CROWDTHERMAL DELIVERABLE D1.3

# STAKEHOLDER AND CASE STUDY ANALYSIS REPORT

*Summary:*

The stakeholder and case study analysis report reflects the results of qualitative interviews and contextual analyses in the three CROWDTHERMAL-case studies in Hungary, Iceland, and Spain. While comparing the three cases which are different regarding the time dimension, technological approaches, and regional contexts, conclusions about relevant stakeholder settings as well as social dynamics and the meaning of psychological variables can be drawn. Especially the roles of trust and well-functioning stakeholder networks became obvious as central aspects for acceptance of geothermal projects in all three case studies.

*Authors:*

Jan Hildebrand, IZES gGmbH, Head of Department Environmental Psychology
Kathrin Klein, IZES gGmbH, Research Assistant

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# 1 INTRODUCTION

The need of a more sustainable living as well as decarbonizing our society and renewing our energy system has gained a special importance since the European Union uncloaked its plan to be climate neutral by the year 2050. Climate change became an increasing threat that was no longer to ignore.

The benefits and versatility of geothermal energy find an increasing consideration in terms of renewable energy intents. Since it has the ability to produce electricity, heating, cooling and domestic hot water and is available day and night over the entire year, it is a key component for the fight against climate change.

With alternative financing schemes and engaging communication strategies the *Crowdthermal* project pursues the goal of empowering Europeans to become a part of the development of geothermal projects which would have the desirable consequence of less dependency on fossil fuels in Europe.

In order to reach public support for community financing of geothermal projects that provide benefits for the wider society, public perceptions and barriers concerning geothermal energy need to be clarified. The described task is the superordinate goal of Work Package 1 of the *Crowdthermal* Project. The research of this Work Package is supposed to lead to the development of an "acceptance model of geothermal energy".

There are three case studies that will validate the findings of the *Crowdthermal* project: the Housing Cooperatives *Arroyo Bodonal* and *EAI 310* in Spain, *the District Heating System of Szeged* in Hungary, and the *Húsavík Community Greenhouse* in Iceland.

This report provides a detailed explanation of each case study with data retrieved from questionnaires and characteristics. Stakeholder interviews were conducted whose results were used to generate a stakeholder analysis for each case, providing an overview of the framing conditions and social dynamics between involved groups.

# 2 SAMPLE

## 2.1 BRIEF PRESENTATION

*Spanish case studies*

By using geothermal heat pumps as well as ventilation equipment with heat recovery, the project *Edificio Arroyo Bodonal* in Tres Cantos, Madrid provides heating, cooling and domestic hot water to 80 houses.

The project *EAI 310 building*, sited in the middle of Madrid´s district Chamartín, consists of 220 apartments distributed in several buildings that are being provided with energy from a shallow geothermal system.

*Hungarian case study*

The geothermal energy project from Hungary consists of nine projects that each target multiple, currently gas-based heating circuits in the district heating system of Szeged. A total of 27 geothermic (9 production and 18 injection) wells are being constructed, whereby the supply of 26,338 end users (of the 27,257 total) will be based on renewable energy.

*Icelandic case study*

The aim of the project Community Greenhouse is the illustration of how crowdfunding can increase the share of geothermal energy in food production and processing and therefore increase the regions sustainability with value creation.

## 2.2 SELECTION

The selection of the case studies for validation occurred according to certain aspects that are described in the following.

*Geothermal*. The most trivial and at the same time the most important criterion to be taken into account for a case study of the *Crowdthermal* project was the involvement of geothermal energy. *The district heating system of Szeged* was chosen because of its 1700 – 2000m deep thermal wells, producing around 70m³ of 90°C hot thermal water. The case study *EAI310 Cooperative* was elected due to its geothermal system providing heating, cooling and domestic hot water for 220 dwellings. *Edificio Arroyo Bodonal* offers geothermal heat pumps from a shallow geothermal system, providing heating, cooling and domestic hot water to 80 households and was therefore selected. And lastly, the

decision to pick the *Húsavík Community Greenhouse* as a case study was due to the use of geothermal energy to heat the greenhouse for food production.

*Crowdfunding.* Since the goal of the *Crowdthermal* project is to empower citizen to participate in the development of geothermal projects, the financing over crowdfunding was requested, but not coercively necessary, which is for instance why the *district heating system of Szeged* was notwithstanding chosen as a case study although it involved financing over EU funding and private investors.

*Geographical distribution*. In order to achieve an expressiveness that is as high as possible so that the results can be used internationally, it was minded that there is an adequate geographical distribution of the chosen projects. Thereby it is warranted that the possibility of differences over countries in points of views, atmospheres and such are represented in the results.

*Range of developmental stages*. The attempt to search for case studies that were progressed to different degrees arose from the desire to be able to have a focused look on different developmental stages of a geothermal energy project.
For *Arroyo Bodonal* and *EAI310*, not only the headstones had been laid, but also the entire implementation and energy production had already taken place before the *Crowdthermal* projects´ official start. Consequently, the process of development could not be accompanied, but rather described in the retrospective. The missing process experiences regarding already completed projects can be counterbalanced through the advantage of asking for a conclusion, “lessons learned” as well as for the general satisfaction with the final outcomes and the experiences after ending the construction works. *The District Heating System of Szeged* is a project that combines the completion of many geothermic well systems. This leads to the circumstance that although the project has already been implemented in 2017, a part of the implementation works can be accompanied by the *Crowdthermal* project, since the finalization of the works is scheduled for 2022, which enables a profitable generation of data concerning a running construction phase. In comparison to the other projects, the *Húsavík Community Greenhouse* cannot offer any evaluation of approaches because the project is still in the planning phase. Moreover is not intended to start financing or any construction works within the time period of the Crowdthermal project. Thus it is accompanied in the developmental and idea shaping state which is beneficial to gain insights on the processes during the planning phase of a geothermal project, including concrete visions and motivations.

## 2.3 GENERAL DELINEATION OF INVOLVED CASE STUDIES

The following summaries of information about each case study are based on the results of characteristics wherefore a “stakeholders and events” questionnaire was applied (compare chapter 4.1). These methods were used to gain details about a project´s individual history, initial idea, involved groups and other important facts like technical data, allowing a deeper understanding of the particular case.

### 2.3.1 Edificio Arroyo Bodonal

The project *Edificio Arroyo Bodonal* in Tres Cantos, Madrid, contains 80 houses that are being provided with heating, cooling and domestic hot water (DHC) by using geothermal heat pumps as well as ventilation equipment with heat recovery.

The project was established by the *Arroyo Bodonal Cooperative* which was constituted in 2003. Its founders decided to develop residential buildings with the highest degree of efficiency and energy savings while using sustainable energy.

The approximately 80 members of the cooperative were the main risk owners since the project was entirely financed by them. According to Antonio Martinez Ovejero, former director of the *Arroyo Bodonal Cooperative*, the residences were for people who wanted to invest in power saving because they offered an economical benefit and minimized the environmental burden. The houses cost between 127.000 and 350.000€ which corresponds to 8-10% more than ordinary ones but, since the energy savings reduce the electricity bills about 75% of the investment, they were profitable in the long term.

The integration of geothermal energy in the project was planned from the beginning, whereby no risk with public engagement occurred because the members of the cooperative (who fully agreed with the concrete plans) simultaneously were the final consumers of the produced energy.

***History of the project***

The cooperative started planning the basic project right after its constitution in 2003. In 2007 the organization process contained a concrete search for building land. By obtaining the desired plot of land in December 2009, the basic project was finished and the execution part of it began.

In the time period where the project started the construction of sustainable buildings hadn´t been as extended as it is today in Spain. This circumstance hindered the granting of permits and the finding of financing entities and construction companies to help with the implementation of the project since they showed a lack of trust and credibility. The cooperative and the responsible architect for the

project were so convinced of the benefits of using high-quality installations that they held on to their position even though subcontractors proposed using lower-quality installations to save money. They showed full confidence in the initial project. The challenge to find construction and installation companies helping them without wanting to change certain aspects of the project delayed the implementation of it.

Finally, in 2013, after receiving financial credit from *Triodos Bank*, the realization of the plans began and the following construction works officially ended in March 2015. One month later, the houses were handed over to their owners and the first energy production took place.

**Figure 1:** Edificio Arroyo Bodobal - The finalized project.

***Technical data, energy consumption and emissions***

Compared to the primary construction plans, there was an improvement for the geothermal energy system of the project. Several heat pumps per portal were planned, and the system implemented was a centralization with a power of 430 kW. There is no petroleum gas nor solar modules, air conditioning systems or another backup system.

The amount of energy savings is up to 80% which corresponds to half a million kilowatt hours per year. The reduction of $CO_2$ emissions per year should amount to 120 tons which are 73% less than the emissions of a conventional building.

***Involved groups***

The *Edificio Arroyo Bodonal* project involved several groups during its planning and implementation phase. Next to the *Arroyo Bodonal* cooperative that functioned as the promoter, investor and final consumer, *ACRE Arquitectura* was involved in the project and offered the support of Carlos Nieto Gómez, an experienced architect on the field of projects containing geothermal. Retrospectively he played a very important role in convincing doubters on the potential of the project due to his know-how. Incorporated engineering companies were *Render Industrial*, *Sacyr Industrial* and *Indra*; installer companies involved were *Ferconsa* and the *HDA Group*. *Ferrovial Agroman S.A.U.* served as the main constructor of the project. Since the Triodos Bank offered the financial credit to realize the project plans, it represented the involved financial entity. Lastly, since the project´s place of location is Tres Cantos, the local municipality *Tres Cantos City Hall* was another stakeholder of the project.

***Appreciation for the project***

Media reports indicate the geothermal project from the *Arroyo Bodonal Cooperative* is one of the first estates in Spain with an A-energy label, thus the highest standards for energy efficiency are warranted. Compared to a building of lower G-class, the $CO_2$ emissions per square meter of this one are less than one-tenth. Regarding these numbers, the project won the award for "the best energy efficiency housing initiative at the national level" by ASPRIMA (Madrid Real Estate Developers' Association). The high energy label is not the only appreciable aspect of the project. Due to the combination of geothermal energy, the reuse of gray-water, optimal isolation conditions and the recuperation of kinetic energy in elevators, it has also received the LEED PLATINUM certificate in July 2016 which reveres special building strategies and practices. Obtaining this certification was a clause in the contract with Triodos Bank since they asked for a measurement of the project´s success. Moreover, in June 2016, the Counselling of Industry and Economy of Madrid awarded a price for the best geothermic system contained in the construction of a private building in Madrid. In March 2017 the project respectively the Arroyo Bodonal Cooperation was awarded by the CONCOVI (National Confederation of Housing Cooperatives) to the "best Cooperative Society 2017".

### 2.3.2 EAI310 Cooperative

***General data***

The project *EAI 310 building*, sited in the middle of Madrid´s district Chamartín, consists of 220 apartments distributed in several buildings provided with heating, cooling and (DHC) thanks to a exchange geothermal system. The buildings are surrounded by gardens, sports areas, and a swimming pool, and include a supermarket company in the commercial basement.

**Figure 2:** EAI310 building: Model of the housing complex.

***History of the project***

The project had its official start in October 2012 in form of preliminary designs with performance specifications and the establishment of the Cooperative EAI310. The founders of the Cooperative were a group of people from the neighborhood who bought or rented houses that became too small as their families grew bigger. According to Joaquín García Llaneza, president of the EAI310 collective and one of the architects of the project, as they could not find an affordable offer, they perceived the possibility to bid on the site where the old municipal council building had been constructed on to develop their own apartments using geothermal as their energy source.

With the mortgage loan concession in September 2013 and the awarding of the site one month later the Cooperative was finally able to bring the project to life. The official start of the construction work was in November 2013, beginning with the demolition work which was already as good as complete

in January of the following year. The works continued to advance until the finalization in December 2015. With the commissioning of the HVAC (Heating, Ventilating and Air Conditioning) installation, including the geothermal exchange system, in March 2016 and the following handover of the apartments to their owners the first energy was produced in July 2016.

