# RAISING AWARENESS ABOUT GEOTHERMAL ENERGY AMONG THE COMMUNITY OF UNIVERSITY OF COMAHUE

Lucio Belvedere
University of Comahue, Argentina (luciobelve@gmail.com)

Eros Gastón Bustos Martinez
University of Comahue, Argentina (erosbustosmartinez@gmail.com)

Franco Tomás Crespillo
University of Comahue, Argentina (fcrespillo38@gmail.com)

**Abstract**

This paper addresses the awareness of geothermal energy within the university community of the University of Comahue (Universidad Nacional del Comahue, UNCo), within the framework of Sustainable Development Goal (SDG) No. 7: Affordable and Clean Energy. The study combined a quantitative-descriptive and educational-participatory approach through surveys conducted before and after a scientific outreach campaign that included printed brochures and digital infographics. The results showed a significant increase in the level of knowledge and an improvement in the perception of geothermal energy as a clean and safe source, along with a reduction in misconceptions about its environmental impacts. Likewise, a greater willingness to change opinions after receiving reliable information was observed, confirming the effectiveness of the implemented communication strategies. Overall, the findings demonstrate that scientific education within the academic environment is a key tool to promote social acceptance of renewable energies and strengthen the transition toward a sustainable energy model.

**Keywords:** Energías renovables; percepción; aceptación.

## 1. INTRODUCTION

The development of renewable energies is a central axis in the global agenda toward sustainability. Within this field, geothermal energy stands out as a key alternative due to its renewable, reliable, and low-emission nature, directly contributing to the achievement of SDG No. 7: Affordable and Clean Energy (Tester et al., 2021). However, despite its potential, its adoption at both global and regional levels remains limited compared to other sources such as solar or wind energy.

Recent studies have shown that one of the main challenges for the expansion of this technology lies not only in technical or economic aspects but also in the level of public knowledge and perception surrounding it (Balzan-Alzate et al., 2021). These authors, through a survey conducted in five European and American countries, demonstrated that public awareness is still insufficient, which directly affects the acceptance of future projects. Similarly, in the United Kingdom, Jones et al. (2020) found that local perceptions of geothermal projects are influenced by factors such as trust in institutions and access to information, confirming the need for clearer and more accessible communication strategies.

Based on this evidence, there is a notable gap in the implementation of awareness and educational projects at academic and community levels in countries such as Argentina, where, despite having significant geothermal potential in regions like Patagonia, the visibility of the resource remains very low. This underexplored area opens the possibility of designing scientific education and communication initiatives that not only inform but also promote self-directed learning.

In this context, our project proposes the development of an awareness campaign on geothermal energy aimed at students and the academic community of the city of Neuquén. The initiative will be carried out during 2025 and includes the creation of printed brochures, digital infographics, and popular science reports. In addition, its impact will be evaluated through pre- and post-campaign surveys to measure the extent to which these actions contribute to increasing visibility and understanding of the local geothermal resource.

## 2. METHODOLOGY

This study was part of an academic project aimed at raising awareness about the energy potential of geothermal resources among students of the University of Comahue (Universidad Nacional del Comahue, UNCo). The implemented methodology combined a quantitative-descriptive and educational-participatory approach, with the purpose of gathering

information, developing outreach materials, and evaluating the impact of a communication intervention based on scientific education and self-directed learning.

Data were collected through a structured digital survey created using the Google Forms tool. The questionnaire was developed following the theoretical and conceptual guidelines proposed by Cees et al. (2020), Fernández Fuentes et al. (2022), and Balzan-Alzate et al. (2021), which served as a reference framework for selecting variables and indicators.

The survey was designed to explore three main dimensions:

- The level of knowledge and perception about geothermal energy.
- The degree of interest and acceptance regarding its use as a renewable source.
- The willingness to modify beliefs or attitudes after receiving scientific information.

The form included 15 questions distributed across six sections: informed consent, demographic data, prior exposure, factual knowledge, attitudes and perceptions, willingness to change, and one open-ended question.

During the first stage of the project (pre-awareness), an initial set of responses was collected, serving as a baseline for assessing the participants' level of knowledge and perception regarding geothermal energy. Subsequently, after the implementation of the information campaign—which included the distribution of a printed brochure and a digital infographic—a second survey (post-awareness) was carried out. This made it possible to compare the results obtained in both stages and analyze the changes resulting from the communication intervention.

