

Inside the User's Mind – Perception of Risks and Benefits of Unknown Technologies, Exemplified by Geothermal Energy

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Abstract. In the context of large scale projects public acceptance is indispensable for a sustainable roll out and broad implementation of technology. Especially when those projects deal with the implementation of relatively unknown technologies like geothermal energy. To find out what communication need the general public has, knowledge about the underlying cognitive attitudes toward the technology as well as the mental representation is important. In this context especially uncertainties about the consequences and risks are of importance. In this study we get a deeper understanding of the mental representation of geothermal energy by uncovering acceptance-relevant cognitions which were assessed by interviews with open answer format. Results show, that especially the communication about risks and possible disadvantages should be integrated in an adequate information strategy.

Keywords: Technology acceptance · Geothermal energy · Communication strategy · Information strategy

1 Introduction

Due to the climate change and the need to find alternatives to fossil fuels, renewable energy forms are very important for our society. Although the acceptance of renewable energies in general is rather high, several studies revealed that when it comes to concrete projects, people start to oppose them [1, 2]. Especially unknown technologies often lead to feelings of distrust and to a decreasing acceptance in society [3, 4]. Thus, adequate and timely information and communication strategies for large-scale projects - such as geothermal projects - is an important part in social acceptance [5, 6]. As several studies showed, the lack of adequate communication between project managers of large-scale technologies and the local residents is one major reason for a lack of acceptance [7, 8]. Project managers often face the difficulty that they don't have the knowledge about how to communicate and which content is adequate for the general public [9]. Especially in the context of complex technologies, communication between experts and non-experts is difficult, because there is no shared base of knowledge and technical terms. Perceived risks of lay peoples might not be "real" or "valid" out of the perspective of a person with

a high domain knowledge [10]. Experts thus are often not able to evaluate the information need of the public [11].

Hence, for the development of adequate information strategies, the understanding of underlying mental models of energy technologies, in this case geothermal energy, is essential. It is assumed that the internal representation shapes unconsciously (risk) perceptions and, in consequence, the overall acceptance of the technology. By exploring people's internal representation of geothermal energy, we get a deeper understanding of the image of geothermal energy in the public, as well as about the need for information and communication. To get insights into the mental representation of geothermal energy and to uncover implicit meanings and hidden drivers for user acceptance, a free answer format study design is methodologically very important [12–14]. As several studies have shown, the public level of knowledge about geothermal energy is low [15–17]. This makes it difficult to uncover relevant acceptance patterns without shaping the perception by giving information, as this would be the case for example in questionnaires. Therefore, we examined the perception of geothermal energy in this study by a free answer format interview guideline.

With this approach we aim at deeper insights into the mental representation of geothermal energy, uncovering barriers and perceived benefits, which can be used as a information base for a communication strategy that considers the perception of geothermal energy in the general public [18, 19].

2 Conceptual and Methodological Approach

To prepare a communication strategy that is adequate for the public, a deeper understanding of the information need is indispensable [4, 5]. Traditional research methods such as questionnaires might not be suitable in the case of an unknown technology. By choosing questions with given answer format and giving directional input, answers are shaped in a concrete direction.

Thus, a first step for a communication guideline has to be the uncovering of existing mental representations of geothermal energy. As we know, mental models shape the perception and thus the acceptance, it is important to understand when trying to develop an adequate communication strategy. Insights into the mental representation of geothermal energy can be collected whenever participants have the possibility to freely associate what might come into their mind in connection to a specific technology. The benefit of that method is to get an unobstructed view of the perception of benefits and risks of geothermal energy because people are free to answer questions in their words and verbal elaborateness of their own choosing.

Both the language usage, the verbal associations but also the specific choice of words and the level of detail in which the participants answer, might give information about the cognitive representation of geothermal energy. From the specificity of answers, conclusions can be drawn about the level of knowledge and public perception of geothermal energy. The latter might help to plan and to tailor further research studies, but also to develop an adequate communication strategy which is based on the actual demand for communication and information in the public.

