CROWDTHERMAL RECOMMENDATIONS

CROWDTHERMAL

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CROWDTHERMAL DELIVERABLE D4.10

RECOMMENDATIONS

Summary:
This document presents recommendations at EU level for further public engagement to enhanced synergies with existing EC policies to achieve the Green Deal EU Strategy.
The main results of the project will be presented within a roadmap to achieve the objectives of the European Commission for REPowerEU Plan 2030.

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EXECUTIVE SUMMARY

This deliverable “D4.10 Recomendations” has been developed by EFG, GEORG and GEOPLAT. It presents the main outcome for the CROWDTHERMAL projects in the WP1, WP2, WP3 and WP5. This deliverable is part of the Task 4.5, “Recommendations”, as the last task of the WP4, Integrated Development Schemes. The aim is to provide recommendations on how to connect to the new approaches brought forward by CROWDTHERMAL: financing, public engagement and risk mitigation schemes, and launch a new European mobilisation campaign. The project partners have developed research, case studies and reports addressing the target audiences of the project, concerning social and environmental aspects, risk mitigation, alternative finance, and geothermal energy. This document presents the most relevant outcomes from these reports formulated as recommendations to the EU level, and suggestions of possible measures on public engagement and financing. The recommendations seek synergies with relevant existing EU policies and strategies, matching the project findings in WP1-WP5 with relevant policies.

In particular, following the results obtained by CROWDTHERMAL, this document presents a series of recommendations contributing to the objective of the European Green Deal of a climate-neutral EU by 2050, including EU’s energy challenge for 2030 to increase the use of renewal energy (REpowerEU and Fit for 55). The findings from this project are also relevant for several EU directives, in particular the Renewable Energy Directive, and its implementation in EU Member States in the coming years. The focus of the recommendations inn this document is on the objective of greater citizen participation in the decarbonisation of Europe.

At the same time, the findings of CROWDTHERMAL's on social acceptance mechanisms have revealed new instruments that can be used also in other European projects in the field of renewable energy, and in particular in geothermal energy projects for heating and cooling as well as for electricity generation.

One of the overarching conclusions are the strong call for action at local and community level, actions by local authorities and project developers. Apart from setting the right legal framework conditions for citizens’and community engagement, governments at national and EU-level have limited tools and relevance.

The strong political directionality provided through the European Green Deal and its accompanying regulatory package in the Fit-for-55, including the new ambitious and concrete target of 45 % use of renewable energy in the EU by 2030, has provided inspiration and incentives for citizens'engagement in renewable energy sources, and in particular geothermal energy. Geothermal energy has a huge untapped potential to contribute to this policy and its specific targets. Geothermal district heating networks have the potential to provide energy for 25% of the European population.

However, as clearly analysed in this project, the European Green Deal will not by fully delivered without the local engagement of citizens, project developers and local authorities. There are important social and environmental concerns, as well as financial risk mechanisms that need to be addressed. The CROWDTHERMAL project presents here concrete recommendations to unleash the high potential of geothermal energy through targeted and comprehensive bottom-up actions, combined with the right national and EU legislative framework. The recommendations focus on the social, environmental, financial, and risk mitigation factors needed to roll out urgently.

1 THE POLITICAL FRAMEWORK OF THE CROWDTHERMAL PROJECT

The REPowerEU plan, communicated in March and published in May 2022 by the European Commission, aims to reduce EU dependency on Russian gas and proposes to revise the EU target for renewables in total final consumption from 40% to 45% by 2030 under the Fit for 55 package. In addition to a solar PV strategy, it contains provisions for industry sector decarbonisation through (among other measures) electrification, the use of large-scale heat pumps and renewables-based hydrogen, and the deployment of other renewable energy sources, including by integrating solar thermal and geothermal technologies into district heating systems.

EU policy is on the forefront of driving a systemic shift in the energy field, addressing both supply and demand of energy while transitioning towards sustainable and renewable resources. In December 2019, the European Commission launched the European Green Deal (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en), a comprehensive policy to accelerate energy transition in the EU to ensure a climate-neutral EU by 2050. Investment, regulations and reforms are mobilized in parallel to create the right framework conditions for industry and consumers. More recently, responding to EU's geostrategic energy dependency on Russia, the EU launched the Repower EU policy (https://ec.europa.eu/commission/presscorner/detail/en/IP_22_3131), which includes an ambition to double the deployment of geothermal energy in the EU.

This has been the context and motivation for the CROWDTHERMAL project (Figure 1). Geothermal energy has a large potential for EU's energy supply. Concrete actions for citizen and community engagement can help unleashing this potential. More broadly, for all surces of renewable energy, there is a clear need to learn more on public engagement and social acceptance. With the right framework conditions, citizens would not only accept renewable energy sources but actively promote them, engaging as co-investors. Community funding and innovative use of crowdfunding are correlated with increased public engagement and trust.

