

ENHANCING MARKET ACCEPTANCE OF SHALLOW GEOTHERMAL HEAT PUMPS IN THE DANUBE REGION: A TRANSNATIONAL APPROACH

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Abstract: The aim of the Danube GeoHeCo project is to promote the widespread adoption of shallow geothermal (SG) heat pumps within the Danube Region, aiming to overcome barriers hindering their uptake. This paper presents a comprehensive elucidation of the project's methodology and objectives, focusing on tailored communication strategies, eye-tracking techniques, and barrier-free learning principles. The study investigates suitable formats, presentations, and explanations to increase awareness and market acceptance among diverse target groups. Preliminary findings highlight the importance of tailoring information materials and integrating barrier-free learning principles for increased stakeholder engagement. Eye-tracking analysis reveals preferences in visual attention patterns, informing content optimization. Results underscore the multifaceted nature of stakeholder perceptions regarding SG heat pumps, emphasizing the need to address both positive value propositions and negative triggers. The conclusion emphasizes the pivotal role of tailored communication strategies and eye-tracking evaluation in fostering SG heat pump adoption. Future research directions advocate for longitudinal studies, iterative refinement of communication strategies, and leveraging technological advancements in eye-tracking technology to further optimize information dissemination efforts. Through these endeavours, the Danube GeoHeCo project aims to catalyse the widescale adoption of SG heat pumps, transforming the region's heating landscape towards sustainability and resilience.

Keywords: Shallow Geothermal Heat Pumps, Target Groups, Eye-Tracking

1 INTRODUCTION

The Danube GeoHeCo project represents a concerted effort to expedite the widespread adoption of shallow geothermal shallow geothermal (SG) heat pumps within the Region. These heat pumps utilise the thermal energy stored near the earth's surface to heat and cool buildings. They work by transferring heat in and out via heat exchangers installed at a shallow depth below the earth's surface [1]. Recognizing the pivotal role of SG heat pumps in advancing sustainable heating and cooling solutions, the project is dedicated to overcoming critical barriers hindering their uptake. Chief among these obstacles are the formidable challenges associated with installation, gaps in public awareness, and the imperative for fostering market acceptance of this transformative technology. This paper serves as a comprehensive elucidation of the research methodology and overarching objectives delineated by the Danube GeoHeCo project. Through the strategic integration of cutting-edge eye-tracking techniques, the project endeavours to optimize the efficacy of these materials, ensuring their seamless alignment with the informational needs and preferences of the intended audiences. In essence, the project stands as a beacon of innovation and collaboration, poised to transcend existing barriers, and catalyse the widespread adoption of SG heat pumps throughout the Region.

2 BACKGROUND

The participating countries in the Danube GeoHeCo project share similar hydrogeological and climatic conditions, making shallow geothermal energy an attractive solution for heating and cooling needs. However, challenges persist in promoting the adoption of SG heat pumps, including limited awareness among stakeholders and barriers to market acceptance.

SG heat pumps excel in energy efficiency, lowering consumption and costs with stable ground temperatures. They mitigate environmental impact, ensuring consistent performance. Despite initial costs, their durability and reduced maintenance make them economically viable. Their compact design, quiet operation, and dual heating-cooling function add to their appeal. Government incentives promote their adoption among homeowners and businesses. SG heat pump systems offer benefits but face challenges. High initial costs, site suitability, installation complexity, space requirements, maintenance, and long cost recovery periods deter investment. Water usage and ground contamination risks also pose concerns, especially in water-scarce areas. [2, 3]

The main research question is about finding effective formats, presentations, and explanations to boost SG heat pump adoption across diverse groups. The methodology also examines designing information materials for eye-tracking analysis to enhance content effectiveness.

Research Question 1: Which formats, presentations, and explanations are suitable to support the preparation of shallow geothermal (SG) heat pumps and increase awareness and market acceptance among different target groups?