The sample consisted of students from the University of Comahue (UNCo), primarily from the Engineering College, although students from other related programs also participated. The sampling was non-probabilistic and voluntary, as participation was free, anonymous, and without incentives. Most participants were between 20 and 24 years old and had basic scientific or technical training, which was consistent with the objectives of the study.

The analysis of results was conducted using descriptive statistics, applying frequency and percentage calculations for each closed-ended variable. Data were processed with basic tools such as Google Sheets and Microsoft Excel, which allowed the generation of tables and bar charts to visualize general trends and comparisons among categories. The main goal of the analysis was to identify patterns of knowledge, perception, and adaptation of geothermal energy before and after the awareness campaign. Open-ended responses were examined through a simple qualitative analysis, grouping comments according to recurring topics or concerns (for instance, fears about resource exploitation or the economic feasibility of geothermal development).

## 3. RESULTS

The following section presents the results obtained from the initial and final surveys conducted as part of the research on geothermal energy awareness within the university community of the University of Comahue (Universidad Nacional del Comahue, UNCo). The purpose of these surveys was to assess the degree of knowledge, perception, and willingness of students toward the use of geothermal energy as an alternative source within the broader context of the national energy transition. The first survey was conducted prior to the awareness campaign, while the second took place afterward, allowing for a comparative analysis of changes in attitudes and knowledge among respondents.

Responses were mainly provided by students from the Engineering College (FAIN) and, to a lesser extent, from the College of Law and Social Sciences (FADECS). Most participants were between 20 and 24 years old, representing a young university audience still in training. This demographic trend remained consistent across both surveys, ensuring comparability between pre- and post-intervention results.

Regarding prior knowledge, a high percentage of respondents—mostly engineering students—indicated that they had previously heard about geothermal energy, although many acknowledged having only superficial information. The main sources of knowledge were the University and social media, followed by traditional media and technical talks. Later, in the final survey, an improvement was observed among students from non-geological disciplines (such as FATU, FADECS, and FACIMED), achieving a more balanced overall understanding of geothermal energy.

In terms of conceptual comprehension, the majority of respondents in the initial survey correctly identified that geothermal energy harnesses the Earth's internal heat. In the second survey, this majority became unanimous (Figure 1). However, in the first phase, some participants expressed uncertainty regarding the products derived from this energy, associating its use exclusively with electricity generation. After the awareness campaign, the proportion of respondents who recognized that geothermal energy can generate electricity and also provide direct heat for uses such as building heating increased significantly (Figure 2). This result demonstrates a better understanding of the multidimensional potential of this energy source.

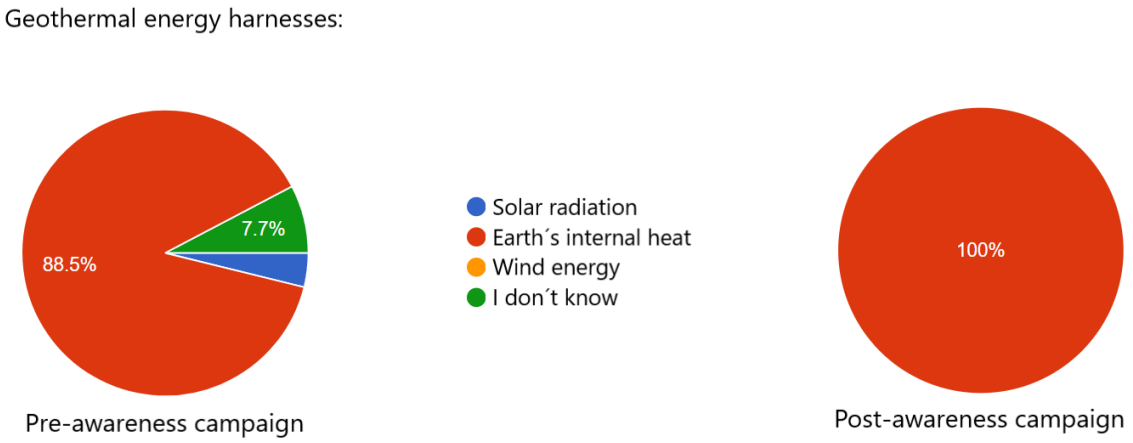


**Figure 1.** Level of understanding of the geothermal energy concept before and after the awareness campaign. The pie charts show an increase in the proportion of correct answers after the intervention, demonstrating an overall improvement in the comprehension of this energy source's origin.

