.659	5.288	−2.759 (0.0075)
Jobs/employment important for geothermal to be accepted and supported	3.732	4.542	−3.535 (0.0006)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Community awareness important for geothermal to be accepted and supported	3.892	4.804	−3.458 (0.0010)
Community consultation important for geothermal to be accepted and supported	3.976	4.593	−2.431 (0.0177)
Community compensation important for geothermal to be accepted and supported	3.585	4.424	−3.397 (0.0010)
Frequence of hearing about geothermal in the news	2.146	3.034	−3.533 (0.0006)
Frequency of hearing the term geothermal potential in energy debates in the news	2.585	3.102	−1.837 (0.0693)
Frequency of hearing the term economy in energy debates in the news	3.146	3.424	−0.869 (0.3870)
Frequency of hearing the term climate change in energy debates in the news	4.049	3.729	1.066 (0.2890)
Frequency of hearing the term ecological security in energy debates in the news	3.122	3.136	−0.046 (0.9635)
Frequency of hearing the term energy security in energy debates in the news	3.146	3.458	−0.100 (0.3198)
Frequency of hearing the term national security in energy debates in the news	2.634	3.068	−1.327 (0.1877)
How do you feel about electricity generation from geothermal	4.195	4.746	−1.879 (0.0632)
How do you feel about heat generation from geothermal	4.902	5.169	−1.132 (0.2603)
Opinion on developing geothermal project if hydraulic stimulation is required	4.049	4.525	−1.515 (0.1330)
(4) Community acceptance			

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Understand geothermal and how it works	4.537	4.78	−0.910 (0.3664)
Facility location important in involving local communities in geothermal exploration	4.341	4.661	−1.330 (0.1881)
Risks and benefits to society important in involving local communities in geothermal exploration	4.61	4.966	−1.613 (0.1099)
Environmental impacts important in involving local communities in geothermal exploration	4.805	5.102	−1.331 (0.1862)
Public health and safety important in involving local communities in geothermal exploration	4.512	4.983	−1.815 (0.0739)
Insufficiently service maturity deters from switching to geothermal-only energy supply	3.805	4.254	−1.651 (0.1020)
Hidden/unknown costs deter from switching to geothermal-only energy supply	4.146	4.475	−1.208 (0.2310)
Inconvenience of switching deters from switching to geothermal-only energy supply	2.927	4.102	−4.438 (0.0000)
Credibility, transparency and trust deter from switching to geothermal-only energy supply	3.854	4.322	−1.729 (0.0870)
Concerned about environmental impacts of geothermal drilling near property	4.61	4.712	−0.345 (0.7310)
Concerned about aesthetics of geothermal drilling near property	3.244	3.881	−2.123 (0.0363)
Concerned about safety of geothermal drilling near property	4.22	4.542	−1.056 (0.2936)
Concerned about public health issues due to geothermal drilling near property	4.537	4.475	0.192 (0.8480)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Concerned about transparency of geothermal drilling near property	3.805	4.407	−2.134 (0.0354)
Concerned about depreciation of property values due to geothermal drilling near property	3.878	4.491	−2.244 (0.0271)
Reliability of energy supply convincing in purchasing energy from deep geothermal	4.878	5.068	−0.888 (0.3764)
Economic benefits convincing in purchasing energy from deep geothermal	4.61	5.085	−1.818 (0.0740)
Social benefits convincing in purchasing energy from deep geothermal	3.634	4.475	−3.136 (0.0023)
Environmental benefits convincing in purchasing energy from deep geothermal	4.659	5.153	−1.936 (0.0569)
Trust national/public administration to help decide about switching energy supplier	3.878	4.237	−1.259 (0.2111)
Trust regional/local administration to help decide about switching energy supplier	3.659	4.068	−1.678 (0.0965)
Trust print/broadcast media to help decide about switching energy supplier	2.098	3.424	−5.169 (0.0000)
Trust Internet/social media to help decide about switching energy supplier	2.049	3.203	−4.568 (0.0000)
Trust energy suppliers to help decide about switching energy supplier	2.854	3.305	−1.640 (0.1042)
Trust environmental associations to help decide about switching energy supplier	3.049	4.119	−3.764 (0.0004)
Trust research journals and expert publications to help decide about switching energy supplier	4.585	4.966	−1.393 (0.1684)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Trust friends and colleagues to help decide about switching energy supplier	3.488	3.932	−1.700 (0.0923)
Concerned if fossil fuel installations were built in the near area	4.707	4.983	−0.997 (0.3214)
Concerned if nuclear energy installations were built in the near area	3.512	4.78	−3.916 (0.0002)
Concerned if hydropower installations were built in the near area	2.756	3.186	−1.357 (0.1780)
Concerned if wind installations were built in the near area	3.293	3.237	0.157 (0.8756)
Concerned if PVs were built in the near area	2.683	2.61	0.219 (0.8269)
Concerned if geothermal installations were built in the near area	2.976	2.966	0.032 (0.9745)
Concerned if biomass installations were built in the near area	3.293	3.305	−0.038 (0.9699)
Concerned about GHG emissions of geothermal	3.171	3.508	−0.955 (0.3420)
Concerned about landscape impacts of geothermal	3.293	3.763	−1.546 (0.1254)
Concerned about infrastructure impacts of geothermal	3.171	3.678	−1.761 (0.0814)
Concerned about induced seismicity of geothermal	3.829	4.085	−0.820 (0.4145)
Concerned about water aquifer risks of geothermal	4.537	4.508	0.098 (0.9225)
Concerned about legal transparency of geothermal	3.073	4.203	−4.121 (0.0001)
Receptive to geothermal if monitoring offered safety assurance	4.293	4.695	−1.615 (0.1095)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Receptive to geothermal if electricity cost reductions	4.39	4.983	−2.584 (0.0112)
Receptive to geothermal if increase in employment	3.78	4.475	−2.625 (0.0101)
Receptive to geothermal if controlled by public institutions	3.976	4.186	−0.880 (0.3808)
Receptive to geothermal if compensation for local residents	3.756	4.288	−2.104 (0.0380)
Groundwater contamination contributes to public concern about deep geothermal drilling in the area	4.537	4.627	−0.355 (0.7232)
Soil contamination contributes to public concern about deep geothermal drilling in the area	4.22	4.322	−0.369 (0.7136)
Radioactive wastes contribute to public concern about deep geothermal drilling in the area	2.902	3.271	−1.090 (0.2784)
Induced seismicity contributes to public concern about deep geothermal drilling in the area	4.366	4.475	−0.388 (0.6989)
Air pollution contributes to public concern about deep geothermal drilling in the area	3.39	3.661	−0.887 (0.3773)
Water use contributes to public concern about deep geothermal drilling in the area	4.366	4.458	−0.353 (0.7248)
Visual impacts contributes to public concern about deep geothermal drilling in the area	3.805	4.136	−1.237 (0.2189)
Noise contributes to public concern about deep geothermal drilling in the area	3.756	4.339	−2.211 (0.0294)
Ever experienced an earthquake in the area	Yes 16 (39.02%)	Yes 30 (50.85%)	
Earthquake unpleasant	3.333	3.793	−0.959 (0.3424)