**Figure 3:** EAI310 building: Impression of the construction works.


**Figure 4:** EAI310 building: Finalization of the project.

***The geothermal system***

The buildings with its 220 apartments were planned under the Trias Energetica concept (see Figure 5). It is sustainable using geothermal energy to cover most of its demand for cooling, heating and DHC. To cover the demand peaks, conventional systems like boilers and chillers are installed as well. The geothermal system is a combination of a closed vertical system and heat pumps and represents the biggest closed geothermal system for residential purposes in Spain.

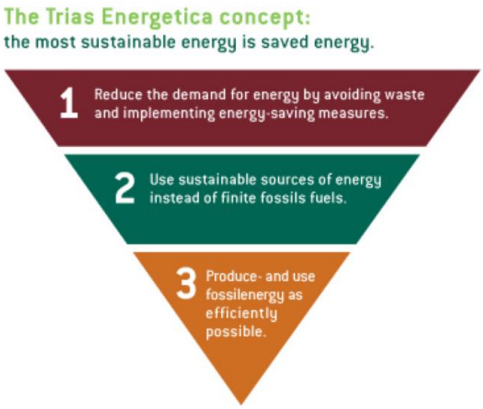



**Figure 5:** Graphic model of the Trias Energetica concept

In July 2016 the system was ready to be used and produced energy for the first time to provide the households. With additional promotive arrangements, like highly isolating material, the building is offering attractive consumption data.

***Beneficial aspects concerning energy consumption and emissions***

During the build-up process, several intermediaries proposed cheaper systems of lower quality to save money. The cooperative kept hold of the original plan with its high-quality geothermal system and other sustainable specifications regarding long-term financial benefits in form of energy savings.

With the implemented system the energy consumption per square meter is around 15 kWh/year (to compare: the average reference value in Madrid is 248,2 kWh/year, which is 16 times more), the CO2 emissions are about 3 kilograms per square meter a year (reference value for Madrid: 56,3kg). Another reason for the environmental friendliness is the furtherance of electric mobility by providing 12 installed charging stations on the area.

***The project´s popularity***

Before the actual build-up started, the EAI310 Cooperative had already reached its full number of members and all of the apartments had been assigned. Not only that, the interest in getting one of the 220 apartments was so high that a waiting list with over 100 prospective buyers was generated in case one gets free.

Since the geothermal system had been part of the initial idea and interested were free to decide whether to join the cooperative under the given circumstances or not, no discussion about using geothermal came up. Still the project planners made sure that cooperative members´ interests were cared about by providing an expert with deep knowledge on the project itself as well as on geothermal in general they could address.

***Financing of the project***

The funding for buying the property and constructing the building was secured from the beginning. To become a member of the EAI310 collective, registration with a commission of 300€ seed capital needed to be made. They also paid 30% of their apartment´s final price beforehand, thus there was no financial insecurity concerning the implementation of the project. The entire project has been solely financed by the members of the cooperative which makes them the main risk owners.

***Involved groups in the project***

There were several involved entities in the project. The members of the *EAI310 Cooperative* were the promoters, investors and inhabitants at the same time. The operator of the project, also responsible for the maintenance and monitoring of the geothermal exchange system and the HVAC installation was *INSSERCO*, a company for energy supply services. The main contractor during the construction phase of the project, specifically in charge of the HVAC and MEP installations, was *Ferrovial Agroman S.A.U*. Furthermore, several architects from *EAI Arquitectura S.L.P.* were involved in the realization of the residential buildings. Responsible for security coordination was *CSP Coordinación*. The company in charge of the energy modeling was *Eurocontrol S.A*. The engineering of the geothermal exchange system was the task of *IFTEC GeoEnergía S.L.*, more precise of Marcel Hendriks, who is also one of the *EAI310 Cooperative´*s founders. The municipality of Madrid and representatives of the *Madrid City Council* were involved authorities.

### 2.3.3 District Heating System of Szeged

***General information***

The geothermal energy project from Hungary facilitated by the *District Heating Company of Szeged* started on September 26th, 2017. Since then, the project has been in constant progress. Nine projects that each target multiple heating circuits have received EU funding and works have either started or will start soon.

A total of 27 geothermic well systems are being constructed, whereby 9 heater loops on basis of renewable energy emerge. With about 96% of end-users affected it is going to be the second biggest geothermic district heating system in Europe, following Reykjavik.

***Technical data***

The design of the project contains a total of 27 geothermic well systems with nine heater loops on basis of renewable energy. The warm water of 90° that rises up the wells of 1700-2000 meters depth results in up to 600.000 gigajoule thermal energy per year. In average, the wells will produce about 70 cubic meter water per hour which is being used as a heating medium for boiler rooms. The operation period of a geothermal system can be up to 60-80 years, if serviced correctly. Drilling a borehole can take up to three months; overall 54km need to be drilled for all boreholes of the project. Another necessary procedure is the construction of pipelines between the wells and the boiler houses (42km long altogether) and 75 heat exchangers in district heating centres.

***Financial aspects***

As known through research financial is the most important aspect for the acceptance of geothermal energy by the public is. The entire costs of the project aggregate to 63.000.000€, the EU covers about 50% of it while the rest is paid by the financial investor. Although the geothermal production of heat is cheaper compared to gas there will be no cost reduction for the citizens by the DH Company because district heating (as well as water and electricity) tariffs are sate regulated in Hungary.

***Environmental aspects***

The realization of the geothermal project in Szeged might not score in financial benefits, but it does in environmental aspects. It is expected that thanks to the thermal well systems and their produced heat 30 billion cubic meter gas used annually for district heating as well as 45.000-55.000 tons of carbon dioxide emissions will be bisected after around four years of operating time. According to projections the natural gas saving in terms of energy will be about 595.887 GJ (82%) a year, in terms of volume 17.525.718m$^3$ per year (68%) and the CO2 emission saving per year is expected to be about 34.699 tons (65%). Furthermore the geothermal project in Szeged will result in an independency from gas imports due to the local production of thermal water.

***Timeline of the project***

A closer look at the planning and organization of the project reveals that the construction procedures started in 2019 and are expected to end in 2022. In March 2019, they started drilling Uptown, in May they started laying pipelines in Odessa which ended in November. The year 2020 contains the start of laying pipelines in Rókus in January (Figure 6-8), in the Northern area in April, in Észak 1B, in Rókus II, in Tarján as well as in Szilléri in June. Furthermore, starting the drilling Downtown in April and ending the drilling for Uptown in March and for Rókus in September are part of the organizer´s planned

steps for the year. The actions projected in 2021 are the end of drilling in the Northern area in January and in Rókus II in September as well as the end of laying pipelines in Downtown in May. Finally, the last steps of the geothermal project in 2022 are the end of drilling in Szilléri in January and in Tarján in June as well as the end of laying pipelines in Észak 1B.

**Figure 6:** Public event at the drilling site of the Rókus area.

**Figure 7:** Impressions of the tour over the drilling site in the Rókus area.

**Figure 8:** A closer look of the constructions on the Rókus drilling site.

***Involved entities***

The project is being operated by private investors who have founded a company – *Geo-Hőterm Ltd.* – specifically for this project. The state owned non-profit organization *NFP Ltd*., that is responsible for public procurements and communication and the municipally owned *SZETAV Ltd*. (*District Heating Company of Szeged*), a well-established company in Szeged, complete the three-member-partnership that implement the project. The different installations that are contained in the projects have different owners. For instance, thermal water production and injection installations belong to *Geo-Hőterm Ltd.* whilst pipelines and heating centres like boiler rooms, furnaces or heat exchangers belong to *SZETAV*. Responsible for the communication and participation process is the *NFP Ltd.* as well as specialized firms like *Truecolour Ltd.* for Uptown, *EPS Kereskedőház Ltd.* for Odessa és Rókus housing projects and *Medialog Hungary Ltd.* for the Nothern area. Representatives of the municipality are part of the municipal administration of the city of Szeged (*Szeged Megyei Jogú Város Önkormányzata*).

***Public´s acceptance***

Since drilling is inevitable and the systems are not only built in peripheries but in residential zones, certain discomforts like noise, pollution and uncongenial smell concern the inhabitants.

Generally the project planners reported complaints about the noise, smell or mess whereof most were addressed to *SZETAV*. A containment of the noise could – at least partly – be reached through the build-up of a noise protecting wall around the construction area.

A possible amendment of the project´s image could be achieved by the start of a new “Green Szeged” campaign implemented by the City Hall. The geothermal developments are supposed to depict the flagship project of it.

Furthermore *SZETAV* offered tours of the project´s siting areas (such as depicted on figures 6-8), participated in public hearings or gave interviews to heighten transparency.

### 2.3.4 Húsavík Community Greenhouse

The geothermal energy project will be developed in Húsavík, a town 50 km north of Lake Mývatn, in the north-east part of Iceland. This is a showcase for the direct use of geothermal energy and its possibilities.

***Eimur – Initiator of the project***

The project is initiated by Eimur, a sustainability initiative working towards more diversity in utilization and innovation of geothermal for the north-eastern area of Iceland. The superordinate goal of Eimur is an increased sustainability, which its members are trying to accomplish by promoting the utilization of geothermal energy as well as emphasizing the importance of natural resources that have a positive impact on the quality of life. Spreading suitable information to improve the knowledge on how the community, the environment, the resources and the economy can function together and mapping the fields of natural resources for potential utilization are part of the tasks Eimur has undertaken.

***The idea of the Showcase***

The idea behind the project Community Greenhouse is the illustration of how crowdfunding can increase the share of geothermal energy in food production and processing and therefore increase the regions sustainability with value creation. The project is also meant to improve the living conditions in the town of Húsavík, and to spark ideas for innovative use of geothermal. Harnessing the local resources, among others geothermal energy, creating new jobs, supporting the local economy and providing continuous access to local carbon neutral produced foods are further sustainable and beneficial effects of the project.

***Why Húsavík?***

Several convenient factors of the region Húsavík influenced the decision to site the project there. As depicted on *Figure 9*, Húsavík offers an old warehouse that is suitable to transform into the planned Greenhouse, since it is surrounded by geothermal energy because the region is located near five active volcanoes. Húsavík does not only offer geothermal fields whose obtained energy can be used

to heat the greenhouse and provide energy for artificial lights so that the plants can grow independently from seasons, but it also offers a respectable amount of fresh water.

Furthermore the project and the remarkable number of tourists visiting Húsavík allows a mutual profiting for both sides. Besides, another very helpful factor is the supportive municipality of Húsavík that facilitates the implementation of necessary steps.

**Figure 9:** Old warehouse in Húsavík that will be transformed in to the Greenhouse.

***Composition of the project***

A communal vegetable garden where individuals and businesses can rent a slot to grow vegetables, fruits or herbs or do small scale experiments to account for agricultural innovation is one of three parts the construction consists of. The garden can also be used by schools for teaching matters. Another part of the project is the greenhouse laboratory. In cooperation with the brewery Húsavík öl hops are planted and grown in this controlled environment. Every part of the plant can be fully utilized. The project offers the opportunity to observe the hops in the greenhouse and taste the beer brewed from it. Once the growth is done, the members of the community can sell their harvest on a market place that is also contained in the project´s construction. For the third part of the construction there are plans to create a multifunctional public space for different matters like catering, lectures and local events.