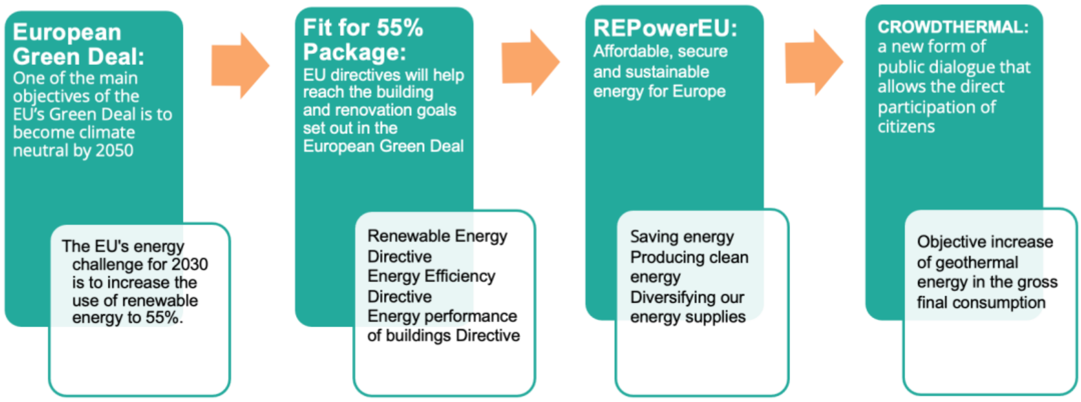

Figure 1: *Political framework for the CROWDTHERMAL project*

Source: CROWDTHERMAL, 2022

CROWDTHERMAL aims to empower citizens to directly participate in the development of geothermal projects with the help of alternative financing schemes (crowdfunding) and social engagement tools. In order to reach this goal, the project has focused on the following work strands:

- Understand the requirements for social licencing and develop a Social Licence to Operate (SLO) model for the different geothermal technologies and installations;
- Review successful case studies, as well as national/EU bottlenecks to alternative financing of geothermal energy in EU Member States and other European countries;
- Formulate new financial models for crowdsourcing;
- Develop recommendations for a novel risk mitigation scheme that will be complementing the alternative financing solutions while also protecting private investors' interest;
- Validate findings with the help of three case studies in Iceland, Hungary and Spain;
- Develop core services for social media based promotion and alternative financing of geothermal projects, working closely with existing structures & conventional players.

The Target Groups for this work are in particular:

- Local authorities interested in involving the community to develop a Sustainable Energy and Climate action plans for 2030.
- Communities of citizens keen to become actors in the energy transition process. The benefits for these communities could be economical or environmental;

- Geothermal project developers interested in involving the community to increase commitment and/or fundraising;

The EU's energy policy stresses the importance of citizens and community engagement. Renewal Energy Source (RES) Directive, proposed in 2018 and entered into force June 2021, included the objective of 32% use of renewal energy for 2030. The Directive 2018 introduced new measures for various sectors of the economy, particularly on heating and cooling . It also included new provisions to enable citizens to play an active role in the development of renewables by enabling renewable energy communities and self-consumption of renewable energy.

The revision of the RES Directive targets inside the REPower EU Plan (presented May 2022 and adopted end 2022) allows a scaling up of renewable energy in power generation, industry, buildings and transport, to 45% by 2030. The production of clean energy is one of the three pillars. In this increase of ambition for the use of renewable energy, citizen participation, as well as new sources of financing for renewable energy become even more urgent and necessary.

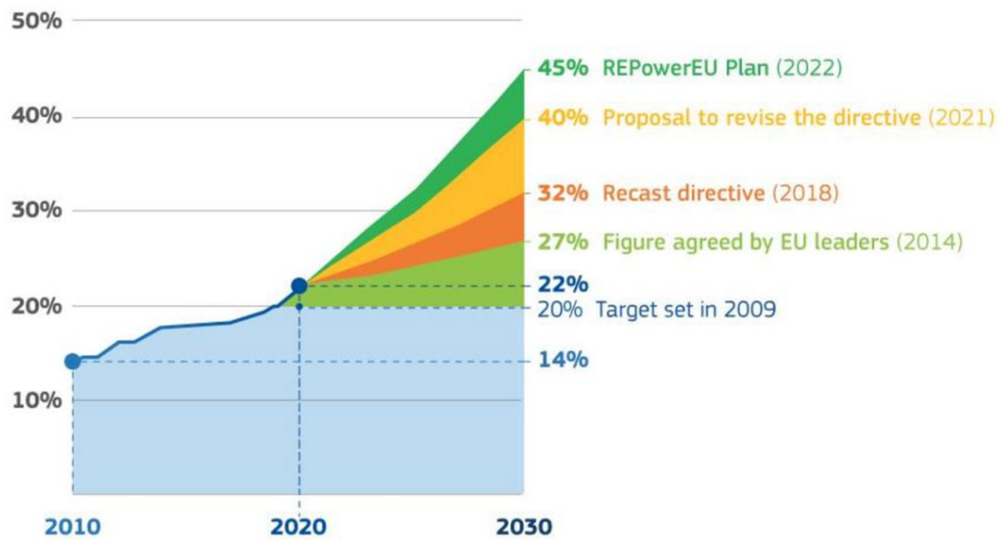

Figure 2: *Evolution of renewable energy targets*

Source: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en)

Through the Clean energy for all Europeans package, adopted in 2019, the EU introduced the concept of energy communities in its legislation, notably as **citizen energy communities and renewable energy communities**.