Variable (short description)	*Cluster 1*	*Cluster 2*	*t statistic (p-value)*
Area prone to earthquakes	Yes 17 (41.46%)	Yes 26 (44.07%)	
Induced seismicity alters perspective towards geothermal	4.122	3.915	0.683 (0.4961)
Actively oppose geothermal drilling in the area	Yes 3 (7.32%)	Yes 5 (8.47%)	
(5) Market acceptance			
Offer of public incentives or facilitating measures to help transition to geothermal	Not aware 26 (63.41%) No incentives 5 (12.2%) Not sure 4 (9.76%) etc.	Not aware 30 (50.85%) Not sure 14 (23.73%) There are a few 6 (10.17%) None 5 (8.47%) There are some 4 (6.78%) etc.	
Quantity of incentives or facilitating measures to help transition to geothermal	2.146	2.492	−1.189 (0.2374)
Economic benefits influential for switching to geothermal only energy provider	4.878	5.068	−0.865 (0.3892)
Social benefits influential for switching to geothermal only energy provider	3.585	4.153	−2.321 (0.0224)
Community awareness influential for switching to geothermal only energy provider	3.537	4.034	−2.091 (0.0391)
Environmental benefits influential for switching to geothermal only energy provider	4.78	4.847	−0.279 (0.7809)
Lower geothermal energy costs affect overall attitude toward geothermal drilling	4.561	4.763	−0.909 (0.3656)

Overall, 50 out of 146 variables (34.2%) exhibited a statistically significant t-test for independent samples at a 95% confidence level, supporting the existence of two clusters in the sample of responses.