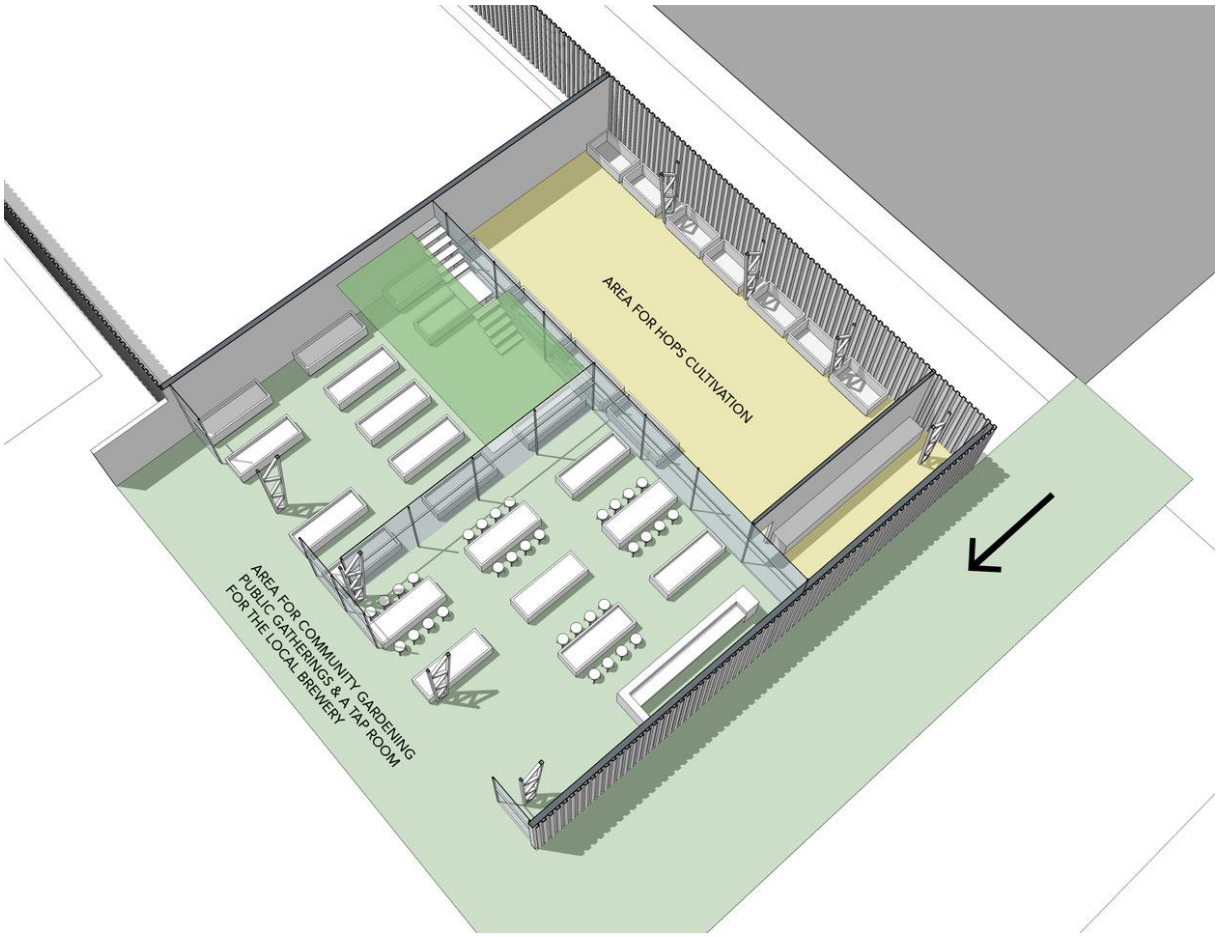



**Figure 10:** Overview of the different areas planned for the Greenhouse.

***Risks of the project***

There are certain concerns with the funding of the project. In this regard the development of a business model that is viable in the long term is one of the biggest obstacles because it decides not only about the implementation but about the endurance of the project. Furthermore the investment capabilities of Húsavík are smaller than the actual investment costs of the project. The financing model is either too complex or simply not appealing enough for the general public to have a serious interest. This circumstance leads to the challenge of finding a strategy to not only make the people and businesses care about the project but to get them involved in it for the long term.

Furthermore, some resource owners like farming communities might consider the project as a competition which reveals the potential of conflicts. Since the project is still in the planning phase there exists a dependence on the local municipality. The current members are supporting the project, but there is no guarantee that future municipality members will have the same opinion upon the plans. Another unfortunate situation could occur for locals and tourists desiring to look at the popular northern lights, since the increase of production in the area might lead to light pollution.

***Unanswered questions***

Before the project can be implemented, a lot of organizational aspects need to be settled. At the current point in time the ownership, the management and the administration is still unclear. Furthermore missing is a concrete plan for the commercial relationship between the project and future resource owners and for risk sharing matters.

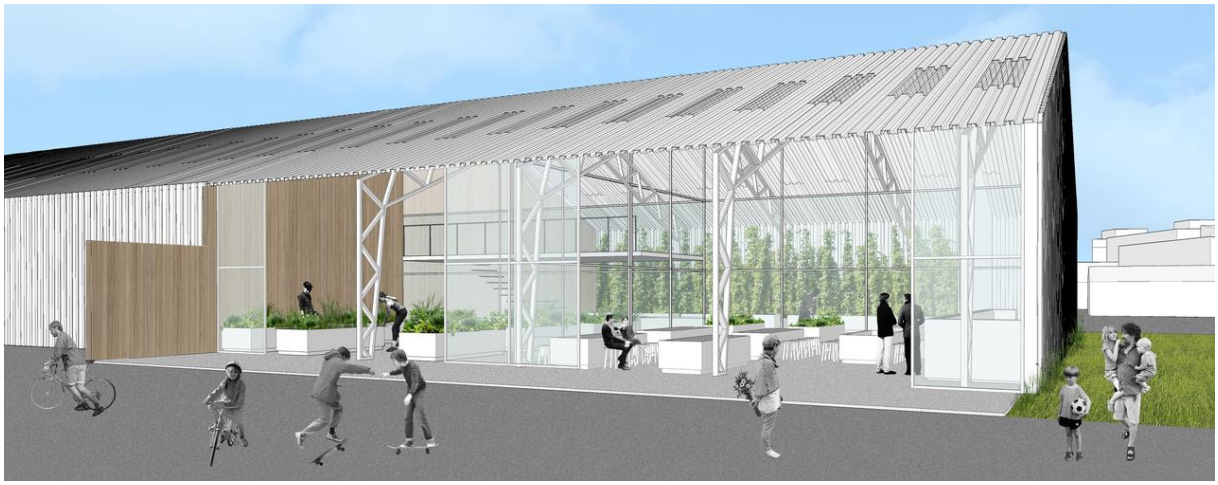


**Figure 11:** Model of the finished Greenhouse with visitors.

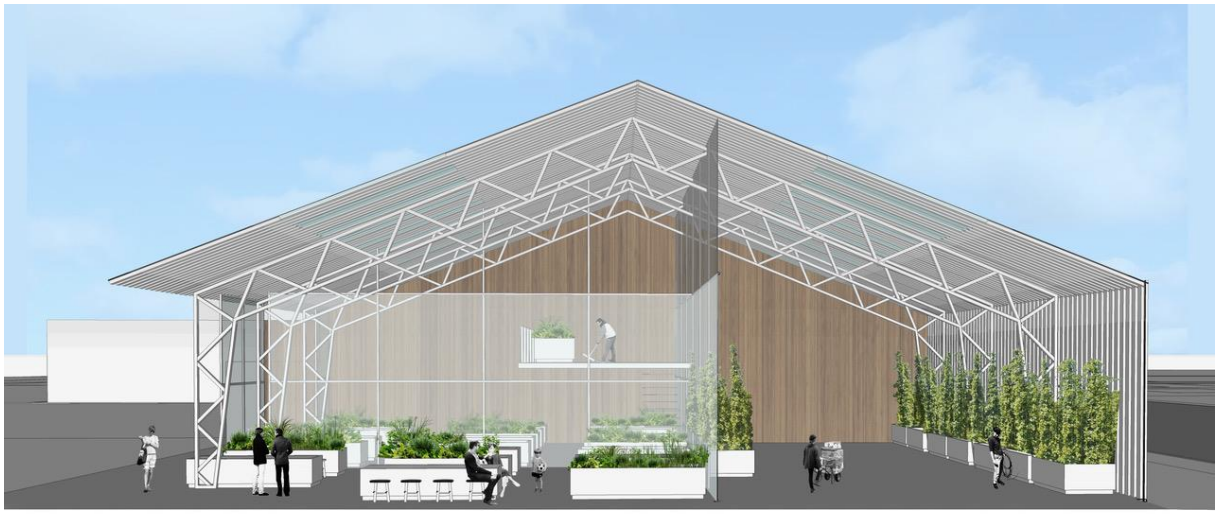


**Figure 12:** Different angled model of the end result.

# 3 BRIEF THEORETICAL BACKGROUND ON SOCIAL DYNAMICS IN DIFFUSION OF INNOVATIONS

The collocation of an "acceptance model of geothermal energy" is a necessary step of procedure for the development of a "Social License to Operate" (SLO) for geothermal energy. Therefore, relevant stakeholder´s individual perceptions regarding needs and concerns as well as their perceptions concerning the development and implementation processes need to be analyzed, since their support or opposition are crucial for determining a projects´ success or failure (Brugha & Varvasovszky, 2000; Montgomery, 1974; Brinkerhoff, 1991).

The stakeholder analysis is an approach, whose appreciation has grown over the years in different domains like management, development and policy fields. (Brugha & Varvasovszky, 2000). It is a set of tools for retrieving knowledge about involved stakeholders as a matter of understanding their interests and intentions as well as their behavior and interrelations (Varvasovszky & Brugha, 2000).

In the meaning of a stakeholder included are all actors who are interested in or affected by the matter as well as those actors with a predictable active or passive effect on particular actions and aims of a project, an organization or a policy direction, more general on decision-making and implementation processes (Varvasovszky & Brugha, 2000; Mason & Mitroff, 1981; Crosby, 1992; Walt, 1994). To give examples, individuals, organizations and networks like alliance groups are included in the concept of a stakeholder (Varvasovszky & Brugha, 2000). For the case of project development, the stakeholders can be categorized into primary or secondary stakeholders. Those stakeholders that are directly affected by the undertaking, whether it is beneficial or disadvantaging, belong to the primary stakeholders whereas intermediaries influencing project outcomes can be collated to the second category (Brugha & Varvasovszky, 2000; ODA, 1995).

To retrieve the data for the analysis, methods like interviews, questionnaires or focus group discussions can be applied (Varvasovszky & Brugha, 2000), where participants are for instance asked about their position, thoughts, attitude as well as about the networks or organizations they are in (Lindenberg & Crosby, 1981; Freeman, 1984; Blair et al., 1990).

The information stakeholder analysis offer can have multiple uses, from project planning to implementation up to evaluation (Brugha & Varvasovszky, 2000; ODA, 1995). Next to implications for stakeholder management and the facilitation of implementing specific decisions as well as a better understanding of the contextual circumstances for future innovations, a decision about rating the stakeholders in terms of their importance could be made in order to find out which ones to pay the most attention to (Varvasovszky & Brugha, 2000; Brugha & Varvasovszky, 2000).

Furthermore assumptions about the reasons for a projects´ success or failure can be made since the framing conditions and social dynamics have been revealed. Ordering the relations between the stakeholders in network maps allows a clear depiction of the full potential of influence and the actual exertion of it, thus the willingness of mobilizing their resources to reach a goal (Brugha & Varvasovszky, 2000; Lindenberg & Crosby, 1981). The mapping of involved stakeholders also offers the possibility to illustrate the relationships between them, that can be either good, neutral or conflicting (Varvasovszky & Brugha, 2000; Reich, 1994), revealing potential alliances among each other, which might be interesting for a projects´ implementation phase (Lindenberg & Crosby, 1981).

Making use of the stakeholder analysis has also gained increasing recognition in the field of implementing renewable energies. There are not only the end users that are involved in such a process, but there are multiple intermediaries and multipliers that altogether shape a social process, which in turn influences the decision-making and implementation processes. For instance, professionals like architects, engineers or installers are intermediaries with crucial influence on decision-making processes since they are the experts on their field on how to implement an aimed project. Policy makers like the municipal council, the mayor or parliamentary groups are responsible for the design of a favorable policy. The decision-making and implementation processes are also shaped by building authorities, permitting authorities and others on the administration level as well as by actors in the economy sector or societal organizations. Also, the public, including residents, but also media that contributes to the informational spread, is part of the interaction. The role of “peer effects” (Munkacsi & Mahapatra, 2019) embodies the influence of social interaction for the dispersal of innovations since it effects potential consumers in their opinion (Rai & Robinson, 2013; Narayanan & Nair, 2012; Geroski, 2000; Falk et al., 2010). Because experiences cannot be made before own acquisition, potential consumers search for references and opportunities to learn more about the technology through orientatating on other peoples experience with the technology, for instance through witnessing installations in the neighborhood and peer-to-peer communication (Rai & Robinson, 2013).