More specifically, the Directive on common rules for the internal electricity market (EU 2019/944) includes new rules that **enable active consumer participation, individually or through citizen energy communities**, in all markets, either by generating, consuming, sharing or selling electricity, or by providing flexibility services through demand-response and storage. The directive aims to improve the uptake of energy communities and make it easier for citizens to integrate efficiently in the electricity system, as active participants.

In addition, the revised Renewable energy directive (2018/2001/EU) aims to **strengthen the role of renewables self-consumers and renewable energy communities**. Empowering renewable energy communities to produce, consume, store and sell renewable energy will also help advance energy efficiency in households, support the use of renewable energy and at the same time contribute to fighting poverty through reduced energy consumption and lower supply tariffs. https://energy.ec.europa.eu/topics/markets-and-consumers/energy-communities_en

2 THE POTENTIAL OF GEOTHERMAL ENERGY IN EUROPE

Geothermal energy is the heat stored beneath the Earth's surface. It is an endless source of renewable energy, which is available all the time, every day, everywhere. It requires no use of critical raw material and it needs no storage.

Geothermal energy is a resource that has potential for considerable development in Europe. However, despite its versatility and economic viability, its deployment is far from its potential or the development achived by the others sources of renewable energy.

There are several types of geothermal energy technologies and different classification schemes. Figure 3 summarises the classifications adopted by the CROWDTHERMAL consortium (CROWDTHERMAL, D5.1 Case Study Assessment Protocol)

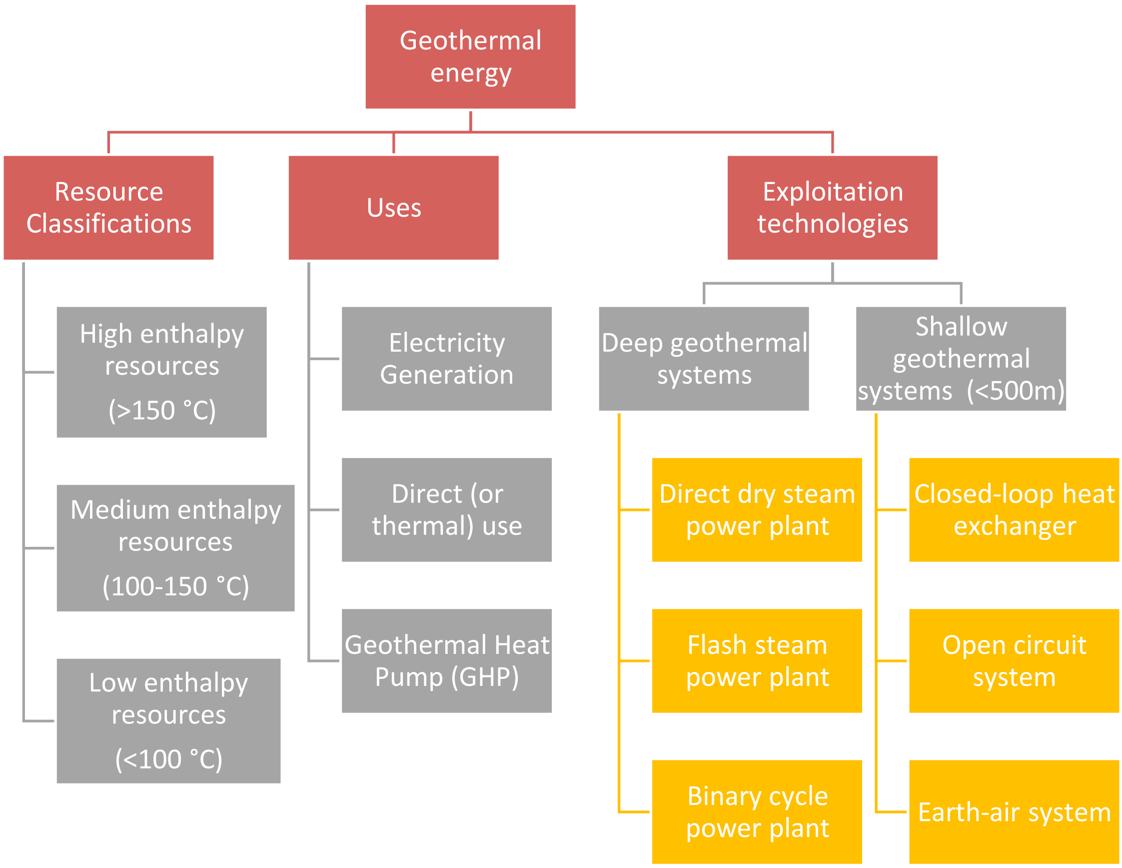

Figure 3: *Classification schemes of geothermal energy projects (source D5.1 CROWDTHERMAL)*

Source: CROWDTHERMAL, 2022

In Europe, the utilisation and potential of geothermal energy range from shallow and low-temperature geothermal (available almost everywhere in Europe) to direct use of hydrothermal resources in sedimentary basins, and high-temperature geothermal resources found in volcanic areas. Sedimentary basins are present in multiple European countries, while there is a lower number of European countries, characterised by young volcanic activity.