Some observations are now due on how variables from various sections of the questionnaire were classified into these two clusters. Beginning with the environmental concerns section, the following may be observed:

- The presence of two clusters was prominent in the cases of the urgency of air pollution, acid rain and soil contamination, exploitation of natural resources, and noise. Cluster 2 respondents gave significantly higher ratings (centroid values of 4.966, 4.203, 4.559, 4.644 and 3.81 respectively) than Cluster 1 respondents (centroid values of 4.366, 3.317, 4.024, 3.78 and 3.103 respectively).
- Moreover, Cluster 2 respondents valued the total impact of the energy production model on the environment significantly higher (centroid value 5.136) than Cluster 1 respondents (centroid value 4.61).
- Finally, Cluster 2 respondents considered the aesthetic degradation/visual intrusion effect on attitude towards geothermal to be significantly more important (centroid value of 3.756), than Cluster 1 respondents (centroid value of 3.049).

Moving on to the sociopolitical concerns section, the following may be observed:

- The presence of two clusters was noticeable in the cases of urgency of food shortages, pandemics, economic crises, unemployment, and poverty. Cluster 2 respondents rated the urgency of these issues (centroid values of 5.017, 4.559, 4.441 and 4.847 respectively) higher than Cluster 1 respondents (centroid value of 4.488, 3.659, 4.024 and 3.805 respectively).
- Cluster 2 respondents rated the importance of energy conservation and energy accessibility (centroid values of 4.932 and 5.085 respectively) higher than Cluster 1 respondents (centroid values of 4.341 and 4.537 respectively).
- Cluster 2 respondents rated the impact of solar, wind, geothermal, biomass, and hydrogen on the way of life (centroid values of 4.881, 4.542, 4.61, 4.288 and 4.542 respectively) higher than Cluster 1 respondents (centroid values of 3.756, 3.366, 3.561, 2.927 and 4.073 respectively).
- Cluster 2 respondents rated the importance of local authorities, energy companies, media, NGOs, environmental organizations, grassroot organizations, and individual citizens in the energy selection process (centroid values of 4.627, 4.424, 4.39, 4.169, 4.339, 4.156 and 4.068 respectively) higher than Cluster 1 respondents (centroid values of 3.585, 3.561, 2.61, 2.585, 2.927, 2.488 and 2.37 respectively).
- Cluster 2 respondents trusted NGOs and the media (centroid values of 3.542 and 2.949 respectively) significantly more than Cluster 1 respondents (centroid values of 2.463 and 1.902 respectively).
- Cluster 2 respondents valued the importance of the environmental impacts of energy systems (centroid value of 5.322) significantly higher than Cluster 1 respondents (centroid value of 4.683).
- Cluster 2 respondents rated the importance of environmental protection, jobs/employment, community awareness, consultation, and compensation for geothermal energy to be accepted and supported (centroid values of 5.288, 4.542, 4.804, 4.593 and 4.424 respectively) higher than Cluster 1 respondents (centroid values of 4.659, 3.732, 3.892, 3.976 and 3.585 respectively).
- Finally, Cluster 2 respondents heard about geothermal more frequently in the news (centroid value of 3.034) than Cluster 1 respondents (centroid value of 2.146).

Turning next to the community acceptance section, the following may be observed:

- Cluster 2 respondents rated the inconvenience of switching, which can deter switching to a geothermal-only energy supply, much higher (centroid value of 4.102) than Cluster 1 respondents (centroid value of 2.927).

- Cluster 2 respondents were significantly more concerned about aesthetics, transparency, and depreciation of property values due to geothermal drilling near their property (centroid values of 3.881, 4.407 and 4.491 respectively) than Cluster 1 respondents (centroid values of 3.244, 3.805 and 3.878 respectively).
- Cluster 2 respondents value significantly higher (centroid value 4.475) the convincing ability of social benefits in purchasing energy from deep geothermal, than those belonging to Cluster 1 (centroid value 3.634).
- Cluster 2 respondents trusted print/broadcast media, internet/social media, and environmental associations to help them decide about switching energy suppliers significantly higher (centroid values of 3.424, 3.203 and 4.119 respectively) than Cluster 1 respondents (centroid values of 2.098, 2.049 and 3.049 respectively).
- Cluster 2 respondents would be a lot more concerned about the prospect of nuclear energy installations being built nearby as well as about the legal transparency of geothermal (centroid values of 4.78 and 4.203 respectively) than Cluster 1 respondents (centroid values of 3.512 and 3.073 respectively).
- Cluster 2 respondents were noticeably more receptive to geothermal energy if electricity costs were reduced, employment was increased, and locals were compensated (centroid values of 4.983, 4.475 and 4.288 respectively) than Cluster 1 respondents (centroid values of 4.39, 3.78 and 3.756 respectively).
- Finally, Cluster 2 respondents believed that noise contributed significantly more to public concern about deep geothermal drilling (centroid value of 4.339) than Cluster 1 respondents (centroid value of 3.756).