In order to make the implementation of a project work, the interactions and relations between the involved groups need to contain aspects like trust, communication, participation and transparency. Open discussions, finding compromises and shaping the process in a way every actor is satisfied with the results and the benefits outweigh the disadvantages for every group count to reliable facts enabling a projects´ success.

# 4 METHODS

## 4.1 QUESTIONNAIRE AND CHARACTERISTIC

A first step in order to come closer to the superordinate goal of WP 1 was to collocate the information in the form of characteristics. It offered the possibility to efficiently receive concrete data of a particular case study.

The approach was identical for every case study. First of all, a "stakeholders and events questionnaire" (compare appendix 8.1) was handed to cooperation partners who were responsible for a certain case study, requesting them to fill it out.

After asking for general aspects like the country and the name of the facility, the involvement in the project was focused. Dates like the project start and the first day of energy production as well as naming the initiator, the operator and the facility owner of the project were items of it. Another aspect of this category was the question about the person in charge of the communication and participation processes. After those general questions the fillers were requested to provide information about involved groups in the geothermal energy project with the plea to provide names and contact details as good as possible in case further inquiries emerged. The selection of groups included the project planner or promoter, the investors or inhabitants, the architects, engineers, installers, the main contractor or constructor, the financial entity and the municipality. A necessity for a stakeholder analysis is an overview of project related events which is why the questionnaire further asked for providing the history of the project as good as possible. Reference points for events of interest were named so that it was clear that for example foundations of citizens´ initiatives, accidents, communication activities or permits from planning authorities were important to mention. A table with three columns - year, month, description of event - facilitated a good overview. To pave the way for analyzing the media coverage and to get a better impression of the events concerning the geothermal energy project as well as reactions of the public and the mood that was spread by media, appropriate documents should be attached below the overview table. And at last, to get a better impression of the project in general, there was the plea to provide pictures or flyers of it whereof a selection is presented in the general delineation of the cases.

After retrieving the filled in questionnaires, the collected information was transferred into a characteristic for every case study (compare appendix 8.2). The way the information was sorted and headlines were selected differed, regarding the individual suitability of a showcase. These characteristics then served as a basis for the description of the case studies in chapter 2.3.

## 4.2 STAKEHOLDER INTERVIEWS

The chosen method to relocate the social dynamics while retracing the history of the project was the stakeholder interview. It was also chosen as a method because of its suitability as an information retrieval tool for the stakeholder analysis, as described in chapter 3.

### 4.2.1 Construction of an interview guideline

An interview guideline was constructed (see appendix 8.3), based on a summary of theoretical background concerning the broad range of acceptance factors of geothermal energy projects investigated so far, that can be divided into three superordinate categories, that are to say project-related aspects, process-related aspects and context-related aspects (see Figure 13).

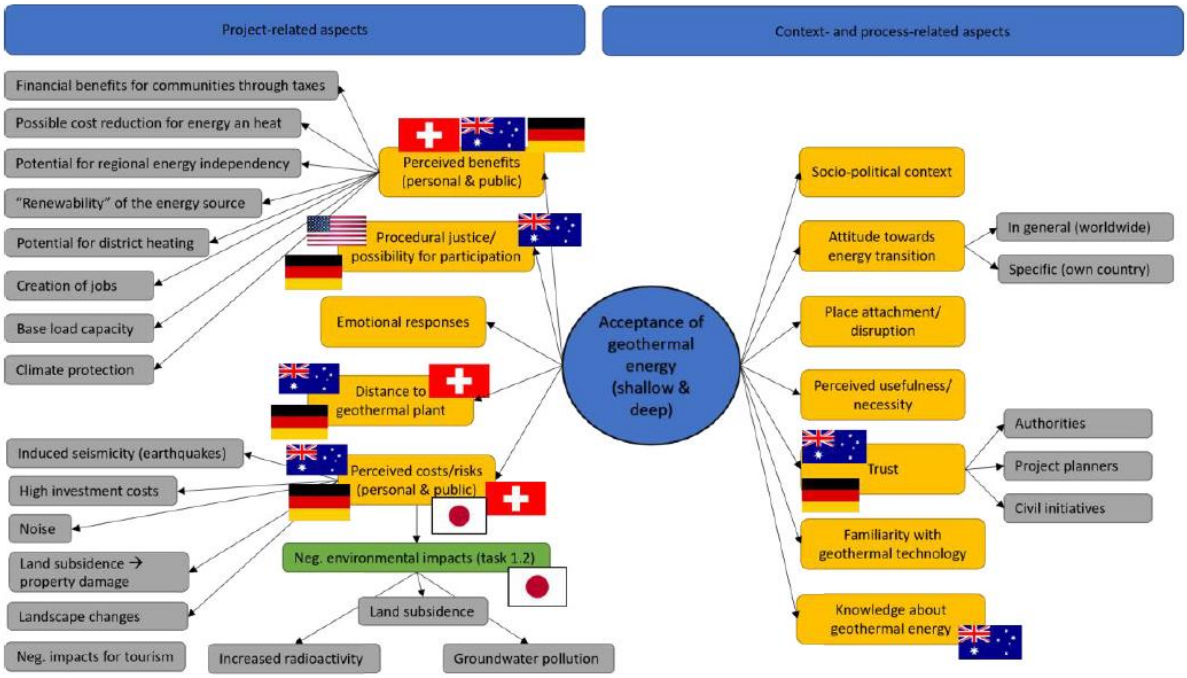



**Figure 13**: Schematic visualisation of studied topics on geothermal projects related to the origin.

The interview guideline constitutes the attempt to measure crucial acceptance factors for geothermal by means of the perception of relevant stakeholders from the different case studies regarded in the *Crowdthermal* project. More specific, there was a focus on important process related factors according to the current state of research, like procedural justice, the possibility for participation or trust. Furthermore it was meant to investigate the different stakeholder perceptions, the perceptions that came up during the process of the case studies and relevant factors concerning promoting investment.

A high amount of manageability was reached through table structuring the guideline for a better overview to ensure an efficient interview performance. The table was divided into the area of interest, the guiding-questions, the sub-questions and the comments. The area of interest represents the superordinate topic that is regarded. Every topic has its own guiding-questions that are more general and that provide the possibility for open answers of the interviewees. The sub-questions on the other hand belong to a certain guiding-question and are more specific, focusing on a certain aspect of the general topic.

The interview guideline is arranged for introducing by asking about the history of the individual project. Since another method used was the questionnaires and characteristics, there is no gain of new information but it creates a possibility to warm up in the interview atmosphere. Furthermore, it is asked to state motivations and visions before the start of the project. Another topic addressed in the guideline is communication and information. The question about undertaken communication measures during the planning and permitting process, which communication channels were used, which measures to activate persons for investment, as well as sub-questions concerning transparency, information providing during the process, possible misunderstandings, lacks of trust and how they were being solved altogether allow a better understanding of the entire project´s process. To recap, there were questions concerning the most successful strategies and the general satisfaction with the communication structure. The guiding-questions concerning participation in planning and decision making address who mainly participated, if locals were engaged or not and potential project-siting conflicts. Since the perception of the financial participation is a big topic of the *Crowdthermal* project, there is the question after relevant factors for the financial involvement, among others political and psychological determinants. The reflection of what worked especially well and that did not and thereupon what advice the stakeholders would give to someone planning to start a comparable project are the final questions that make them state their general conclusion at the end of the interview.

It is important to note that the presented structure of the stakeholder interview was only a guideline, which means it was more an orientation and support rather than a strict script for the interviewer. Furthermore the questions of the guideline were adjusted to the individual and specific situation of every showcase, meaning the tense and the composition of a question were appropriate to the developmental stage of a project.

The interviews were planned and organized together with project partners that were in direct contact with the respective case study. They also hosted the interview because it was held in English, so that possibly upcoming language barriers would not limit the benefit of the exchange. Since the given circumstances during the Corona Virus pandemic did not allow talking in person, the interviews took place via web meeting platforms.

### 4.2.2 Selection of interview partners

The selection of appropriate interview partners was based on theoretical knowledge about who has an influence on the process of project development and implementation, as briefly described in chapter 3. After considerations together with project partners of the respective case study about who would be suitable for an interview, the potential stakeholders were contacted and asked about their availability.

The exact procedure of the interview was different for every case study.

For instance the Spanish case study EAI310 cooperative was a conjoint interview with five stakeholders, who all knew each other through working together in the project that was finished a few years ago. One was the president of the Housing Cooperative EAI310 and in the meantime the architect of the project. Two more members of the Housing Cooperative EAI310 attempted to the interview as well, one having an important role being the vice president of the cooperative, and one being the consulting engineer of the geothermal exchange system, bringing this form of renewable energy into the project. Furthermore a representative of Ferrovial, the main contractor during the construction on the residential buildings of the EAI310 project joined the interview. He was responsible for the HVAC and MEP installations during the detailed design and construction. Another company involved in the project, Insserco, was also represented by a responsible collaborator. This company installed the heat pump installation and commissioned the geothermal exchange system during the projects´ implementation. Today, the company is in charge of the maintenance and monitoring of the geothermal exchange system and the HVAC installation.

For the Hungarian case the interviews were carried out solely by project partners from there because of time management reasons and because the interviews could not be held in English. The translated transcript of each interview was then used to retrieve the data for the stakeholder analysis. Interview partners were the CEO of the District Heating Company of Szeged, the CEO of the drilling company HANSA-KONTAKT LTD, the CEO of the company GEOSZ LTD, which is responsible for operating the wells once they are ready and the advisor for the Green City Program.

For the Icelandic case, three different interviews were conducted. One with the mayor of Norðurþing and therefore also Húsavík, who is the head of administration and in the meantime an elected member of the city council, another one with a beer brewer, who is interested in taking a part of the greenhouse in order to grow beer hops that his company would use for brewing and a third one with a representative of the tourist sector in Húsavík, also working for a PR organization whose general job is appetizing Húsavík on social media, web and other platforms but who will also be responsible for the media coverage and communication of the Community Greenhouse project.

# 5 RESULTS

## 5.1 RESULTS STAKEHOLDER INTERVIEWS

### 5.1.1 EAI310 cooperative

**Starting point - existing network between core stakeholders:** The project EAI310 building was initiated by Joaquin Garcia Llaneza, president of the EAI310 cooperative and José Luis Garcia, vice president of the EAI310 cooperative. The idea came up because of the housing situation in Madrid. Their old houses became too small for their families, other houses they looked out for were too expansive when having the wanted size. This is where the initial determination came from to fund a cooperation that would together with them build their own residence.

The very first persons to join the cooperative were no strangers – they all knew each other already, since their children went on same schools. So the core of the cooperative consisted of people who knew each other, which resulted in a productive work during the process.

One of the core members, Marcel Hendriks, was involved in other geothermal projects during the very early phase of planning, which inspired them to involve geothermal for their project as well. Thus it was an inherent part of the concrete plans on what the project is supposed to include. Still, it was only one part of what they wanted to achieve with this project and not an aim for itself.

All of this leads to the conclusion that next to the motivation to create new homes that are affordable, the regard on its environmental friendliness in energy supply is another important factor that marks the project. But it is also defined by creating something together as a team, as a group of people with a connection to each other. Thus besides economical and technical interests, the social spirit drives the involved to show ambition and put effort in it.

**Shared competences and collaboration within the group**: Wanting to implement an ambitioned project of this size, there are a lot of different challenges to cope with. The tasks were clearly distributed over the different experts involved in the project. Joaquin Garcia Llaneza, an architect by profession, designed the apartment blocks. José Luis Garcia was an important representative of the cooperative due to his position as the vice president and was therefore responsible for their blog and the contact with potential apartment buyers respectively apartment owners after joining the cooperative. Marcel Hendriks was the engineer and consultant of the geothermal system. Next to these members of the cooperative, they received help from two companies. There was Ferrovial, the main contractor of the project, represented by Ignacio Márquez Sánchez. He was in charge of all installations, which was next to the geothermal installation also the heating and the radiant floor that was also used for cooling. He integrated the geothermal system with the installations in general. Juan Lodares, an employee of the other company involved, Insserco, was also part of the EAI310 project. Next to building the installations, from the geothermic pump over to the heat pumps, pipes and complete installations for every apartment, the company is also in charge of the maintenance of the installations.