In the here presented interview study, participants were asked for perceived risks and benefits but also about the meaning of transparency in communication of large-scale technologies and what transparent communication should be like.

Altogether, 159 people took part in this study, aged between 18 to 64 years. Single answers were combined to parent categories for evaluation. For validity reasons, three independent evaluators accomplished the categorization. As found, the categorizations were in high accordance, hinting at a high validity of findings.

3 Results

The results are presented visually in order to reach a high transparency. We chose “word clouds” for a graphical representation of the frequency of response. Different shades indicate different categories.

In each of the questions we first report on outcomes of the whole sample, followed by an analysis of user diversity, taking age and gender into account.

3.1 Perceived Disadvantages

Looking at the answers to the question what disadvantages people think geothermal projects present, we see three main answering categories: costs, unknown risks and earthquakes (Fig. 1).



Fig. 1. Perceived disadvantages of geothermal energy (N = 104)

Answers can be divided in thematic subgroups. One group of perceived disadvantages is, that geothermics could lead to damages for the environment. The fear of environmental damages was mentioned in general but also more specifically people referred to the fear of earthquakes and damage to the groundwater. Another group of perceived risks is the fear of disadvantages for oneself or the community. This includes concerns about noise pollution, costs and damage to private property.

Overall the level of detail of the answers was not very high. Also, a quite negative image was revealed, dominated by distrust in the technology itself, its controllability and its economical and ecological value.

Regarding age differences, there are different perceptions of disadvantages of geothermal projects. A closer look shows, that older people referred more to unknown risks, while the younger tend to distrust the economical benefit (Fig. 2).

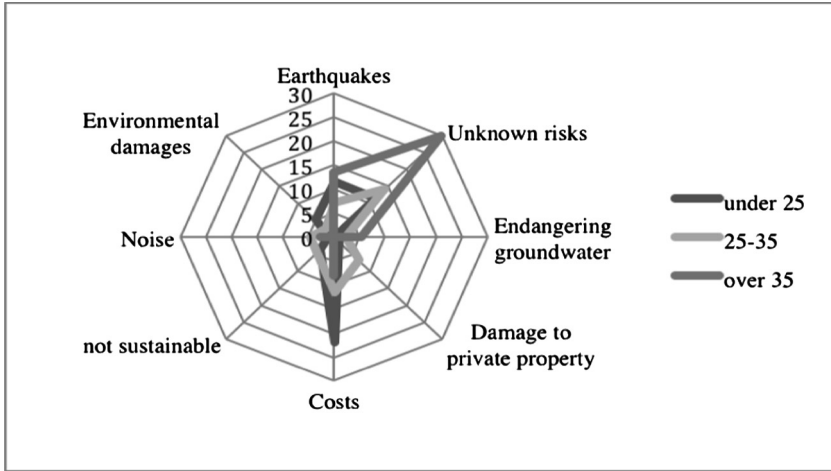


Fig. 2. Age differences in perceived disadvantages of geothermics in percent (N = 104)

Looking for gender differences, we see that women and men perceive risks nearly the same way. An exception is the fear of environmental damages, which is not mentioned by men (Fig. 3).

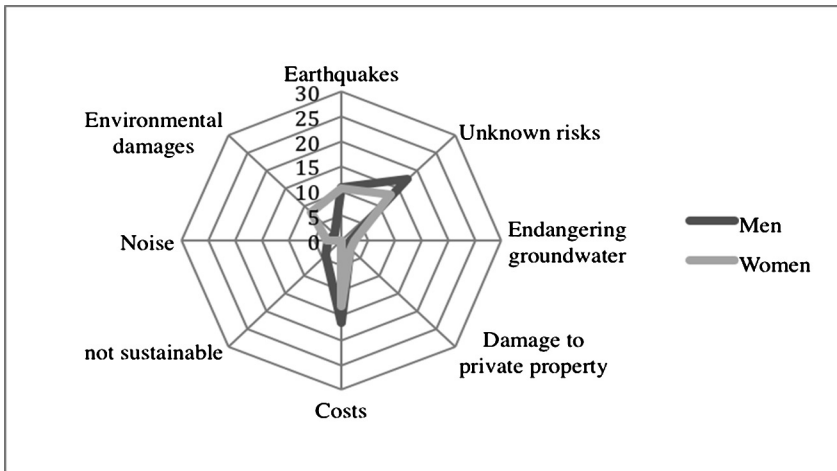


Fig. 3. Gender differences in perceived disadvantages of geothermics in percent (N = 104)