Last, on the market acceptance section, it may be observed that Cluster 2 respondents valued the influence of social benefits and community awareness on the decision to switch to a geothermal-only energy provider (centroid values of 4.153 and 4.034 respectively) higher than Cluster 1 respondents (centroid values of 3.585 and 3.537 respectively).

Other notable demographic and sundry differences between the two clusters were as follows:

- Cluster 1 contained 41% of the respondents.
- Cluster 1 contained fewer males (53.66%) than Cluster 2 (84.75%).
- Cluster 1 contained fewer respondents from France (15 or 36.585%), Greece (10 or 24.39%) and Norway (4 or 9.756%) than Cluster 2 (25 or 42.373% from France, 12 or 30.339% from Greece, and 8 or 13.559% from Norway); Cluster 1 had more responses from the UK (4 or 9.756%) whereas Cluster 2 had more responses from China (4 or 11.864%).
- Cluster 1 contained fewer respondents who were married or living with a partner (53.66%) than Cluster 2 (59.32%).
- Cluster 1 had fewer PhD (19.51%) and postdoc (14.63%) respondents than Cluster 2 (33.9% and 20.34% respectively), but more university graduates and postgraduate respondents (36.59% and 19.51% respectively, compared to 27.12% and 16.95% respectively for Cluster 2).
- Cluster 1 had less experienced respondents (centroid of 14.09 years) than Cluster 2 (centroid of 16.02 years), but the difference was not statistically significant.

- Compared to Cluster 2, Cluster 1 had fewer researchers (36.6% vs 46.55% for Cluster 2), more private employees (21.95% vs 18.97% for Cluster 2), more students (19.5% vs 10.34% for Cluster 2), and fewer faculty members (17.1% vs 24.14% for Cluster 2).
- Compared to Cluster 2, Cluster 1 had fewer respondents from a megacity (24.39% vs 40.68% for Cluster 2), more suburban respondents (24.39% vs 10.17% for Cluster 2), and fewer rural respondents (7.32% vs 15.25% for Cluster 2).
- Cluster 1 contained fewer householders (63.42%), but more tenants (31.7%) than Cluster 2 (67.8% and 25.42% respectively).
- Cluster 1 respondents were less likely to have experienced an earthquake (39.02%) than Cluster 2 respondents (50.85%).
- Finally, a greater proportion of Cluster 1 respondents were unaware of public incentives or facilitating measures to help transition to geothermal energy (63.41% vs 50.85% for Cluster 2).

APPENDIX E: Survey questionnaire (English only version)

Geothermal Social Impact Assessment Survey

ENGLISH — This survey is open to INDIVIDUALS OVER THE AGE OF 18 and is being conducted as part of the ORCHYD (Novel Drilling Technology Combining Hydro-Jet and Percussion for ROP Improvement in Deep Geothermal Drilling) project, which is funded by the European Commission's Horizon 2020 program. Its goal is to evaluate public perceptions of geothermal energy drilling, and to determine how technological advances can meet social demands. We assure you that participation in this survey is completely confidential and cordially invite you to participate. The survey should take about 15 minutes to complete. Your feedback will be extremely beneficial to us. You may learn more about ORCHYD here: www.orchyd.eu, twitter.com/Orchyd5, and www.linkedin.com/company/orchyd-h2020. If you have any questions, please email nkontoulis@unipi.gr.

* Required

SECTION 1: Background information

This section collects anonymous background and sociodemographic data for use exclusively in the project.

1. What is your gender? *

- ◯ Male
- ◯ Female
- ◯ Other
- ◯ I prefer not to answer

2. What is your age? (THE SURVEY IS NOT OPEN TO INDIVIDUALS UNDER THE AGE OF 18) *

- ◯ 18-29
- ◯ 30-39
- ◯ 40-49
- ◯ 50-59
- ◯ 60-69
- ◯ 70-79
- ◯ 80-89
- ◯ 90+
- ◯ I prefer not to answer

3. What is your marital status? *

- ◯ Single
- ◯ Married/Living with a partner
- ◯ Divorced
- ◯ Widower
- ◯ I prefer not to answer
- ◯ Married