A geothermal system is something not everybody is familiar with. This circumstance requires more cooperation within the different experts involved, which according to Marcel Hendriks worked really good since everybody was open minded and really willed to learn and take the best out of the system, optimizing the efficiency of it. Thus although every expert was responsible for the own domain, it was still more like they were working together closely instead of simply next to each other. This was also the impression that came up during the interview which was not held single, but together in their group. The atmosphere was rather frisky and familiar. Many words of appreciation for one another for their work were spoken.

**Advantages and intrinsic motivation:** Although the completion of the apartment blocks laid a few years back when the interview was held, the pride of what they have achieved with this project did not seem to decrease over the time. The energy they spoke with was still filled with the passion and ambition they must have had when starting the implementation of the project.

The initial phase of the project took place in a hard time for Spain since there was a financial crisis. It suggests itself that the initiators were concerned whether they would find enough people to financially support them or not, if there would be people wanting to buy an apartment these unstable times. Although facing this uncertainty, they still believed in their project and wanted to realize it in exactly the way they have planned it, even though they knew in advance there could be occurring possible barriers or limitations, regarding financial and technical aspects for instance.

**Regional context – support from external institutions**: On the other hand, they received some external support through the general director of the industry department of Madrid, encouraging them to push the project since he liked geothermal as a form of renewable energies.

Another fortunate support was given by the company Heldem, giving them 10 million Euros when they bought the plot. The town hall of Madrid facilitated to sell the plot to them, but seemingly simply because they wanted to sell it, not because they viewed it as a special project they wanted to support. After receiving the plot, the treatment of this project did not differ from other, conventional ones. Furthermore, lengthy administrative processing inhibited the project in getting further. At the end of project implementation, a helping hand from the administration was missing, when they had to do the commissioning of the system. The permit for first occupation was not given, so they were not allowed to contract full electric power, which was needed for the case of a geothermal system to do the full commissioning, other than for conventional systems. It threw them a couple of months back in their time table, an unnecessary waste of time due to existing regulations.

Generally the fact that the current legislation obliges to install solar thermal for domestic hot water and demands to justify the usage of another energy efficient system is restricting. The opinion that there is more that could be done from the authorities to bring renewable energies further was explicitly represented during the interview.

**Communication – informal circles, meaning of trust**: Although there was a lot of communication involved in the project, there was no strategic communication plan. It is important to note that the communication was never about geothermal. There were basic specifications of what the apartments would be like. The members who joined the cooperative never fought whether geothermal should be done or not because it was a fact for them that the building includes geothermal energy. The core of the cooperative was the main decision maker. They drafted a plan how the project is supposed to be like and invited people to join under those fixed circumstances instead of needing their approval.

This marks the project as a very special constellated one, making it stand out compared to other ones involving renewable energies. No worries about acceptance of the renewable energy occurred, no conflicts, no persuasive talks, nor education of the people for a better knowledge and therefore less distrust.

Although there was not much need for communication in the above mentioned fields, there was still a lot of communication with potential apartment buyers about other issues, for which a blog was used as a platform. Besides informing about how to become a member of the cooperative, the main questions were of financial kind, like wanting to know more about the overall costs. Other issues

addressed were concerning the building itself, like the finished look of it, the kitchen or the type of furniture.

José Luis Garcia, responsible for the communication with potential buyers in the blog, perceived the refreshing and heating floor as a main positive aspect for evolving interest in the apartments, wherefore geothermal supplies the energy, which again nobody seemed to mind.

Generally the buyers of the apartments were not perceived as more aware of environmental issues because the focus of their interest was rather on lower energy costs than on the geothermal system as the technology behind.

When the core of the cooperative searched for people to join the project, they informed everyone who had an interest, since they all were potential financial supporters. But as soon as they had their needed 300 members, the information work confined on them.

**Authenticity – project roles**: Furthermore, they had the very special opportunity that the project initiators were not only the main decision makers, but also the end users. It was clear what they wanted for themselves as an end result, so it was never questioned during planning and permitting phase as it would be if you are working for building promoters, because you are much more dependent on their calculations, since they try to make as many savings as possible, making it more valuable for them.

**Social network and communication:** The recruitment of further members was mainly done over mouth of word and directly talking to people. At the end of the projects´ initial phase there was a professional management company involved, which announced the project on a well-known Spanish website for people who are searching an apartment to rent or buy in order to help the core of the cooperative finding people to join in.

This was a requirement from the bank and was more seen as a part of funding the project rather than really a needed support for recruitment, because they successfully convinced people by themselves. There was also no media involved in order to make it public.

This indicates how much trust there was between the buyers and the project initiators Joaquin Garcia Llaneza, Marcel Hendriks and José Luis Garcia. There are several reasons for their authentic way of suing the project.

Their motivation to start the project is understandable for other people living in Madrid or their direct neighborhood because they might be in a similar situation or at least heard about the issue through other persons concerned. Since they live in the region the building was supposed to be sited, local identity can also be considered as a facilitation of joining the cooperative.

Furthermore, they successfully managed to keep things simple, they did not think about advertising for their plans in big style, which people might have interpreted in terms of their unconditional conviction of the project finding its reasonable response.

In addition to that, it is not to forget that an occupation like an architect or an engineer increases trust since they are experts in their field and enhance the quality of the final outcome.

Another fact that surely convinced people is that the project initiators were not only that, but also end users of the apartments by themselves, giving the security that the highest comfort possible is tried to achieve since they privately profit from it as well.

Lastly, if they talked about their plans with the same passion and conviction they showed in the interview, this might have also facilitated the decision to join in.

**Post-hoc evaluation very positive, experienced advantages in use:** Since the project has already been finalized a few years ago, a conclusion about the satisfaction with the project could be made.

The satisfaction concerning energy payments is high. They are paying about 50% less than they used to in their former houses – savings that they can make due to the geothermal system.

Another issue that was often addressed when asking for an assessment of the contentedness was the high comfort due to the heating floor in winter, but even more in summer, when the floor is cooling. It is something unusual for comparable buildings in Madrid and attractive because there is no air blast nor noise or any visual impact in contrast to a regular air-conditioning system.

Although they can only be surely speaking for themselves, they estimated the satisfaction of the other apartment owners as high, since there have not expressed any complaints in contact.

The following figure summarizes the results for the case study of EAI310:

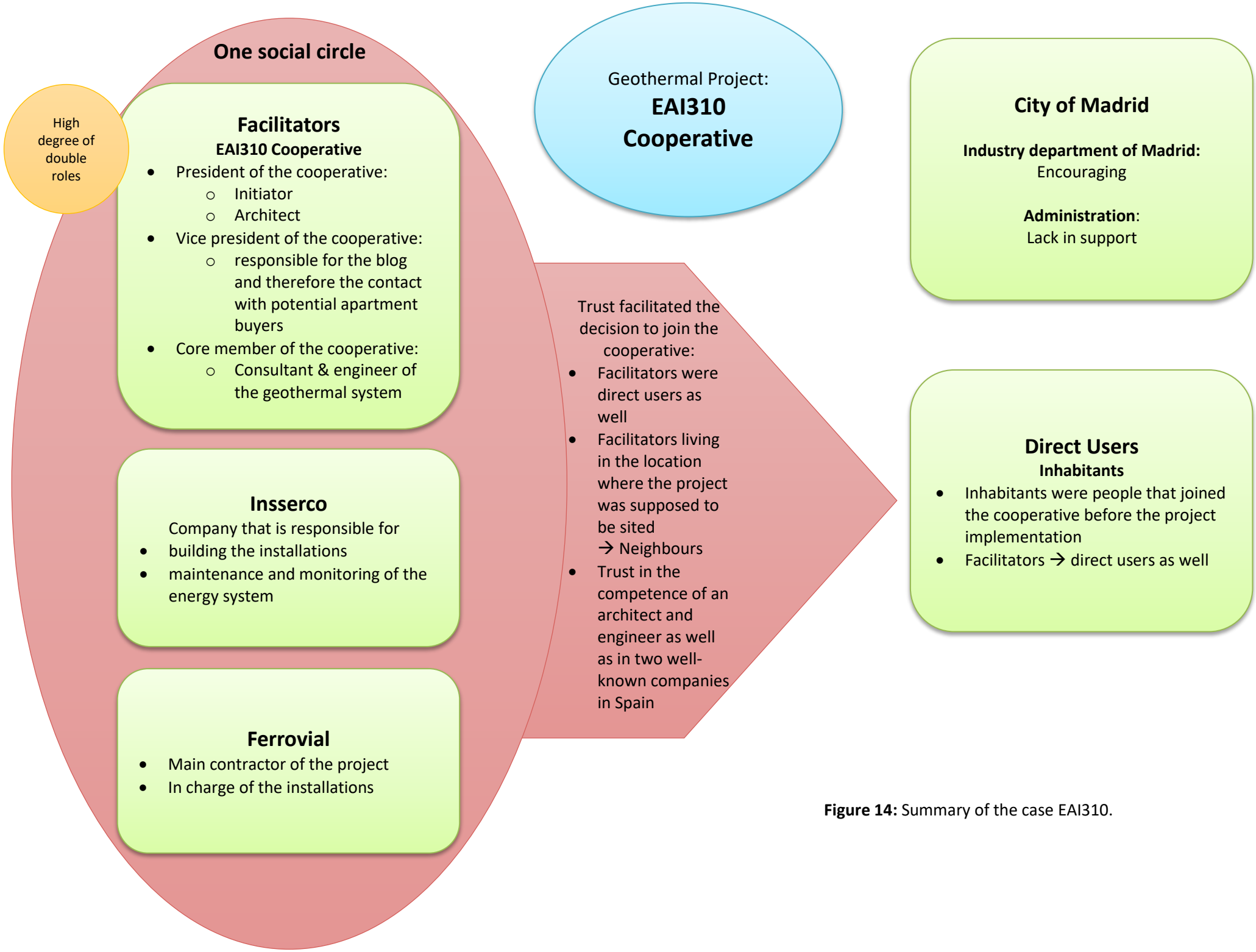



**Figure 14:** Summary of the case EAI310.

### 5.1.2 District Heating System of Szeged

In late 2014 the city council hired a group of young professionals to shape and reform the District Heating Company. Given the opportunity to run the company, it was clear for the new management they wanted to jumpstart the project because they were seeking for change in $CO_2$ emission and gas use but did not have the power to talk to the mayor or anybody in a position to make a change before being in their new position. Driven by guiding examples for the use of geothermal energy around the world as well as the nearby area of Szeged they had the vision to implement their idea of an environmentally safe and sustainable system to provide energy for Szeged. Their attitude was also perceived by other involved stakeholders like the CEO of the drilling company HANSA-KONTAKT LTD, addressing environmental considerations as a strong motivation for the District Heating Company since they sought the modernization of the old system. According to the CEO of the District Heating Company, they were not only driven by environmental issues but also by technical interest on the part of the involved engineers. He estimated an equable distribution of the reasons why they work on the project on care for the environment, pride and financial benefit. Since they invest nothing but their time and effort in the project, money or payback does not play such a crucial role as it does for the private investors, who defray half of the costs of the project. They own the largest food store chain in Hungary and most of the plants they grow come from the area around Szeged. So their decision to invest in sustainable energies for Szeged was partly driven by the desire to thank the region for the profitable harvest. Thus, there are different reasons for being part of the project among as well as between stakeholder groups.

The motivations and visions were much needed since the organizational work for the project demanded a lot of effort. As the CEO of GEOSZ LTD, the company that is responsible for operating the wells once the project is done, explained, finding places to implement the wells was not easy, because several conditions needed to be considered. Next to finding empty slots for 27 wells, there was also a good place to find in terms of well-interaction in collaboration with the hydro geologist colleagues. In order to avoid large insulated and expensive pipelines to connect the wells to the boiler houses, spots where extraction wells are as close as possible to heating centers were also necessary to descry. Although the preparation period was arduous, it was still relatively short compared to other projects. It took about four years, which might sound a lot but according to the District Heating Company, it was still more straightforward than some other projects which had some serious pushbacks or have never even reached the stage of implementation. This leads to the assumption that realizing innovative projects is not self-evident and faced with serious hurdles in Hungary.