The figure 4 schematically illustrates the potential of the three uses of geothermal energy in Europe: Shallow geothermal energy, commonly harnessed through Geothermal Heat Pump (GHP) in residential buildings; Direct use of hydrothermal resouce, low enthalpy resources (<150ºC), with potential for distric heating and large heat uses; and high enthalpy resources (>150ºC) with potential for electricity generation, district heating and other heat uses.

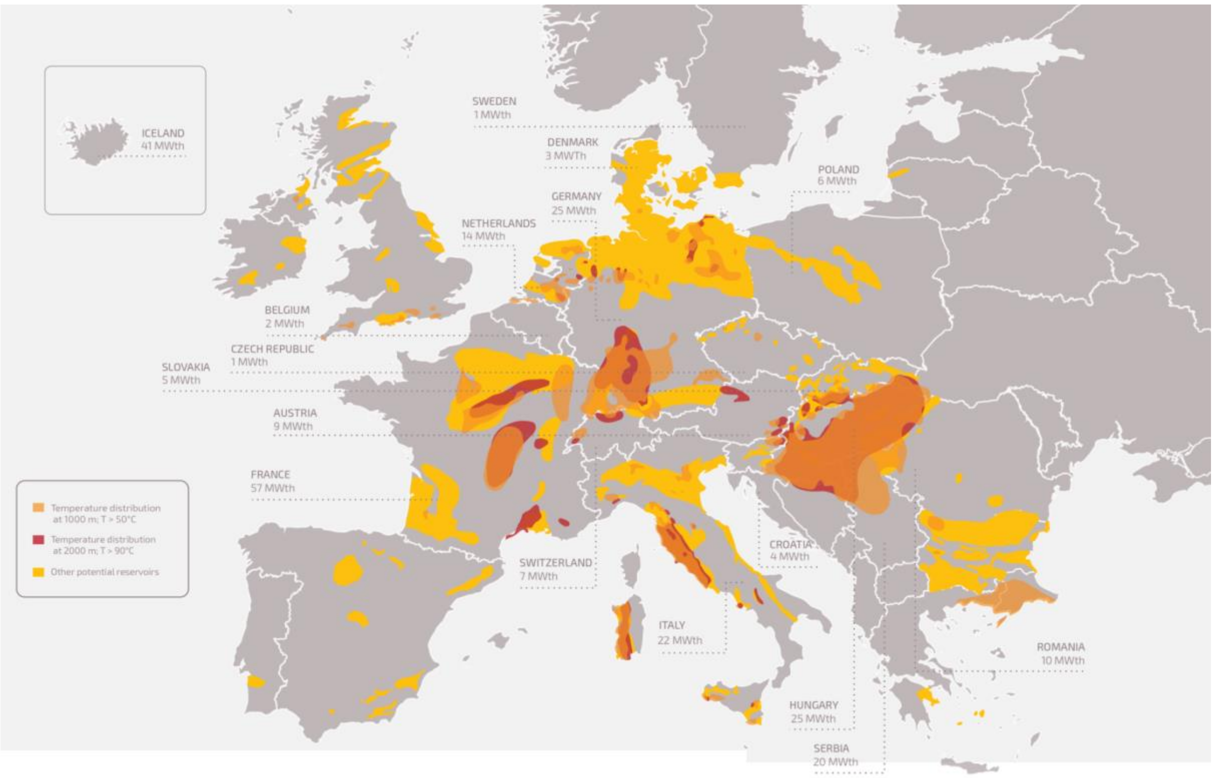

Figure 4: *Scheme of the potential use of geotermal energy in Europe*

Source: EGEC Market Report 20218

Despite its huge potential to supply sustainable, decentralised and low-carbon energy for electricity, heating and cooling, geothermal still plays a marginal role in the European energy mix.

Although the potential for the use of Geothermal Heating Pumps for heating and cooling of residential buildings in all European countries is similar, there are large differences between countries as illustrated by figure 5.