4. Do you have any children? *

- ◯ Yes
- ◯ No
- ◯ I prefer not to answer

5. If yes, how many children do you have?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5 or more
- ◯ I prefer not to answer

6. What is your educational background? *

- ◯ No formal education
- ◯ Primary school
- ◯ Secondary/high school
- ◯ Professional (non-university) education
- ◯ University/College
- ◯ Postgraduate education
- ◯ Doctoral degree
- ◯ Post doctoral
- ◯ I prefer not to answer

7. Which of the following professional classifications best describes you? *

- [ ] Student
- [ ] Self-employed/freelancer
- [ ] Private employee
- [ ] Company owner or business executive
- [ ] State employee/Public servant
- [ ] Energy expert
- [ ] Researcher
- [ ] University professor/Academic faculty
- [ ] Retired
- [ ] Unemployed
- [ ] Other
- [ ] I prefer not to answer

8. How many years of professional experience do you have? *

- ◯ None/I have no professional experience
- ◯ Less than 5 years
- ◯ Between 5 and 10 years
- ◯ Between 10 and 15 years
- ◯ Between 15 and 20 years
- ◯ Between 20 and 25 years
- ◯ Between 25 and 30 years
- ◯ Between 30 and 35 years
- ◯ Between 35 and 40 years
- ◯ Between 40 and 45 years
- ◯ Between 45 and 50 years
- ◯ Over 50 years
- ◯ I prefer not to answer

9. What is your annual income? *

- ◯ I have no income (e.g. dependent family member)
- ◯ Under 10 thousand euros
- ◯ Between 10 and 20 thousand euros
- ◯ Between 20 and 30 thousand euros
- ◯ Between 30 and 40 thousand euros
- ◯ Between 40 and 50 thousand euros
- ◯ Between 50 and 60 thousand euros
- ◯ Between 60 and 70 thousand euros
- ◯ Between 70 and 80 thousand euros
- ◯ Between 80 and 90 thousand euros
- ◯ Between 90 and 100 thousand euros
- ◯ Over 100 thousand euros
- ◯ I prefer not to answer

10. Which country do you currently reside in? *

- ◯ France
- ◯ United Kingdom
- ◯ Norway
- ◯ Greece
- ◯ China
- ◯ Canada
- ◯ United States
- ◯ Other (if you choose this, please see next question)

11. If you reside in another country, please type its name

12. Which city do you currently reside in (please type, for example, London)? *

13. How would you characterize the area in which you reside? *

- ◯ Urban area with a population of more than ten million people
- ◯ Other urban area
- ◯ Suburban area
- ◯ Rural area

14. Which of the following energy consumer types describe your current situation? *

- ☐ Tenant/Leaseholder
- ☐ Householder
- ☐ Landowner
- ☐ Farmer
- ☐ Animal farmer
- ☐ Small commercial consumer
- ☐ Local enterprise
- ☐ Industrial consumer

15. Which is the energy source you use for heating? *

- [ ] Coal
- [ ] Oil
- [ ] Natural gas
- [ ] Electricity
- [ ] Biomass
- [ ] Geothermal
- [ ] Other

16. Do you think your energy utility bill is too high? *

1	2	3	4	5	6
No, it is very cheap					Yes, it is too expensive

17. Please select the options that apply to your current situation from the list below

- [ ] At least one household member is under the age of 12
- [ ] At least one household member is over the age of 60
- [ ] At least one household member is unemployed
- [ ] At least one household member requires additional care due to a medical condition

18. How familiar are you with geothermal energy exploration and development (including drilling)? *

1	2	3	4	5	6
Not at all					Very well

19. What is the distance between your residence and the closest known to you geothermal exploration activities (e.g. drilling)? *

- ◯ I am not aware of any geothermal project in the proximity of my residence
- ◯ 0 - 25 km
- ◯ over 50 km
- ◯ I prefer not to answer

20. What is the significance of public acceptance of geothermal energy development, in your opinion? *

1	2	3	4	5	6

Not significant Very significant

SECTION 2: Environmental concerns

21. How urgent, in your opinion, are the following environmental concerns? *

	1 - Not urgent	2	3	4	5	6 - Very urgent
Decline of biodiversity	○	○	○	○	○	○
River and seawater pollution	○	○	○	○	○	○
Air pollution	○	○	○	○	○	○
Acid rain	○	○	○	○	○	○
Soil pollution/contamination	○	○	○	○	○	○
Waste disposal	○	○	○	○	○	○
Temperature increase	○	○	○	○	○	○
Extreme weather conditions	○	○	○	○	○	○
Exploitation of natural resources	○	○	○	○	○	○
Traffic congestion	○	○	○	○	○	○
Noise	○	○	○	○	○	○