The drilling company HANSA-KONTAKT LTD accepted the challenge of implementing the District Heating System Szeged by applying for the job because they felt appropriate since they have already contracted geothermal projects in Szeged before, which is in contrast to the above mentioned hurdles an example for successful implementation of innovations. GEOSZ LTD is also experienced in establishing geothermal systems in Szeged. Since these offer large capacities and have been running without problems for five years until now, the decision to apply for the investment was made confidently. Formulations of the interviewed representatives like “winning the right to participate” indicate their pride to be part of such a big geothermal project as well as their motivation from the beginning on to realize the plans in their greatest performance possible.

Having the same amount of ambition for the project leaded to a good team work with an as by the drilling company described “outstanding” communication between the consortium partners and the subcontractors, leading to effective work. The representative of the District Heating Company confirms the importance of a good team to manage all that needs to be done for the implementation of such a project since it is no easy business mobilizing a high amount of money, calculating the payback periods, regarding the energy prices and finding suitable locations for the wells. But also for winning project proposals and convincing investors to get on board, a reliable and experienced team is of a high importance, that at best can show a well succeeded example of such a geothermal system to facilitate the decision since they can be sure about the capability of the project planners and constructors as well as of the geothermal system itself.

The communication and work within the projects´ implementing groups functioned really well, but the view on the external support of the project is mixed among the interviewed representatives. First of all, they needed to resolve political disputes that were common from early on. After the city hall declared their support for the project, there was acceptance and tolerance and the implementation could go further. At the current point of time, the city council stands fully behind the project because the mayor of Szeged has the vision to make the city greener, which is also why a new campaign called “Green Szeged” was started by the city hall, with the geothermal developments depicting the flagship projects.

Although the local external support has been received after initial difficulties, there are still some inhibiting factors on the side of administration, like permitting procedures being lengthy in Hungary or that the fees for district heating are state-fixed. The second issue leads to the fact that even if geothermal was cheaper than using gas, people would still need to pay the same. On the other hand, in case geothermal was more expansive than using gas, people would have to pay the same price as for gas and the company would not be compensated for their loss. Thus neither obtaining

geothermal energy would be beneficial for consumers if it was cheaper, nor providing geothermal energy would be profitable for a company if it was more expansive, so either way it poses a disadvantage for one of the sides.

Another aspect that shows the little support of the state for renewable energy projects is the lacking financial aid – the costs are carried by EU sources and private investors, just like it is for this project. The Green City Program advisor, the fourth person to be interviewed, states that the openness about involving renewable energy sources would be mixed, being criticized within the country, but being supported by the EU. Although there is already a considerable movement directing to a more sustainable living, for instance through commitments from the government like afforestation, it lacks in actual implementation. A legislation that facilitates the implementation of similar innovations, more action on the part of the government, providing more funding sources are currently still missing.

Another issue that has not been satisfying during the implementation process was the communication activities directing outwards. Those were done by an external company as a precondition of the funding, so no one of those stakeholders interviewed had an influence there. The opinion, that a lot more could have been done and could still be done for the future projects is represented during the recap of the communication works. The Green City Program advisor claimed the communication with the society as a key component for the successful implementation of a project like this, making a community perceive the positive values of it and helping the concerned to accept it, even if they are facing certain discomforts.

Not adopting the coordinated communication action does not mean involved entities in the project do not communicate at all. For the case of the District Heating Company for example, communication was done by participating in hearings, giving interviews and publishing scientific studies to enrich knowledge about the technology. For the future, they want to remodel their website and set up an "Instagram" account to project a positive image. Since communication and information providing to ensure transparency is not the job of a construction company, the HANSA-KONTAKT LTD does not have any communication activities to show for itself. In contrast, the company responsible for operating the wells, GEOSZ LTD provided leaflets and posters, which – according to them – seemed to work acceptable. As soon as they would perceive a wider demand for residential forums or other forms of exchange, they would organize some. Generally, communication channels that were used so far reach from interviews, news in local media, public hearings up to flyers and posters in the immediate vicinity of the drillings.

Possible reasons for the lack in coordinated communication activities might be due to the fact that the importance of it decreases as soon as there are no worries about funding the project.

In terms of participation, only very few information were given before the concrete planning of the project. Only those in the know knew about it and a couple of interviews were given to local outlets. Whilst local companies have been engaged in the project, the residents have not been informed until the drilling rig was about to start operating in their neighborhood. Since it was not much in advance, they had no possibility to participate and shape the concrete configuration of the project. The CEO of the District Heating Company explained that the people in charge of the projects´ planning have not been much transparent because the District Heating System is a project "for the people", which indicates it is not necessarily "their project". Thus the idea seems to be to plan the project after best knowledge since they are the experts in their field, and under considerateness of putting the least burden on the population, offering people the benefits from it as soon as the project starts.
Furthermore there was only little interest in the project shown by the affected residents. A public hearing was held at the city hall where the vice mayor and journalists came, but nobody from the residents, which is why there is a general insecurity about holding more public hearings.

There was no participation of other stakeholder groups than those named to be involved in the project. According to the District Heating Company, they never thought about which stakeholder groups might be relevant for the realization of a geothermal project. They explain it with people not caring much about the common good and minding their own business in eastern European.
A few months ago they involved a civil association consisting of young people trying to do more about the environment. They painted swallows on one of their boiler houses which the locals living nearby liked because it looked so appealing. But still, there was no round table or other involvement of possibly relevant stakeholders. They only found the civil association to be helpful for acceptance during the process and are planning to work with them again in the course of the project.

A big issue during the implementation phase of the project were conflicts with residents. Since it is a city with houses everywhere, the wells are where there is a little space left. Thus the sites of the drillings have caused stir and conflict as these are sometimes very close to houses. Next to the location, the complaints were also about noise from the drilling and night-shifts. In housing projects with large blocks of apartments for example, there needs to be drilled 24/7 for months. Also, post drilling works containing restoration works can take weeks, but also up to months, being a visual

disturbance for the people in the neighborhood, who are besides that tired already of the long construction works before. They want the site to be completed so that they can get back to normal.

In case a conflict arose, the persons being responsible for the project tried to calm the residents down, asking for patience, trying to show up the environmental benefits and assuring the wells will not make any noise once the construction is done.

Some of the occurred conflicts gained attention in form of media reports, like the Kertész street in Csongrád. Residents showed a negative attitude towards the construction works right next to their homes. Hungarian media was informed that the inhabitants had not received any advance notice about the planned project and that the assigned construction workers did not relinquish any information about what they were about to build when being directly addressed by the inhabitants. As per informants for the media the situation escalated and the police stepped in, whereby first information about the plan to build up geothermal well systems infiltrated. Since then, the inhabitants tried to fight against the lack of information and were demanding to site the well systems somewhere else. Many of them even thought about subleasing for the drilling period because the noise impaired the everyday life too much. They felt disturbed by the works, showed scepticism about the legality of the project and were worried about how future thermic water abstraction might influence their lives.

Another example was the drilling site in Felsőváros. It has caused displeasure among affected citizens because the trucks that transported the building material destroyed the street they had to drive on to reach the site. A statement of the construction company contained the assurance to restore the initial state after the end of the works.

Generally most of the complaints about noise, smell or mess were addressed to the District Heating Company in form of letters, but also to the city council or – as for the two cases above – to the media. A containment of the noise could – at least partly – be reached through the build-up of a noise protecting wall around the construction area.

According to the Green City Program advisor, residents in Új-Szeged stood behind the principle of less $CO_2$ emission, so they liked the idea itself, they were only bothered by the construction noise and mess that affected them in their everyday life.

To sum it up, some of the conflicts could be avoided for future works on the project by increasing information providing and transparency. For other conflicts that are due to the noise, visual impact or damage of transportation routes the usage of noise protecting walls could be attempted, which might also help against the visual impact since the site is covered, and assuring to restore any damages.

The distrust towards geothermal energy on the part of the community might not only be ascribable to the lack of information before starting the construction works, but also to a lack of knowledge about the technology. Especially worries about injection and seismicity occurred, but according to the District Heating Company, they could be resolved through succeeding elucidation. The talk to people and their education in the field of geothermal energy are often missed out because there are so many different things to be busy with during such a project. Still, what was done and what also seemed to work well was bringing people closer to the project by offering locals to join tours over the drilling rigs and boiler houses.

Taken a wider look at the knowledge of the population on renewable energies and environmental awareness, there is a difference between the younger and the older generation. To illustrate, there are elementary schools that describe themselves as being an “eco school”, so students are more and more aware of the importance of environmental awareness and are being educated in those matters. There is a need for ideas to expand the knowledge of the older generation as well.

The following figure summarizes the results for the case study of Szeged:

**Figure 15:** Summary of the case Szeged.

Geothermal Project:
**District Heating System of Szeged**

## Residents

- Some support the idea of decarburization
- Mostly interaction in form of conflicts because the drilling site is in their direct neighbourhood

## Multiplicator

**Media**

- Reports about technical data and other important basic information about the project
- Reports about occurring conflicts

## Determinants of feasibility

### Financial Investors

**Private Investors:**
**Geo- Hőterm LTD**

- Investment expresses gratitude towards the region for the profitable harvest
- Financial investment → the payback period is of a high significance

**EU sources**

- Investing in sustainable EU-projects

### Municipality

**Administration:**
Lengthy permitting procedures

**City Hall:**
Declared support after disputes in early stages

**Mayor:**

- Has the vision to make the city greener
- Initiator of the campaign "Green Szeged" with geothermal developments as the flagship projects

## Project Implementation

### Initiator

**District Heating Company**

- Driven by the idea of implementing an environmentally safe and sustainable system to provide energy for Szeged
- Addressing environmental and financial factors, but also pride for the reasons to bring the project to life

### Constructor

**HANSA-KONTAKT LTD**

- Experienced in geothermal
- Owning the right equipment to drill in urban areas

### Operator

**GEOSZ LTD**

- Experienced in geothermal
- Established geothermal systems of a high capacity running for five years without any problems

Staying strong for the project, not giving up even though facing difficulties like

- hurdles from the political/administrative side,
- choosing the sites for the wells,
- being confronted with conflicts during the drilling works

→ high motivation, pride, ambition

### 5.1.3 Húsavík Community Greenhouse

The interviews with stakeholders form the geothermal project Community Greenhouse Húsavík revealed that all three dimensions of sustainability – social, ecological, and economical- can be linked to the area and the people living there. Projects within the room of the Skjálfandi Bay area can serve as an example for the environmental dimension. There, people have been thinking about sustainability since the height days of whale watching, being very vocal in addressing the importance of it, but also farmers in the area who historically know what it means to be sustainable contribute to the awareness of it in the town. Looking at the project, next to the usage of geothermal energy to power the greenhouse, sustainable goals can also be found in local food production and in the brewery sector searching for ideas to profit from the entire plant, also using the side products of the beer production, which they would like to try to keep organic.

The residents of Húsavík show little knowledge about geothermal energy and generally there is a rather low interest in investing in new innovations from their own. The fact that hardly anyone needs to be conservative about their consumption because there is abundance of it might be one reason why people don´t think about the importance of change that much. Even though not giving much input to new innovations and not being determined to make better use of what community has, the residents are rather open instead of distrustful towards new ideas and innovations, listening to the arguments and give in when they realize the importance of it, which can be interpreted as a sign of trust in the responsible people´s competence.

Since it is a small town, the possibility that residents know people that are involved in the project is fairly high. With a mayor being open to new innovations and ideas and a beer brewer with a pioneering spirit who dares himself into the new realm of hop growing, being ready to invest time to educate himself on the matter and not profiting to the fullest the first years, the residents´ belief in reliance of the project might be facilitated. But also the fact that other renewable energy projects have already been implemented and successfully run in Húsavík and the area around can be expected to ease the local acceptance. Here, it has proven that the innovation is especially welcome, when the community can profit from it in some way, like the great success of the geothermal bath "GeoSea" shows, where people can enjoy an outdoor bath in freshly extracted geothermal water with a temperature of 38-39°C with a view on the mountain range to the west, Skjálfandi Bay and the Arctic Circle itself. Another successful example for a sustainable innovation is a company in Iceland which is practicing indoor vertical farming and which products today are represented in all major supermarkets. Thus, also crucial for positive attitudes towards projects are creating new jobs or value creation through sustainability, a very important aspect to people in smaller communities, addressing the economical dimension of sustainability.