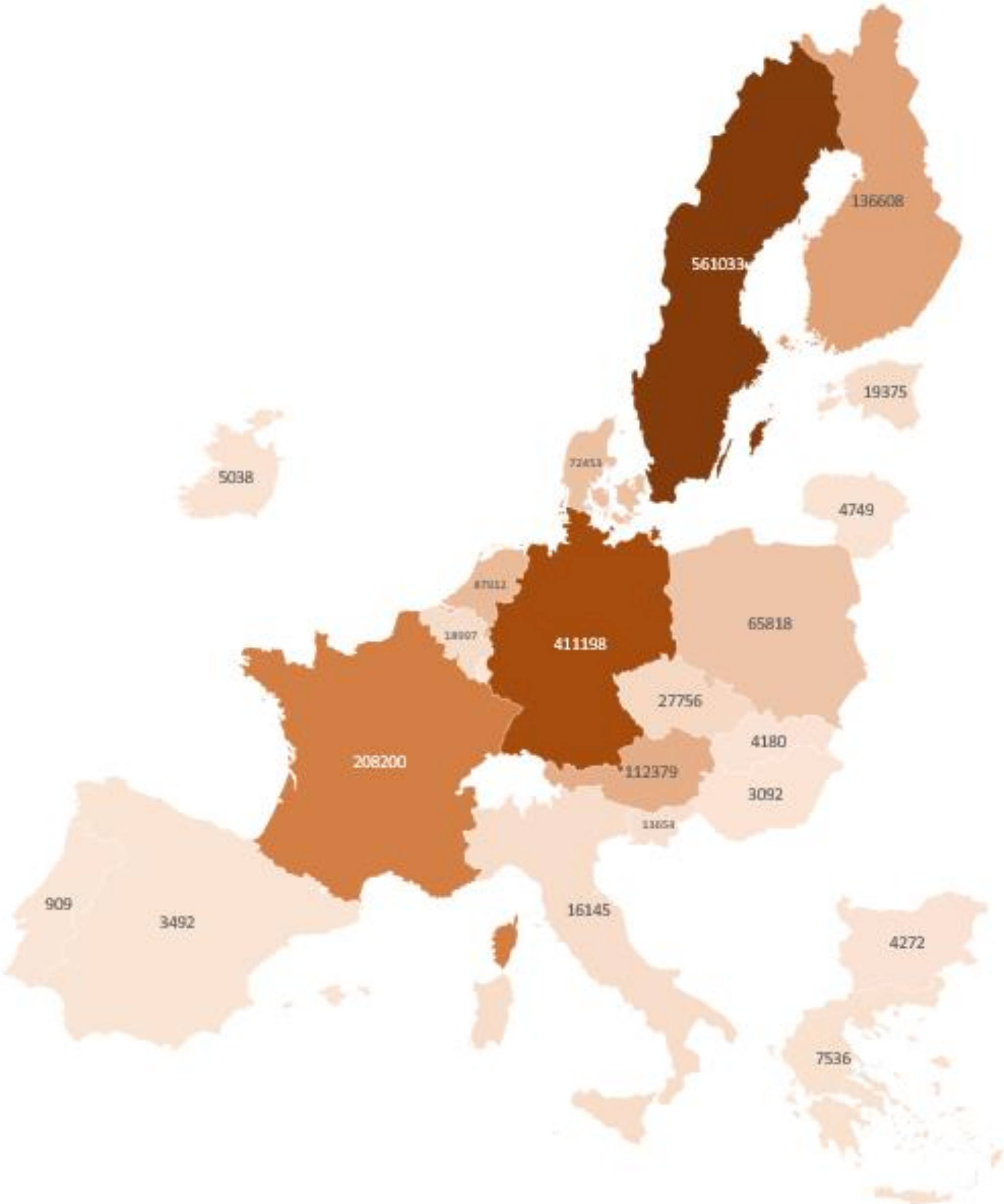

Figure 5: *Total number of heat pumps in operation in 2020 in the European Union*

Source: CROWDTHERMAL based on EurObserv'ER data

Geothermal energy in district heating still covers a marginal niche of around 1% of the European heating and cooling supply, despite the fact that both district heating and geothermal energy are long-time existing technologies. However, they both have a significant potential to cover future heating and cooling demand at low costs, low emissions, low material use, and high level of efficiency and supply guaranty.

Currently the use of geothermal energy in Europe varies greatly between countries (Figue 6). France leads the use of this technology for distric heating. **In the future, geothermal district heating networks have the potential to provide energy for 25% of the European population**. The benefits of Geothermal District Heating and Cooling (GDHC) must be made available to users, enbling citizens to contribute to the demand for these technologies.