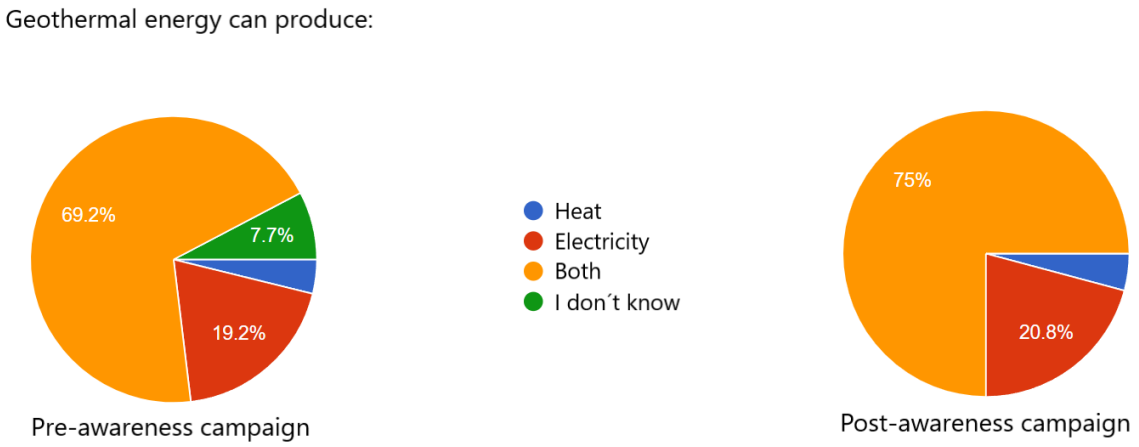


**Figure 2.** Identification of geothermal energy uses before and after the awareness campaign. A significant increase is observed in the recognition of its applications for both electricity generation and direct thermal uses (e.g., space heating in buildings).

Concerning perceived technical risks, surface water contamination and induced seismicity were the most frequently mentioned concerns in the initial survey. However, after the awareness stage, the answers reflected a clearer distinction between real risks and misconceptions, showing a decrease in the direct association between geothermal energy and contamination. Regarding greenhouse gas emissions, while some respondents initially answered "I don't know," the final survey showed a shift toward recognizing that geothermal energy does not produce emissions comparable to fossil fuels, evidencing an improved understanding of its environmental advantages (Figure 3).

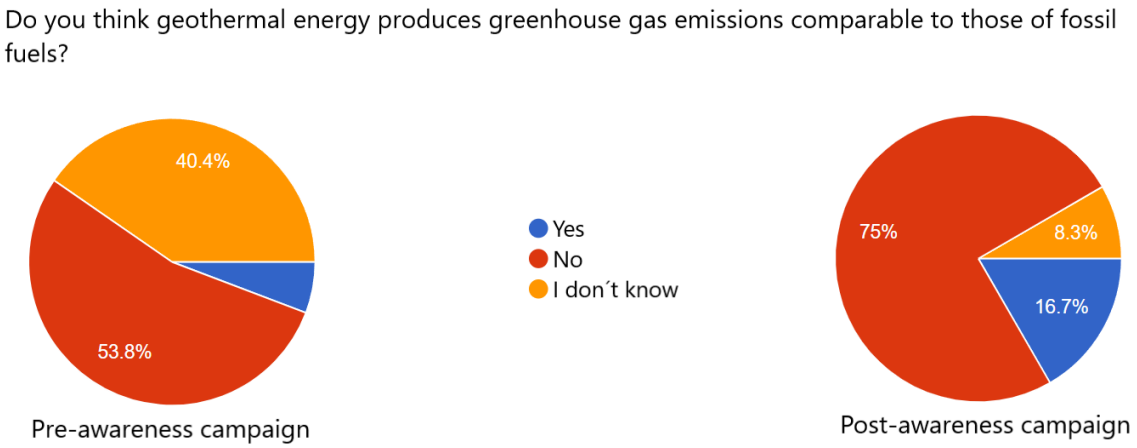


**Figure 3.** Perception of greenhouse gas emissions associated with geothermal energy. Comparative results between both surveys show a decrease in responses that considered it similar to fossil fuels and an increase in the recognition of its relatively low environmental impact.