The social dimension of sustainability is covered by a bethought handling of possibly occurring conflicts through the elaboration of potential hurdles and conflicting topics beforehand, like the possibility that farmers of the area might interpret the Community Greenhouse Project as a competition. The fact that there is only one vegetable grower of the same scale like the Community Greenhouse Project in the area, who is in the meantime the owner of the hot water they use in Húsavík leads to the assumption that no competition thoughts should pose a hurdle in implementing the project.

Furthermore, there are no anticipated clashes of interest among beer brewing businesses, since there are no other hop growers in the area.

A potential of light pollution caused by the greenhouse was also taken into account as a possible conflicting issue, because it might impair watching the northern lights. But since there is already a considerable light pollution from the town itself and there are specific look up points more outside of the town in the south and north, where you would rather go if you want to watch northern lights in pitch darkness, this issue of light pollution is not expected to hinder the project implementation. In case the lights would become more disturbing than expected, a discussed solution was to use curtains. Thus, although certain conflicts are rather unlikely, there are still efforts for having concrete measures immediately available to be able to react quickly.

The idea to make the project a success consists of offering to use it, share the benefits of the project, giving the possibility to participate. It is discussed that people can rent their own slots or only visiting the greenhouse, eating meals out of locally produced food, making a community hotspot out of it.

In order to gain such a high interest in the project and to shape a positive attitude for it so that it is used as a community spot, talking to people and making sure the process is shaped by all affected actors is important.

The project is a typical local community approach with the wish for as much overlap of interest as possible, trying to involve as many potential stakeholders as possible in round tables and discussions. The visions concerning potential links to the community greenhouse are multiple, showing the ambition of people involved in the project planning and how much they believe in the capability of it. The ideas reach from having weekend markets with all kinds of products from the area over involving commercial companies that are interested in using the infrastructure that has been put up or doing their studies. The education sector is decent in the area, for example because of the research center at the harbor that is cooperated with the University of Reykjavík, so it is self-evident to also think about letting schools benefit from the greenhouse for educational matters. Also, the greenhouse

would be very easily accessible for elderly people because it is sited near an elderly home and thus could serve as a meeting point for them outside the estate.
From current point of view, they have introduced the project to the principal of the biggest school and the primary school. Both appreciated the project and already started thinking about what kind of opportunities would come up. They also introduced it to the tourist sector, the farmers in the area around, to the Húsavík academic center, the local brewery and a group of elderly people, who meet every week.

The first formal discussion where there will be tried to bring as many different stakeholders to the table as possible to talk in depth about the details and offering the opportunity to bring in own ideas and proposes will be in October. This leads to the fact that the exact direction of the project is still unclear since the process of working together will form it. The stakeholders are informed in an early stage where there are no irrevocable determinations and things are still possible to change, so that in the best way the benefits outweigh potentially upcoming disadvantages for every stakeholder group.
The main income for the town Húsavík is made by tourism. The tourism sector acts as a multiplicator in the project with an own interest. Estimating the sustainable tourism to grow and trend more and more and feeling the need to change the label of Húsavík as the whale watching town, tourism could benefit from the greenhouse project by using it as an example of sustainability efforts in town.
There have already been thoughts about ways on how to interact with tourists through this project, but no clear strategies have been made up to this point of time.
The representative from the tourist sector is also responsible for the communication work of the project, working in an organization that cooperates with the municipality, being highly dependent on it for grants, but that is also linked to a big PR organization in north Iceland, that might be keen on working on the strategy of highlighting the sustainability in Húsavík or broadly composed Norðurþing. Thus the community greenhouse project can possibly lead to more economical benefits for the town, being part of the new signboard for tourism.
It is planned to reach out to the three groups of locals, domestic tourists and international tourists, in all probability sending different, adjusted messages to each of those groups as a part of a communication plan. Imaginable channels for communicating the information are the magazine and the local website of Húsavík, social media as well as the expected importance of word of mouth, because it is a small town.

In contrast to other renewable energy projects, the community greenhouse project is not expected to have any conflicts concerning the siting area. It is even rather expected to be perceived positively

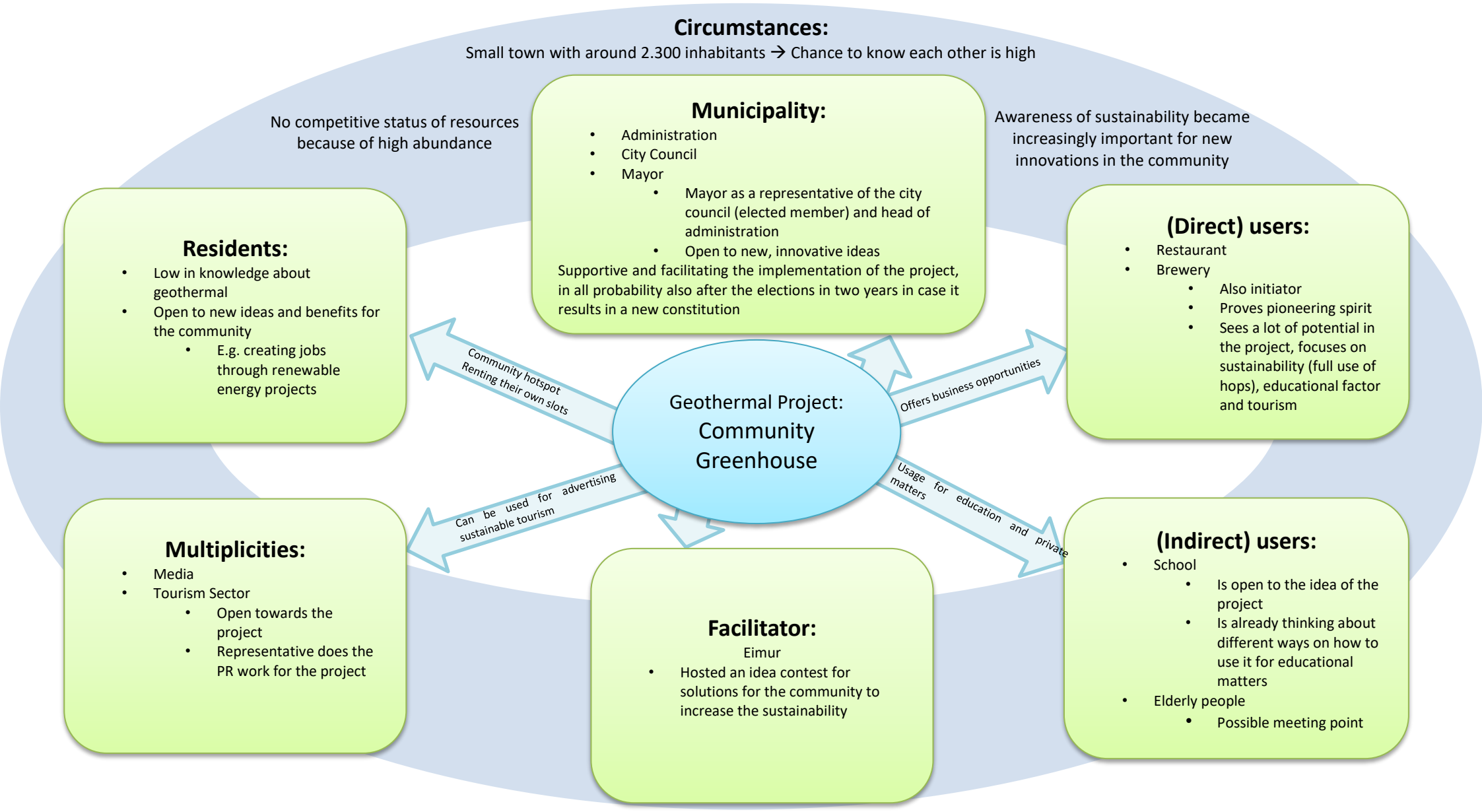
since the housing option is an empty old warehouse in the middle of town where a business could finally run again with the projects´ implementation, which will not be disturbing neighbors because it is neither heavy machinery nor noisy production.

Even though elections are impended in 2022 which could result in a new constitution of the municipality, the mayor does not see a threat for the implementation of the community greenhouse since ideas with a benefit for the community are welcomed, independent from party belonging. There is simply a discussion of practical matters to be expected.

The only potential hurdle that was consistently addressed in the interviews was the funding of the project. The town does not have many inhabitants. Also, crowdfunding in a larger scale is new to the society. Even if the majority of residents would be willing to join the crowdfunding, it would in all probability not be enough. Because of this limited crowdfunding capability, the connection to a broader region might be necessary. Additionally, ideas for a steady income in order to keep the greenhouse on the run once it is implemented, still need to be figured out, because solely financing through hop sales is not realistic due to the fact it is not approximated to cover more than one or two payments. The restaurant and a stop-by café are considered at this point in time.

The following figure summarizes the results for the case study of Húsavík:

**Figure 16:** Summary of the case Húsavík.



# 6 CONCLUSION

The case study analyses showed stakeholder constellations and socio-psychological factors being relevant for the local acceptance of the geothermal projects. Using the research approach of contrasting several cases which differ in time of project standings (finished in Spain, currently ongoing in Hungary, at the very beginning in Iceland), technological approaches as well as their regional and cultural contexts, the results allow to identify those variables being relevant in all cases and therefore can be seen as of particular importance.

Looking at the results it shows that the three dimensions of project-, process- and context-related aspects described in D1.1 (literature review of existing acceptance studies dealing with geothermal applications or other renewable energy projects) provide also a valid structure for the case studies (see figure 17).

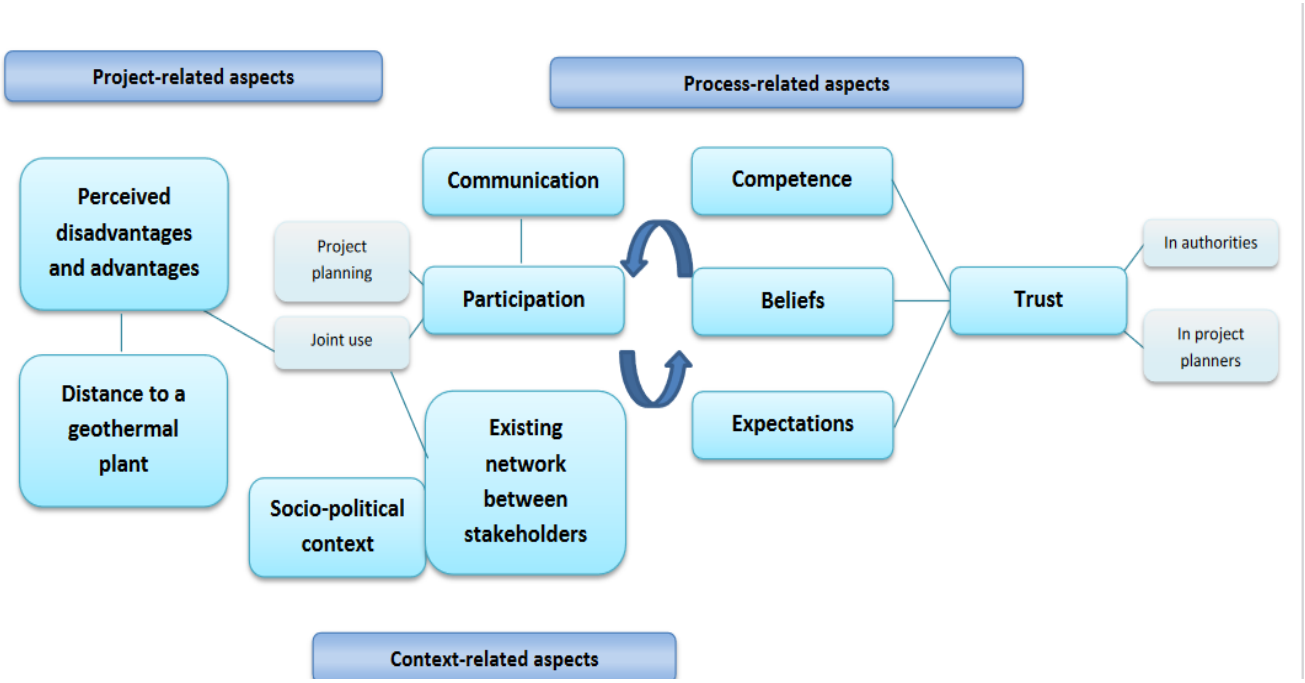



**Figure 17:** Overview of relevant factors in all three cases.

It becomes obvious that a geothermal project is not only a question of technological functionality or money investment but should be seen as a socio-technological system embedded in a social and cultural context. The regional conditions including the socio-political context with its stakeholders represent a relevant resource for the successful development of projects.