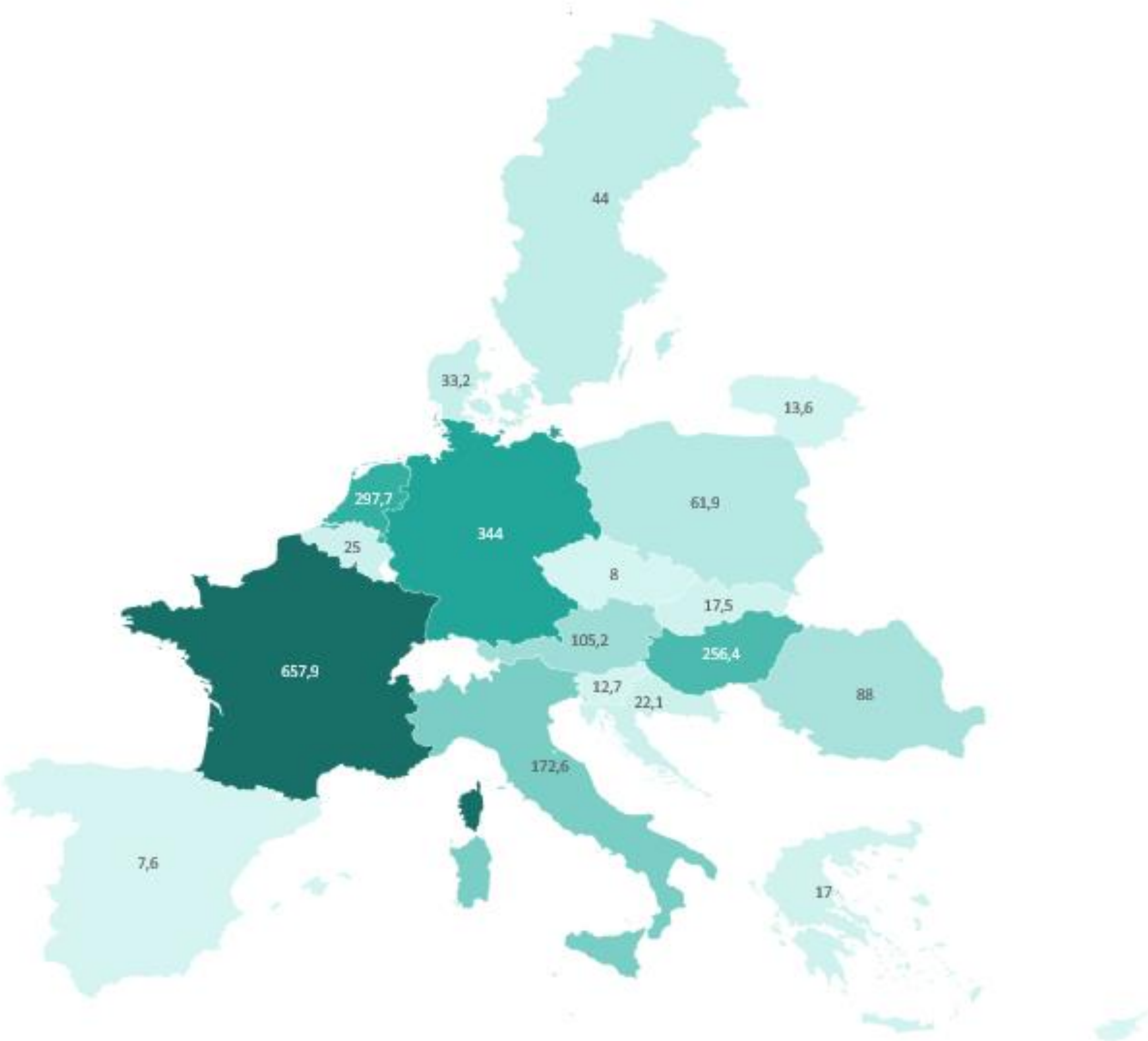

Figure 6: *Capacity of geothermal district heating systems installed in the European Union in 2020 (in MWth)*
Source: CROWDTHERMAL based on EurObserv'ER data

In addition to the use of geothermal energy use for heating and cooling, geothermal energy is used in a large variety of industries with great success. Figure 7 is an infographic from CROWDTHERMAL which illustrates some examples of the use of geothermal energy depending on the temperature of the resource.

In the following, CROWDTHERMAL presents the main factors determining the use of geothermal energy. For the sake of clarity, the analysis distinguishes between three mayor areas of use of geothermal energy: heating and cooling for residential buildings (collective of individual), heating and cooling for district heating systems, and finally electricity generation for households or manufacturing. For each of these three areas of use of geothermal energy, GEOTHERMAL presents the main technical, socio-environmental, and financial chartacteristics. The presentations conclude with concrete recommendations for each area of use.