3.2 Perceived Benefits

Regarding the perceived benefits, mostly the ecological benefits of renewable energies in general were mentioned. The general support of renewables is mentioned most often, followed by environmental friendliness and sustainability. Also economical aspects as



Fig. 4. Perceived benefits of geothermal energy (N = 108)

the local energy supply and the cost saving were referred to. But also more specific answers were given. People mentioned the base load capability of geothermal projects as a key benefit. The answers to this questions show that there is a concrete perception of geothermal energy’s benefits. In contrast to the perceived risks, we see here a higher level of detail in the answers about benefits (Fig. 4).

A closer look at the age groups shows that younger participants tend to see the benefit of geothermal energy mainly in the sustainability, while the middle-aged group most frequently mentions the property of geothermic as an alternative to fossil fuels (Fig. 5).

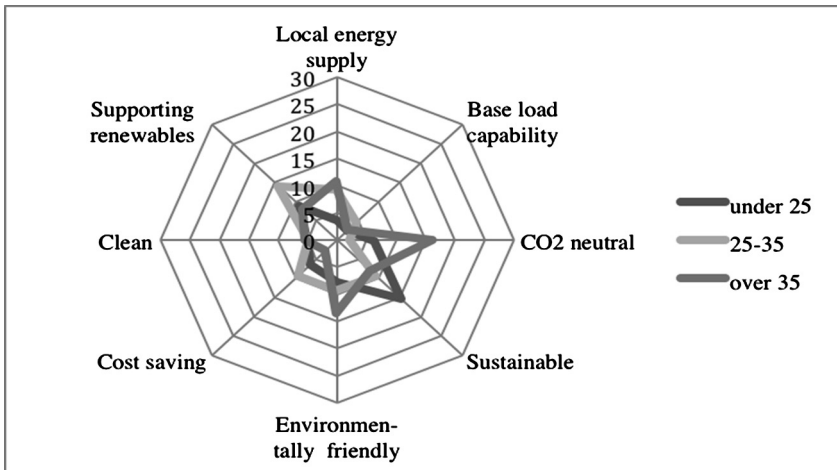


Fig. 5. Age differences in perceived benefits of geothermal energy in percent (N = 108)

The older group focuses on the local energy supply.

Comparing men and women we can observe, that men focus on the economical benefits and the advantage of a local energy source, while women’s perception focuses more on the sustainability and the eco-friendliness (Fig. 6).

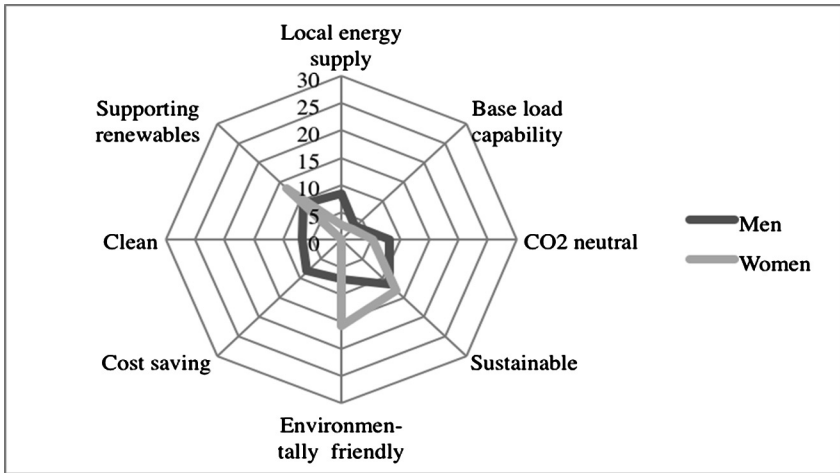


Fig. 6. Gender differences in perceived benefits of geothermal energy in percent (N = 108)