22. In your opinion, how important is the total impact of the existing energy production model on the aforementioned environmental issues? *

1	2	3	4	5	6

Not important Very important

23. How much would air pollution affect your attitude toward geothermal development in your area? *

1	2	3	4	5	6

Not at all Very much

24. How much would noise pollution affect your perception of geothermal development in your community? *

1	2	3	4	5	6

Not at all Very much

25. How much would aesthetic degradation and visual intrusion affect your attitude toward geothermal development in your area? *

1	2	3	4	5	6

Not at all Very much

26. How much would degradation and/or depletion of water resources affect your attitude towards geothermal development in your area? *

1	2	3	4	5	6

Not at all Very much

27. Do you have any feedback on this section? Were there any environmental issues that we overlooked?

SECTION 3: Sociopolitical issues

28. In your opinion, how urgent are the following global issues? *

	1 - Not urgent	2	3	4	5	6 - Very urgent
Climate change	◯	◯	◯	◯	◯	◯
Water shortages	◯	◯	◯	◯	◯	◯
Food shortages and famine	◯	◯	◯	◯	◯	◯
Pandemic crises and their impacts	◯	◯	◯	◯	◯	◯
Economic crises and unemployment	◯	◯	◯	◯	◯	◯
Poverty	◯	◯	◯	◯	◯	◯
Terorrism	◯	◯	◯	◯	◯	◯

29. Who, in your opinion, should ultimately decide on geothermal exploration and drilling? *

- [ ] European/Supranational policymakers and regulators
- [ ] Policymakers and regulators at the NATIONAL level
- [ ] Policymakers and regulators at the REGIONAL level
- [ ] Contractors and service providers
- [ ] Operators and suppliers
- [ ] Environmental groups
- [ ] Local communities
- [ ] Individual citizens
- [ ] Other decision making entities/agents

30. Are you aware of any recent initiatives to promote more sustainable energy generation and consumption? *

- ◯ I am not aware of any such initiatives
- ◯ There are a couple of initiatives, but I'm not sure what they're called
- ◯ I could name a few, but I'm not certain what they're about
- ◯ I am aware of a few initiatives, the names and contents of which are familiar
- ◯ I know for a fact that no such initiatives exist

31. How important do you think environmental regulations are in developing effective strategies for sustainable energy systems? *

1	2	3	4	5	6

Not important Very important

32. How important do you think the following are? *

	1 - Not important	2	3	4	5	6 - Very important
Pollution reduction	○	○	○	○	○	○
Mitigation of greenhouse gas emissions	○	○	○	○	○	○
Energy conservation	○	○	○	○	○	○
Development of renewable energy	○	○	○	○	○	○
Energy accessibility	○	○	○	○	○	○
Energy price stability	○	○	○	○	○	○

33. How significant, in your opinion, will be the impact of the following energy sources on our way of life in the coming years? *

	1 - Not significant	2	3	4	5	6 - Very significant
Coal	○	○	○	○	○	○
Oil	○	○	○	○	○	○
Natural gas	○	○	○	○	○	○
Solar	○	○	○	○	○	○
Wind	○	○	○	○	○	○
Hydropower	○	○	○	○	○	○
Geothermal	○	○	○	○	○	○
Biomass/biofuels	○	○	○	○	○	○
Hydrogen	○	○	○	○	○	○
Nuclear	○	○	○	○	○	○

34. How important do you consider the following actors in the energy selection process? *

	1 - Not important	2	3	4	5	6 - Very important
European Union	○	○	○	○	○	○
National governments	○	○	○	○	○	○
Local authorities	○	○	○	○	○	○
Energy companies	○	○	○	○	○	○
Scientists and researchers	○	○	○	○	○	○
Media	○	○	○	○	○	○
Non-Governmental Organizations (NGOs)	○	○	○	○	○	○
Environmental organizations	○	○	○	○	○	○
Grassroot movements	○	○	○	○	○	○
Individual citizens	○	○	○	○	○	○

35. How much do you trust the following sources? *

	1 - Not at all	2	3	4	5	6 - Very much
European Union	◯	◯	◯	◯	◯	◯
National governments	◯	◯	◯	◯	◯	◯
Regional/local governments	◯	◯	◯	◯	◯	◯
Energy companies	◯	◯	◯	◯	◯	◯
Non-Governmental Organizations (NGOs)	◯	◯	◯	◯	◯	◯
Print/broadcast and online media	◯	◯	◯	◯	◯	◯