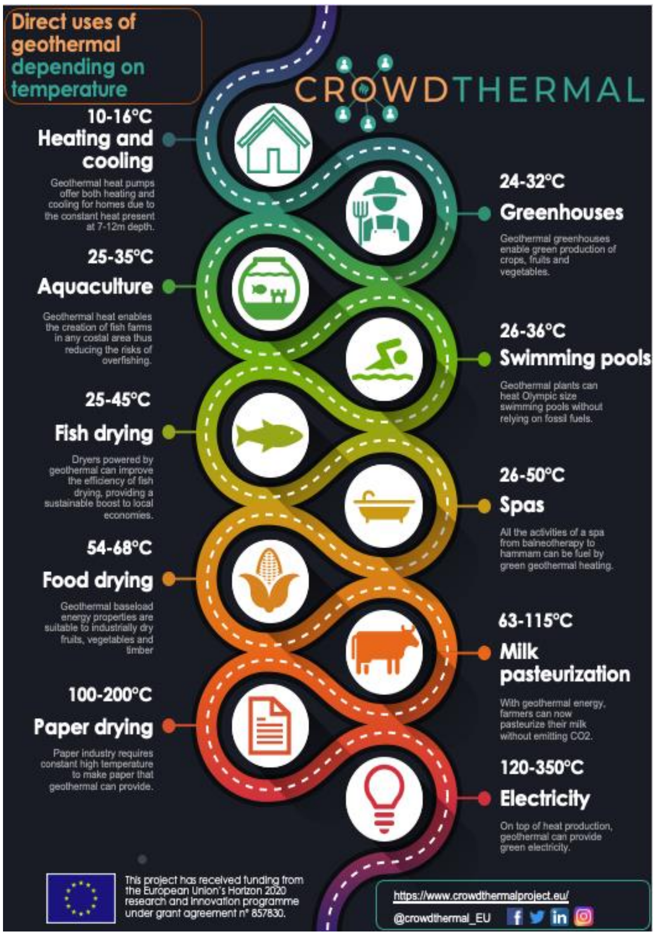

Figure 7: *Direct uses of Geothermal energy in relation the temperature of the resource*

3 CROWDTHERMAL EXPERIENCE IN HEATING AND COOLING

CROWDTHERMAL has analysed three complementary uses of geothermal energy: heating and cooling of residential building, heating and cooling of districts or neighbourhoods in cities (district heating), and geothermal energy for electricity generation. It is essential to keep these three uses in mind to fully understand and utilise the potential of geothermal energy. In this chapter, CROWDTHERMAL presents lessons learned from three case studies in the use of geothermal in heating and cooling.

3.1 HEATING AND COOLING OF RESIDENTIAL BUILDINGS

The REPower EU plan proposes the cumulative installation of 10 million new hydronic heat pumps in the next five years and 30 million units in the buildings sector by 2030. This would mean a more than 20% annual increase in hydronic heat pump installations in the European Union throughout this decade, from a starting point of 1.1 million units in 2021.

In this section we consider the capacity to heat and cool buildings from shallow geothermal energy, which does not depend on the existence of high temperature resources but can in principle be used in any ground. Shallow geothermal energy is almost always associated with a heat pump, which uses the constant temperature existing in the first meters of the earth's crust. It penetrates no more than 500 meters into the subsoil and use layers with temperatures 8-20°C. Depending on the temperature of the geothermal resource, the geothermal energy can be exploited directly or by using a Geoexchange system (Geothermal Heat Pump + loop heat exchanger). Several technologies have been developed to leverage heat from the subsurface based on the accessibility to the geothermal resource. All of them could classified into two main types:

- Open circuits, where water is pumped from an aquifer
- Closed circuits, where an exchanger is installed on-site to exploit the energy resources

CROWDTHERMAL case study in Spain: Two housing cooperatives in Madrid

The cooperative EAI310 consists of 220 dwellings distributed in several buildings. The project was planned under the Trias Energetica concept. The heating and cooling system is bivalent. On the one hand, the geothermal system designed consists of a closed vertical system of very low enthalpy in combination with a heat pump, which provides heating and cooling and even domestic hot water. The comfort obtained thanks to a geothermal system is superior to those obtained with conventional systems. Geothermal integration has a high value for cost ratio. The mediation of an expert, a geothermal consultant, was fundamental for the success of the project.

Arroyo Bodonal cooperative is a sustainable construction and energy efficiency project that provides heating, cooling and domestic hot water to 80 houses in Tres Cantos (Madrid), with up to 80% savings in energy consumption. This is achieved through the use of geothermal heat pumps (shallow geothermal system) and the integration of ventilation equipment with heat recovery. The biggest problem found to carry out the project was the lack of trust and credibility on the part of financing entities and construction companies. From 2003 to 2012, when the project started, sustainable building projects, including geothermal ones, were not so extended in the country. However, having an architect with experience in this type of projects helped considerably to encourage the different entities to collaborate in the project. Hence, it is very important to count on experts to justify the convenience of a project.

Community motivation is key: In the two cases mentioned above, communities have organised themselves to obtain financing with the main objective of having more sustainable housing. In both cases, the high level of success obtained with geothermal energy is evident. **The success of these projects is partly due to the fact that they have involved experts from the beginning.**

A third lesson from these case studies was the high level of satisfaction of the **reduction in energy cost.** The residents are paying about 50% less than they used to in their former houses – savings that they can make due to the geothermal system. In addition, the residents highlighted in the survey the **high comfort** due to the heating floor in winter, but even more in summer, when the floor is cooling. The high motivation of the community **allowed the project developers to take higher financial risks.**

Furthermore, there are some **technical recommendations** deriving from these case studies, including avenues to address enviromental concerns also found in the EU legislation:

- Grouting the Borehole Heat Exchangers (BHE), sealing of annulus to avoid contamination /connection of overlapped aquifers, in order to avoid connection of different aquifer layers or connecting aquifers to surface;
- Legislation for installation of geothermal (esp. open loop) systems in drinking water areas to avoid drinking water contamination;
- Drill rigs equipped with adequate safety equipment to detect, gas and artesian water outflows, GIS data to assess the risk of artesian groundwater.