3.3 Perceived Transparency in Communication About Geothermal Energy

Being asked what transparency in communication means to them, participants associated most often the disclosure of risks, expert reports, and costs. Another often mentioned aspect of transparency is the involvement of the public in the decision-making process and information in time. Also mentioned were honesty and comprehensibility (Fig. 7).



Fig. 7. Named characteristics of transparent communication (N = 94)

We see that the idea of transparent communication is very concrete in contrast to the perceived risks. The answers emphasize the wish for open communication about disadvantages, and a feeling of control by getting insights into expert opinions. Comparing men and women it can be seen from Fig. 8 that the wish for the disclosure of disadvantages is not gendered, thus is not different between men and women. An exception is the wish for disclosure of the costs and the wish for comprehensibility, which is not mentioned by women.

Contrasting the age groups (Fig. 9) it was found that the older group more often mentions honesty as an important factor for transparent communication.

Concluding, overall results show, that lay people have a high communication need. As the findings regarding perceived disadvantages clearly showed, the perception of

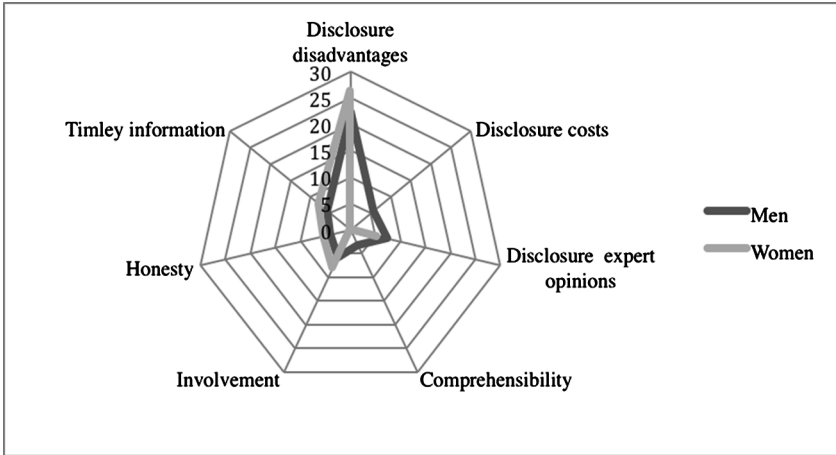


Fig. 8. Gender differences in criteria for transparency in percent (N = 94)

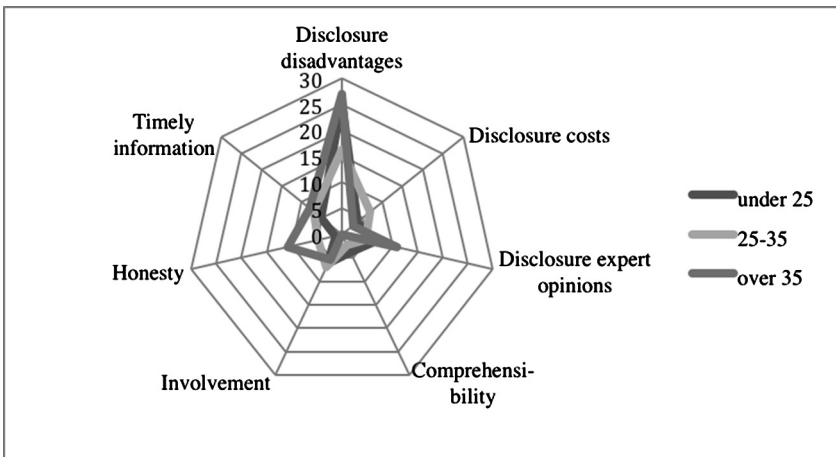


Fig. 9. Age differences in criteria for transparency in percent (N = 94)

the public is dominated by a high uncertainty about possible (negative) consequences of a geothermal project for the environment, but they also assume economical risks and unforeseeable consequences for them personally. The most often mentioned aspect “unknown risks” illustrates the unsharp fear of uncontrollability and perceived information lacks about risks and disadvantages.