This question addresses the need to identify effective communication strategies tailored to diverse target groups. By understanding the preferences and information needs of various demographic segments, the study aims to determine the most suitable formats, presentations, and explanations to promote SG heat pumps effectively.

Research Question 2: How should materials be prepared for eye-tracking evaluation?

This question concerns how information materials are prepared for eye-tracking analysis, covering content layout, visual elements, and presentation formats to enhance viewer engagement and comprehension. It aims to ensure effective evaluation using eye-tracking techniques for actionable optimization insights.

3 METHODOLOGY

The methodology in this study employed a multifaceted approach to gather insights into stakeholder perceptions. Utilizing posters as a tool for information dissemination, the study aimed to provide participants with an overview of the GeoHeCo project, its objectives, and the benefits and challenges associated with SG heat pump technology.

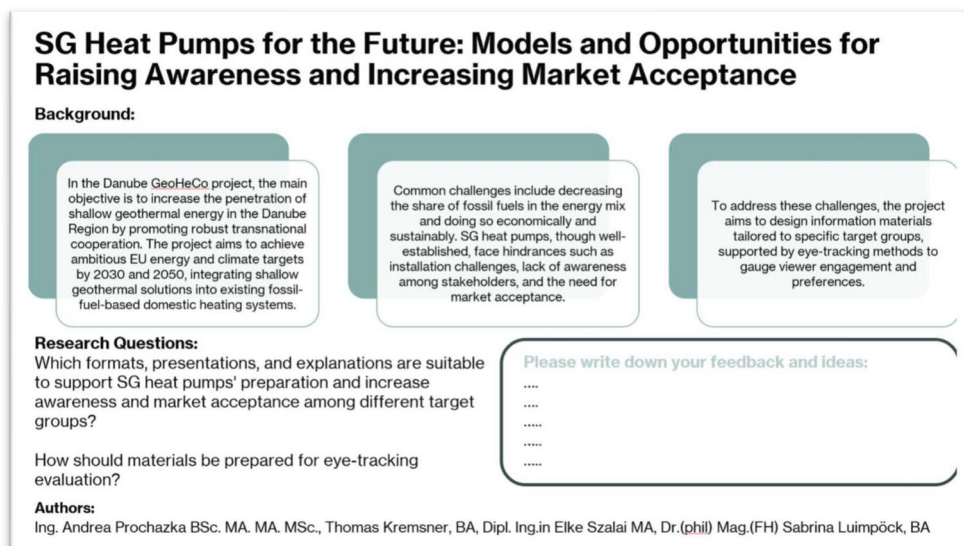


Figure 1. Overview Poster SG Heat Pumps for the Future

Two posters were created for participant engagement. One highlighted the Value Propositions (VT) of SG heat pumps, emphasizing energy efficiency, environmental benefits, reliability, and cost-effectiveness. The other focused on Negative Triggers (NT), such as installation complexity and upfront costs. Participants affixed stickers to indicate

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their priorities, offering insights into their perceptions of SG heat pump technology. The research methodology included conducting interviews with target groups to develop personas representing typical customers. These served as a framework for designing information materials tailored to diverse demographics. Eye-tracking was employed to assess the effectiveness of initial material concepts in capturing viewer attention and comprehension in relation to the identified VT and NT. Eye-Tracking is a method to accurately assess the eye-movements of participants during a study [4]. In this study, the Tobii Glasses 3 were used to measure participants' eye movements.

In the eye-tracking analysis, 3 participants were shown two posters, each containing advantages and disadvantages of SG heat pumps. On these posters, each advantage and disadvantage are considered a separate area of interest. They then analysed which advantages/disadvantages were most fixated.