When asked whether geothermal energy is perceived as a safe alternative compared to fossil fuels, the initial survey revealed a generally positive trend, with average values between 4 and 5 on the Likert scale. After the intervention, results showed a consolidation of this positive perception, with a greater proportion of responses in the highest value (Figure 4). Similarly, most respondents considered it important to include this alternative in Argentina's transition toward clean energy sources, a tendency that became more pronounced in the final survey. This shift suggests an increased strategic appreciation of geothermal resources within the national energy landscape.

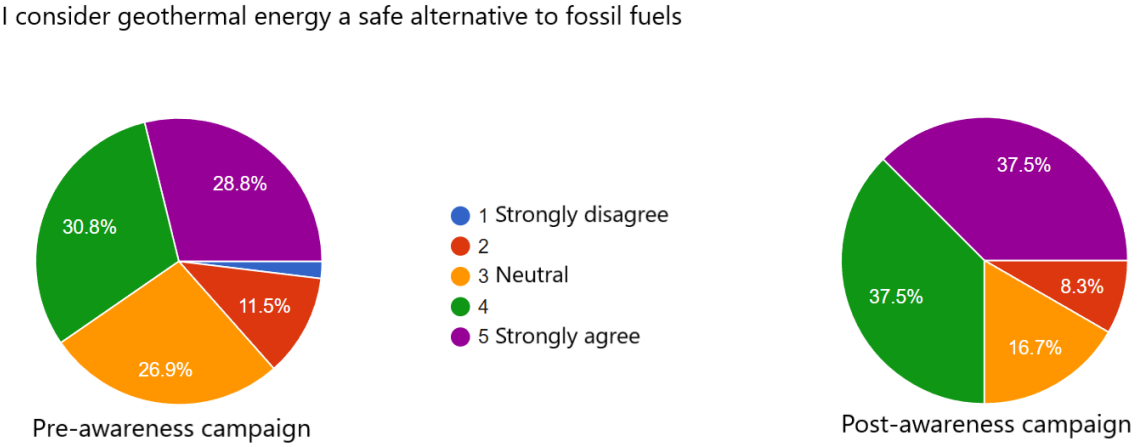


**Figure 4.** Evaluation of geothermal energy as a safe alternative to fossil fuels. The results show an increase in positive perception and greater confidence in its role within the transition toward clean energy sources.

One of the most relevant indicators was the respondents' willingness to modify their opinion after receiving information about geothermal energy. In the initial survey, answers were

distributed between “moderate” and “a lot,” with few cases of resistance (“little”). After the awareness activity, responses shifted toward higher levels of openness, with most participants choosing “a lot” or “completely.” Similarly, self-assessment of knowledge (“I have enough information to express an opinion about geothermal energy”) showed an average increase of at least one point on the scale, indicating that the information was presented clearly and concisely, avoiding excessive technicalities that could confuse non-specialized audiences.

Regarding doubts or concerns, the initial survey responses focused mainly on economic and technical aspects such as implementation costs, project feasibility, or local applicability. After the awareness process, concerns became more specific and substantiated, focusing on energy efficiency, utilization capacity, and environmental monitoring. This evolution indicates a shift from a general perception toward a more technical and critical understanding of the topic.

## 4. DISCUSSION

The results obtained allow us to establish a direct relationship between the implemented communication intervention and the changes in perception and knowledge within the university community regarding geothermal energy. As evidenced by previous studies in other contexts (Balzan-Alzate et al., 2021; Jones et al., 2020), scientific information and education play a decisive role in shaping social acceptance of renewable energy sources. In the specific case of the University of Comahue (Universidad Nacional del Comahue, UNCo), the experience developed demonstrates that well-planned and contextually adapted dissemination can have a significant impact even among groups with a basic scientific or technical background.