Regarding the projects the special role of trust and the degree social cohesion between stakeholders characterised by a joint vision, shared values and intrinsic motivation as well as a transparent and trustworthy communication became evident.

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# 8 APPENDIX

## 8.1 STAKEHOLDERS AND EVENTS QUESTIONNAIRE

## General aspects

| | |
|---|---|
| Country | |
| Name of facility | |

## Involvement in the project

| | |
|---|---|
| Date of project start | |
| Initiator of the project (investor, major, etc.) | |
| Date of first energy production | |
| Name of operator | |
| Name of facility owner (if not operator) | |
| Who was/ is in charge of communication and participation processes? | |

| Please provide information about involved groups in the geothermal energy project. Please provide names and contact details as good as possible. | | |
|---|---|---|
| *When involved, please set a X.* | *Group* | *Contact details (email, telephone number)* |
| | Project planner / Promoter | |
| | Investor/s = Inhabitants | |
| | Architects | |
| | Engineering | |
| | Installers | |
| | Main contractor/Constructor | |
| | Financial entity | |
| | Municipality | |

## History of the project

In order to conduct a stakeholder analysis, it is necessary to have an overview about the events regarding the project. Please provide us with the history of the project as good as possible.

Possible interesting events are: start of project, exploration drillings, building measures, foundation of citizens' initiatives, accidents, demonstrations, permit from planning authority, communication activities, media reports etc.

| Year | Month | Description of Event |
|---|---|---|
| | | |
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| | | |

We also ask you to attach important documents regarding the events in your region, such as: media reports, official project brochures, protocols of informational events, etc.

## Impression of the project

If possible, please provide us with pictures or flyers of the project.

## 8.2 EXEMPLARY CHARACTERISTIC: EAI310 COOPERATIVE

### EAI310 cooperative

***General data***

The project EAI 310 building in Madrid, Spain, containing the build-up of 220 apartments distributed in several buildings that are being provided with energy from a geothermal system, had its start in October 2012 in form of preliminary designs with performance specification and the establishment of the Cooperative EAI310.

220 apartments with 1, 2, 3, 4 or 5 bedrooms have been built in the middle of Madrid´s district Chamartín. They are surrounded by gardens, sports areas, a swimming pool and an included supermarket company in the commercial basement of the building. The apartments cost 3.365€ per square meter, an attractive price for housings in the center of Madrid. A dwelling with three bedrooms costs around 385.000€, the cheapest ones are available for 165.000€.

***The project´s popularity***

Before the actual build-up started, all of the apartments had already been assigned and the collective EAI310, which was responsible for the realization of the project, had already been complete. Not only that, the interest in getting one of the 220 apartments was so high that a waiting list with over 100 prospective buyers was generated in case one gets free.

***Financing of the project***

To become a member of the EAI310 collective, a registration with a commission of 300€ seed capital needed to be made. Because the members of the collective had also paid 30% of the apartment´s final price there was no financial insecurity concerning the implementation of the project. The funding for buying the property and constructing the building was secured from the beginning on. The entire project has been solely financed by the members of the cooperative.

***Involved groups in the project***

The operator of the project was INSSERCO, a company for energy supply services.

More information about involved groups in the geothermal energy project is provided in Table 1.

*Table 1 - Overview of involved groups in the geothermal energy project*

| Group | Contact Details |
|---|---|
| Promoters | **EAI 310**, Sociedad Cooperativa Madrileña (coopeai310@gmail.com) |
| Investors = Inhabitants | **EAI 310**, Sociedad Cooperativa Madrileña (coopeai310@gmail.com) |
| Architects | **EAI arquitectura S.L.P**: (http://www.eaiarquitectura.es/)<br><br>**Architects**:<br>1. Miguel Fernández Ochoa (https://www.linkedin.com/in/miguel-fernandez-ochoa-7b016b3b/?originalSubdomain=es)<br>2. Joaquín García Llaneza (https://www.linkedin.com/in/joaqu%C3%ADn-garc%C3%ADa-llaneza- |

| | |
|---|---|
| | 50114159/?originalSubdomain=es);<br>3. Alberto Prado García<br>4. Ana Belén Robles Delgado<br>5. Alberto Rubini (https://www.linkedin.com/in/alberto-rubini-681a6a63/?originalSubdomain=es);<br><br>**Technical Architect**:<br>Daniel Pérez González |
| Security Coordinator | **CSP Coordinación** – Francisco Molina Molina |
| Geothermal Engineering (Design geoexchange system) | **IFTEC GeoEnergía S.L.** – Marcel Hendriks (https://www.linkedin.com/in/marcel-hendriks-28238aa/) |
| Main contractor/Constructor | **Ferrovial Agroman S.A.U.** (https://www.ferovial.com/en/business-lines/construction) |
| Energy Modeling | **Eurocontrol S.A** |
| Authorities | **Madrid City Council** (https://www.madrid.es/portal/site/munimadrid) |
| Municipality | Madrid |

***The EAI310 Cooperative***

Who exactly is standing behind the EAI 310 collective? People from the neighborhood who bought or rented houses that when their family grew bigger became too small. According to Joaquín García Llaneza, president of the EAI310 collective and one of the architects of the project, as they could not find an affordable offer they perceived the possibility to buy the site where the old municipal council building had been constructed on.

***Overview of the build-up timeline***

With the mortgage loan concession in September 2013 and the awarding of the site one month later the Cooperative was finally able to bring the project to life. The official start of the construction work was in November 2013, beginning with the demolition work which was already as good as complete in January of the following year. The works continued to advance until the finalization in December 2015. With the commissioning of the HVAC installation including the geothermal exchange system in March 2016 and the following handover of the apartments to their owners the first energy was produced in July 2016.

***The geothermal system***

The buildings with its 220 apartments were planned under the Trias Energetica concept. It is sustainable using geothermal energy to cover most of its demand on cooling, heating and warm water. To cover the demand peaks conventional systems like boilers and chiller are installed as well. The geothermal system is a combination of a closed vertical system and heat pumps and represents the biggest closed geothermal system for residential purposes in Spain.

In July 2016 the system was ready to be used and produced energy for the first time to provide the households. With additional promotive arrangements like highly isolating material the building is offering attractive consumption data.

***Beneficial aspects concerning energy consumption and emissions***

During the build-up process several intermediaries proposed cheaper systems of lower quality in order to save money. The cooperative kept hold of the original plan with its high-quality geothermal system and other sustainable specifications regarding long term financial benefits in form of energy savings.

With the implemented system the energy consumption per square meter is around 15 kilowatt hours a year (to compare: the average reference value in Madrid is 248,2kWh, which is 16 times more), the CO2 emissions are about 3 kilograms per square meter a year (reference value for Madrid: 56,3kg). Another reason for the environmental friendliness is the furtherance of electric mobility by providing 12 installed charging stations on the area.

***Public relations***

Concerning public relations can be said that in comparison to other projects more effort has been made. The people in charge, like José Luis Garcìa, wrote a blog for the future apartment owners and the prospective buyers to keep them updated during the planning and construction phases. A commentary function allowed people to ask questions that were answered by contacting Javier Gómez (jgomez@domogestora.com), who apparently was responsible for the communication and information process. Since the members of the cooperative agreed to the utilization of geothermal energy to provide the buildings from the beginning on, no concerns about public engagement came up. Still the project planners made sure that cooperative members´ interests were cared about by providing an expert with deep knowledge on the project itself as well as on geothermal in general they could address to.

***Media reports***

How much the general public knows about the environmental friendliness of the project is doubtful. Most of the media reports do not contain any technical data, information about the power consumption or $CO_2$ emissions. Geothermal energy is often not even mentioned, although the offer is more than respectable.

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## 8.3 STAKEHOLDER INTERVIEW GUIDELINE

Note that this is exemplary for the interview guidelines. For the actual interviews, it was adjusted to the individual situation of every case study.

**Focus**

- **Acceptance factors**
- **Stakeholder perceptions**
- **Process perception in case studies**
- **Factors promoting investment**

| **Case study:** | | |
|---|---|---|
| **Date:** | **Time:** | **Place:** |
| | | |
| **Participants:** | **Record:** | **Documentation:** |
| | If recorded | |

| **Topic/Area of interest** | Guiding-Questions | Sub-Questions | Comments |
|---|---|---|---|
| | | | |
| **Introduction/ History of the project** | | | |
| | Could you please provide us a short review back about the history of the project starting from the first idea, planning permitting, operating and so on...? | | |
| | What were your motivations and visions before the start of the project? | | |
| | | Have these visions been fulfilled, have they changed during the process or have they remained unfulfilled? | |
| | | | |
| **Communication/ information** | | | |
| | Which communication measures have been undertaken during the planning and permitting process? | | |
| | | | |

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| | | Which measures to inform the broad public/to secure transparency have been applied?<br>1. How much information was spread before concrete planning of the geothermal project?<br>• How much information was spread during the implementation of the project?<br>• Have you experienced residents/interested/opponents directly contacting you to gain more information?<br>2. How transparent were the people in charge of the project´s planning during the process?<br>3. To which extent have there been misunderstandings between different stakeholders? Could they be solved? How? | |

| | | | |
|---|---|---|---|
| | | 4. To which extent have you perceived a lack of trust in individuals that were part of the decision process? Where did the distrust come from? | |
| | | Which measures to activate persons for investment have been chosen? | |
| | | Which seemed to be successful strategies? | |
| | | | |

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| | | What kind of communication channels were used (e.g. mass media, special networks, public speeches held by project members...) | |
| | | To which extent have you been satisfied with the general communication structure? | |
| | | Which significance did the communication work have in general? | |
| | | | |
| **Participation in planning and decision making** | | | |
| | Who participated in planning and decision making processes most of the time? | | |

| | | | |
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| | Have local residents been engaged in the project? | | |
| | | How high was the interest in participating? | |
| | | Can you give examples for participation measures? | |
| | To which extent did the decision making and realization process of the geothermal power plant´s siting cause any conflicts? | | |
| | | In case of a conflict:<br>1. Who were the conflicting parties? | |

| | | | |
|---|---|---|---|
| | | 2. What were the main arguments and critical topics?<br><br>3. What have been potential solutions<br><br>4. Which stakeholder groups are relevant for the realization of a geothermal project (roles like gatekeepers, multiplicators, supporters etc.) | |
| | | | |
| **Financing and Crowdfunding** | | | |
| | With the experience of this project – what are relevant factors for the financial involvement (factors that approve financial involvement as well as factors that pose barriers)? | | |
| | | Political frame conditions vs. psychological determinants:<br>1. Which political frame conditions were important in your perception (e.g. low acquisition costs and high feed-in remuneration; governmental promotion)?<br><br>2. How high do you estimate the influence of the political frame conditions on the decision about financial involvement?<br><br>3. Which psychological determinants were important in your perception (e.g. social motivation; environment protection; independence from big utility companies; technological interest)?<br><br>4. How high do you estimate the influence of the psychological determinants on the decision about financial involvement? | |
| | | | |
| **Outlook /transfer of lessons learned to other projects** | | | |
| | What advice would you give someone who is planning to start a comparable project? What are your "lessons learned"? | | |

| | | | |
|---|---|---|---|
| | | What worked especially well? | |
| | | What did not work so well? | |
| | Which other relevant issues you would like to address? | | |