36. How important are the following issues to you? *

	1 - Not important	2	3	4	5	6 - Very important
Energy independence	◯	◯	◯	◯	◯	◯
Energy efficiency	◯	◯	◯	◯	◯	◯
Energy affordability	◯	◯	◯	◯	◯	◯
Energy availability	◯	◯	◯	◯	◯	◯
Diversification of the energy supply	◯	◯	◯	◯	◯	◯
Development of renewable energy	◯	◯	◯	◯	◯	◯
Environmental impacts of energy systems	◯	◯	◯	◯	◯	◯

37. How important do you believe the following conditions are for a geothermal energy exploration project to gain acceptance and support? *

	1 - Not important	2	3	4	5	6 - Very important
Public safety	◯	◯	◯	◯	◯	◯
Environment protection	◯	◯	◯	◯	◯	◯
Jobs/employment	◯	◯	◯	◯	◯	◯
Community awareness	◯	◯	◯	◯	◯	◯
Community consultation	◯	◯	◯	◯	◯	◯
Community compensation	◯	◯	◯	◯	◯	◯

38. How frequently do you hear about geothermal energy in the news in your country? *

1	2	3	4	5	6

Never Very often

39. In your opinion, how often are the following terms used in geothermal energy debates in the media of your country? *

	1 - Never	2	3	4	5	6 - Very often
Geothermal potential	○	○	○	○	○	○
Economy	○	○	○	○	○	○
Climate change	○	○	○	○	○	○
Ecological security	○	○	○	○	○	○
Energy security	○	○	○	○	○	○
National security	○	○	○	○	○	○

40. How do you feel about geothermal energy being used to generate electricity in your country? *

1	2	3	4	5	6

Very negatively Very positively

41. How do you feel about geothermal energy being used to generate heating in your country? *

1	2	3	4	5	6

Very negatively Very positively

42. What is your opinion on developing a pilot geothermal energy project in your country, if (underground) hydraulic stimulation is required? *

1	2	3	4	5	6

Very negatively Very positively

43. Any thoughts? Did we overlook anything concerning sociopolitical issues?

SECTION 4: Community acceptance

44. Do you understand what geothermal energy is and how it works? *

1	2	3	4	5	6

No, not at all Yes, very well

45. How important are the following in involving local communities in geothermal energy exploration? *

	1 - Not important	2	3	4	5	6 - Very important
Concerns about facility location	◯	◯	◯	◯	◯	◯
Risks and benefits to society	◯	◯	◯	◯	◯	◯
Environmental impacts	◯	◯	◯	◯	◯	◯
Concerns about public health and safety	◯	◯	◯	◯	◯	◯

46. How much would the following deter you from switching to a geothermal-only energy supply? *

	1 - Least impactful	2	3	4	5	6 - Most impactful
Insufficient service maturity	◯	◯	◯	◯	◯	◯
Hidden/unknown costs	◯	◯	◯	◯	◯	◯
Inconvenience of switching	◯	◯	◯	◯	◯	◯
Issues of credibility, transparency, and trust	◯	◯	◯	◯	◯	◯

47. How concerned would you be about the following issues regarding geothermal drilling near your property? *

	1 - Not concerned	2	3	4	5	6 - Very concerned
Environmental impacts	◯	◯	◯	◯	◯	◯
Aesthetic issues	◯	◯	◯	◯	◯	◯
Safety	◯	◯	◯	◯	◯	◯
Public health	◯	◯	◯	◯	◯	◯
Transparency	◯	◯	◯	◯	◯	◯
Depreciation of property values	◯	◯	◯	◯	◯	◯

48. How convincing would the following factors be to you if you were considering purchasing energy supplied by deep geothermal sources in your area? *

	1 - Least convincing	2	3	4	5	6 - Most convincing
Reliability of energy supply	◯	◯	◯	◯	◯	◯
Economic benefits	◯	◯	◯	◯	◯	◯
Social benefits	◯	◯	◯	◯	◯	◯
Environmental benefits	◯	◯	◯	◯	◯	◯

49. How much would you trust the following platforms to help you make an informed decision about switching energy suppliers? *