The comparison between the initial and final surveys shows that students not only increased their factual knowledge about geothermal energy but also changed their perception of its viability and environmental safety. This transformation aligns with the observations made by Cees et al. (2020), who argue that evidence-based learning processes are key to building trust in emerging technologies. In particular, the reduction of misconceptions — such as the direct association between geothermal energy and environmental pollution or deforestation — reflects progress toward a more accurate and informed understanding of the resource.

Moreover, the improvement in the valuation of geothermal energy as a clean and safe alternative indicates an internalization of the sustainable energy discourse. This phenomenon can be interpreted as an outcome of informal education within the university setting, where the combination of visual materials, accessible language, and local examples facilitates knowledge appropriation. The results also suggest that information presented through direct and tangible

media (such as printed brochures and digital infographics) has substantial influence in shaping attitudes and increasing openness to change, as also reported by Fernández Fuentes et al. (2022) in the context of environmental education campaigns.

A particularly relevant aspect of this experience is that most respondents expressed a strong willingness to change their opinions once provided with reliable information. This behavior reinforces the idea that lack of prior knowledge, rather than negative attitudes or social resistance, constitutes the main barrier to geothermal technology adoption in local contexts. On the other hand, the shift in concerns — from general economic aspects to more specific technical issues — suggests a process of cognitive maturation, resulting in a more critical and informed perception of the topic.

Finally, although the analyzed sample was relatively small and non-probabilistic, the findings allow for the inference of representative trends within the university environment. Initiatives of this kind, if replicated on a larger scale, could become a foundational tool to integrate energy education into academic programs, strengthening the link between applied research and social awareness about geothermal resources in Argentina.

## 5. CONCLUSIÓN

This study confirmed that the awareness and scientific dissemination strategies implemented within the university environment generate a positive impact on knowledge and perception regarding geothermal energy. After the educational intervention, participants demonstrated a stronger understanding of the origin, functioning, and potential of this resource, as well as a more favorable perception of its incorporation into the Argentine energy landscape.

An overall increase was observed in self-reported knowledge levels, a decrease in misconceptions related to environmental impacts, and a greater willingness to change opinions. These results highlight the effectiveness of scientific education as a tool for promoting informed and critical attitudes toward the use of renewable energy sources.

Furthermore, the study confirmed that the main obstacle to social acceptance of geothermal energy does not lie in a rejection of the technology itself but rather in the lack of accurate and accessible information. The experience developed demonstrates that, through appropriate communication strategies, it is possible to strengthen public trust and interest in this energy source.

From an institutional perspective, the experience suggests that the integration of renewable energy topics within the academic environment can directly contribute to achieving the Sustainable Development Goals, particularly SDG No. 7. Replicating this type of project in other colleges or universities could foster a more informed academic community committed to energy sustainability.

In summary, the awareness campaign developed at the University of Comahue (Universidad Nacional del Comahue, UNCo) proved to be an effective instrument for increasing the visibility of geothermal energy and encouraging active student participation in the transition toward a cleaner and more sustainable energy model.

## REFERENCES

Balzan-Alzate, D., López-Sánchez, J., Blessent, D., Raymond, J., Dezayes, C., Portela, J. P., Ramírez Restrepo, E., Moreno Rendón, D., Malo, M., Goderniaux, P., Daniele, L., & Le Borgne, T. (2021). *An online survey to explore the awareness and acceptance of geothermal energy among an educated segment of the population in five European and American countries*. *Geothermal Energy, 9*(9). https://doi.org/10.1186/s40517-021-00188-x

Fernández Fuentes, I., Barich, A., Baisch, C., Bodo, B., Elíasson, O., Falcone, G., Friederichs, G., de Gregorio, M., Hildebrand, J., Ioannou, A., Medgyes, T., Miklovicz, T., Pérez, P., & Pinto, M. T. (2022). *The CROWDTHERMAL project: Creating public acceptance of geothermal energy and opportunities for community financing*. *Energies, 15*(21), 8310. https://doi.org/10.3390/en15218310

Willems, C. J. L., Ejderyan, O., Westaway, R., & Burnside, N. M. (2020, April 26–May 2). *Public perception of geothermal energy at the local level in the UK*. In *Proceedings of the World Geothermal Congress 2020* (Reykjavik, Iceland). International Geothermal Association.