4 RESULTS

Participants selected Value Triggers (VT) highlighting various benefits of using SG Heat Pumps in the Danube Region. 5 participants stressed energy efficiency, 3 noted versatility, and environmental benefits, while another 3 mentioned long-term cost savings. Additionally, 3 participants recognized consistent performance, 1 acknowledged durability, and another 1 highlighted quiet operation. These VTs demonstrate potential for widespread adoption and the role in fostering a sustainable energy landscape in the region. The selection of Negative Triggers (NT) reveals challenges in adopting SG heat pumps in the Danube Region. 5 highlighted high initial costs, emphasizing the need for cost-benefit analyses. Another group of 5 emphasized the importance of site geology, stressing thorough site assessments. Concerns about water availability in 2 voices suggest exploring alternative heat sources. 2 noted SG heat pumps' reliance on electricity, urging sustainable energy solutions. 3 highlighted installation complexity, advocating for comprehensive training and support. Understanding these challenges aids stakeholders in navigating towards sustainable heating solutions for a resilient energy landscape.

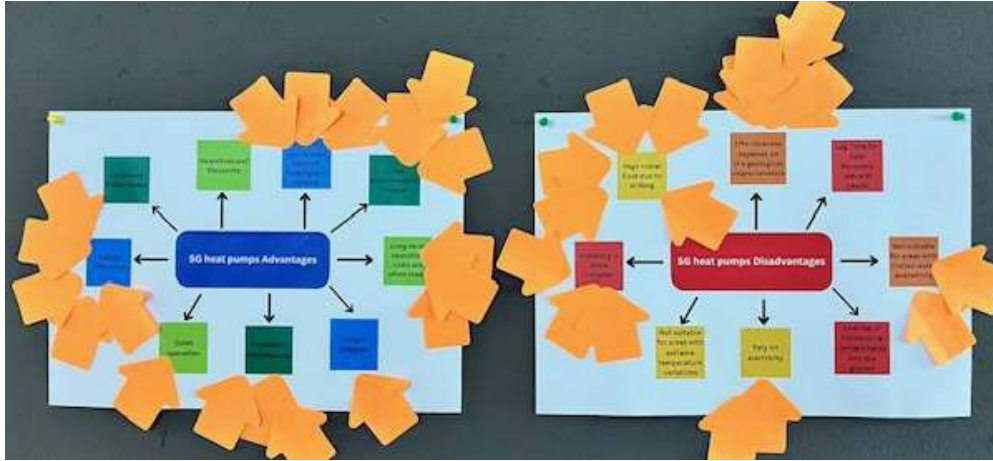


Figure 2. Overview Poster focused on VT and NT

The eye-tracking analysis also provides clear results regarding the main advantages and disadvantages of SG heat pumps: Among the advantages, the ‘Quiet Operation’ point was viewed most frequently. The first point the test subjects looked at on the advantages poster was ‘Consistent Performance’. The most frequent fixations occurred for the benefit ‘Longer lifespan’ with 9 fixations, followed by ‘Long-term operating costs are often lower’ with 8 fixations. The two points ‘Versatility’ and ‘Lower environmental impact’ were considered the least. In terms of the disadvantages the AOI ‘Installing is more complex’ was viewed most frequently with a total of 14 fixations. This disadvantage was also fixated the fastest. The AOI that received the least attention was ‘Low risk of introducing contaminants into the ground’. Only 2 fixations were identified here. Furthermore, none of the participants looked back into the field more than once. The time the participants spent reading the disadvantages presented ranged from 621.1ms for ‘Not suitable for areas with extreme temperature variants’ to 2504.5ms for ‘Installing is more complex’. Furthermore, no relationship between the evaluated data of the AOIs and the colours used could be established.

5 CONCLUSIO

The Danube GeoHeCo project aims to boost the adoption of shallow geothermal (SG) heat pumps in the Danube Region by addressing both their benefits and challenges. While SG heat pumps offer energy efficiency, sustainability, and versatility, challenges like high costs and installation complexity exist. Targeted communication and support frameworks are crucial. The study focuses on identifying effective formats and presentations to support SG heat pump adoption, leveraging insights from participant feedback and eye-tracking analysis. Overall, tailored strategies and innovative methodologies are key to fostering SG heat pump adoption, paving the way for a more sustainable energy landscape. Further research is needed to validate the findings of this first qualitative study.

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