The idea of transparent communication is very concrete. It shows the wish for information about the disadvantages of geothermics. This reflects also the need and the request for information about possible disadvantages.

4 Discussion

Acceptance is indispensable for the acceptance of large-scale projects - especially in the renewable energy sector which is important with regard to the climate change and the need to find alternatives to fossil fuels [20, 21]. For social acceptance in the general public and a successful implementation of renewables, communication and information strategies are a key factor [22]. Project leaders often face the problem not to know how to communicate with a non-expert, heterogeneous target group [11]. One condition for an optimal communication guideline is therefore the understanding of the mental picture the public has of a certain technology and its implementation. In this study we got deeper insights into the mental model of geothermal energy and the way users form their opinions.

It is noteworthy that associations in this context are mostly negative (if not explicitly asked for benefits) and center about risk and uncontrollability in terms of economic or environmental issues. Outcomes mirror findings of Huits et al. [22], which conclude that “worrysome environmental and societal problems related to energy use have spurred the development of more sustainable energy technologies” (p. 526). In their comprehensive paper they analyze psychological factors that impact acceptance in the energy sector. Authors argue: “the resistance can result from perceived hindrance and safety risks, but resistance can also arise because people think that collective resources could have been spent in a better way, or the cost-benefit ratio is too low” (p. 526).

It is an interesting finding that the acceptance-related negative cognitions are both, specific for geothermics and at the same time, quite unspecific and generic. While the perceived risk for earthquakes, for example, is specifically related to geothermal energy technology, the broad aloofness towards economic or environmental related risks represent more unspecific fears that were also reported for other energy technologies [23, 24], but appear in completely different contexts, such as V2X technologies [25], information and communication technologies [26, 27], or, even medical technologies [28, 29].

Future studies will have to find out in how far these generic concerns deal with the innovation openness of persons towards novel developments in the technological sector and the fact that unpopular technologies naturally evoke concerns. Bell [30] concludes in this context that “each generation is reimagining the dangerous impacts of technology on mind and brain. From a historical perspective, what strikes home is not the evolution of these social concerns, but their similarity from one century to the next, to the point where they arrive anew with little having changed except the label” [30, <http://www.slate.com>].

From the results we can draw insightful guidelines for communication and information strategies. With this study we identified the topics that should be integrated in a communication concept. Especially the communication about risks and disadvantages could be identified as a major topic for communication. The lack of information about possible consequences of the technology leads to distrust and insecurity and thus to a decrease in acceptance. In particular, the frequently mentioned fears of unknown risks underline the need for explanation of possible negative consequences of a geothermal project. Another important perceived risk was the fear of earthquakes. This is common

to other studies that found out, concerns about geothermal technology often concentrate on the fear of seismic activity [31].

Based on our results we can draw conclusions about the wording of communication as we know in which terms people talk about geothermal energy. Taking that into account leads to a better understanding of information given to the public, because it helps to prevent misunderstandings caused by the use of technical terms or differing understanding of terms. For example the participants didn't mention seismic activity, but used the term earthquakes.

Also we could identify first results about the communication specific to the target group. We found age and gender specific focuses in the perception of disadvantages and benefits. Results show that there is need and request for information and communication strategies in the context of geothermal energy projects. For a successful implementation of geothermal projects, these strategies should discuss risks and benefits [32].

Continuing this line of research future studies have to evaluate the findings referring to the choice of topic, type of information, and wording regarding their practicability and validity for further guidelines for communication. Also, deeper insights into the relevance of age and gender specific communication for an adequate information strategy are necessary.

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