	1 - Least trusted	2	3	4	5	6 - Most trusted
National public administration	○	○	○	○	○	○
Regional/local administration	○	○	○	○	○	○
Print and broadcast media	○	○	○	○	○	○
Internet and social media	○	○	○	○	○	○
Energy suppliers	○	○	○	○	○	○
Environmental associations	○	○	○	○	○	○
Academic/research journals and expert publications	○	○	○	○	○	○
Friends and colleagues	○	○	○	○	○	○

50. How concerned would you be if one of the following energy plants/installations were built in your area? *

	1 - Not concerned	2	3	4	5	6 - Very concerned
Fossil fuel	○	○	○	○	○	○
Nuclear	○	○	○	○	○	○
Hydropower	○	○	○	○	○	○
Wind	○	○	○	○	○	○
Solar panels (PVs)	○	○	○	○	○	○
Geothermal	○	○	○	○	○	○
Biomass	○	○	○	○	○	○

51. How concerned would you be about the following aspects of geothermal drilling? *

	1 - Not concerned	2	3	4	5	6 - Very concerned
Greenhouse gas emissions	◯	◯	◯	◯	◯	◯
Landscape impacts	◯	◯	◯	◯	◯	◯
Infrastructure impacts	◯	◯	◯	◯	◯	◯
Induced (micro)seismicity	◯	◯	◯	◯	◯	◯
Water aquifer-related risks	◯	◯	◯	◯	◯	◯
Legal transparency	◯	◯	◯	◯	◯	◯

52. How receptive would you be to geothermal drilling in your area if the following were true? *

	1 - Not receptive	2	3	4	5	6 - Very receptive
Monitoring offering safety assurance	◯	◯	◯	◯	◯	◯
Electricity cost reductions	◯	◯	◯	◯	◯	◯
Increase in employment	◯	◯	◯	◯	◯	◯
Control by public institutions	◯	◯	◯	◯	◯	◯
Compensation for local residents	◯	◯	◯	◯	◯	◯

53. How much do the following factors, in your opinion, contribute to public concern about deep geothermal drilling in your region? *

	1 - Not at all	2	3	4	5	6 - Very much
Groundwater contamination	◯	◯	◯	◯	◯	◯
Soil contamination	◯	◯	◯	◯	◯	◯
Radioactive wastes	◯	◯	◯	◯	◯	◯
Induced (micro)seismicity	◯	◯	◯	◯	◯	◯
Air pollution	◯	◯	◯	◯	◯	◯
Water use	◯	◯	◯	◯	◯	◯
Visual impacts	◯	◯	◯	◯	◯	◯
Noise	◯	◯	◯	◯	◯	◯

54. Have you ever experienced an earthquake in the area of your residence? *

- ◯ Yes
- ◯ No
- ◯ I don't remember

55. If you have experienced an earthquake, how unpleasant was your experience? *

1	2	3	4	5	6

It was not at all unpleasant

It was very unpleasant

56. Is your area prone to natural earthquakes? *

- ◯ Yes
- ◯ No
- ◯ I am not sure

57. How might the prospect of induced seismicity alter your perspective on geothermal development in your area? *

1	2	3	4	5	6

Not at all

Very much

58. Would you actively oppose geothermal drilling operations in your area? *

- ◯ Yes
- ◯ No
- ◯ I am not sure
- ◯ I prefer not to answer

59. Any suggestions? Did we miss any community issues?

SECTION 5: Market acceptance

60. Is your country offering any public incentives or facilitating measures to assist consumers in making the transition to geothermal energy? *

- ◯ I am not aware of any incentives or facilitating measures
- ◯ There are some, but I'm not sure what they offer
- ◯ There are a few, and I am aware of them in broad terms
- ◯ There are some, and I'm trying to learn more about them
- ◯ I know that there are no incentives or facilitating measures in place

61. How would you characterize the quantity of incentives or facilitating measures available in your country to help customers transition to geothermal energy? *

1	2	3	4	5	6

Very few A great many

62. How influential do you think the following factors would be in switching to a geothermal-only energy provider? *

	1 - Least persuasive	2	3	4	5	6 - Most persuasive
Economic benefits	◯	◯	◯	◯	◯	◯
Social benefits	◯	◯	◯	◯	◯	◯
Community awareness	◯	◯	◯	◯	◯	◯
Environmental benefits	◯	◯	◯	◯	◯	◯

63. How does the fact that geothermal energy costs less than traditional energy sources affect your overall attitude toward geothermal drilling? *

1	2	3	4	5	6

Not at all A lot

64. Any thoughts? Were there any issues with the market that we didn't cover?

All done - thank you very much for your time and insight!

65. If you wish, you are welcome to leave an overall comment below before submitting