Finally, a more general finding deriving from the litterature study on heating and cooling using geothermal energy, is that there is insufficient room in the current policy for initiatives by small users. This limitation can hamper the development of new geothermal initiatives. If necessary, it is possible to combine small projects to achieve the necessary size to reap all possibilities and discounts. In this more general ground, our **recommendation is for the legislation to ensure there is enough room for small initiatives to grow and enter and compete in the market.**

3.2 HEATING AND COOLING OF DISTRICTS IN CITIES OR IN MANUFACTURING

In 2021, there were 360 geothermal district heating systems in operation in the EU, with 5.6 GWth of capacity and producing more than 20 TWh. In fact, **geothermal resource has the potential to cover 25% of the heat demand in the EU**. More than 200 geothermal district heating (DH) projects are now under development. Leading markets such as France, Germany or the Netherlands are looking at greatly expanding the number of projects installed with more than 100 projects planned or in development. Meanwhile, all European countries are set to rapidly scale up their installed capacity, with leading emerging markets such as Poland and Denmark where geothermal is clearly identified as a strategic resource moving forward.

During these three years of work in the CROWDTHERMAL project we have received numerous enquiries from communities, local authorities and promoters, interested in developing disitric heating projects in different European countries: Germany, France, Ireland, Greece and Hungary. In the cases promoted by communities, the main motivation is to reduce CO2 emissions into the atmosphere. The challenge in these cases was to have the technical support and permissions to promote this kind of projects. In the case of geothermal project developers and local authorities the obstacle was linked to problems of social acceptance.

CROWDTHERMAL case study in Hugary: District Heating in Szeged

The District Heating Company of Szeged (SZETAV) is a 4th generation District Heating and Cooling system that utilises natural gas and, recently, local geothermal energy as its heat source. The company supplies heat and domestic hot water to 27,256 households and 433 public buildings in the Hungarian city of Szeged. The company is a municipally-owned SME with 3 departments (operations, finance, and energy) and 147 employees. The total energy output of the system is 782,514 GJ/year (547,967 GJ heat energy, 234,547 GJ domestic hot water) with a total installed capacity of 224mW. The system has 23 heating circuits with 1-20mW boilers in 19 remotely operated and 4 staffed boiler houses, 239 heating substations and 215km pipelines.

Imported natural gas had, until recently been the sole energy source of the system, making the company the single largest local emitter of CO2. That changed with the integration of renewables into the system. Geothermal is now being introduced to the 15 largest heating circuits and solar power provides electricity to the pumps in several boiler rooms. Set off in 2019, the Euro 63 million development, co-financed by the EU and private investment, is among the largest district heating system overhauls in Europe. Currently, 9 extraction wells are being drilled. As a result, nearly 20 million m3 of natural gas will be replaced with 536,298 GJ of geothermal energy annually, reducing the greenhouse gas load of the city by 68%.

Public concern is still relatively high towards the project, mainly because the drilling 27 wells and laying pipelines in a densely populated city is a significant annoyance for inhabitants. A second reason of concern derives from the fact that utility costs of private households are state-controlled in Hungary. Therefore switching to renewables does not imply any financial benefits for the end-users. This is why it is **very important to highlight the environmental advantages of geothermal and showcase its long-term environmental benefits**.

The case study of Szege, Hungary, is an example of a good combination of factors. In late 2014, the city council hired a group of young professionals (experts form the University of Szege) 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 rationale of the project based on **care for the environment, pride and financial benefit.** Since they invested nothing but their time and effort in the project, money or payback did not play such a crucial role as for 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.

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 the administration, e.g. 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 the 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.

There are also some **technical-environmental recommendations** that can be learned from this case study. First, to ensure credibility and trust, it is important to count on contractor(s) with good environmental records. Second, to avoit groundwater contamination, wells casing and grouting, it is recommendable to take expertise advice in the perforations. Finally, as drilling takes place in the city, one of the environmental problems is related to noise and visual impact. To avoid these problems it is recommended to install noise barriers to avoid disturbances of residential areas, to make a careful landscaping during operation, and to avoid ecologically sensitive areas

CROWDTHERMAL has also analysed lessons of community engagement from the third case study, this one in Iceland. The case study focused on the industrial use of geothermal energy, i.e. in the development (heating) of a greenhouse facility in Northern Iceland.

CROWDTHERMAL case study in Iceland: A community greenhouse

The Húsavík Community greenhouse was developed for the Crowdthermal project in the town of Húsavík in NE-Iceland, led by Eimur. The aim of the project was to co-develop a concept for a multi-use greenhouse facility in Húsavík. This was carried out through a series of stakeholder interactions, and towards the end of the project, a small team of local people joined in advocating the concept in a very successful open meeting on the project. Húsavík is a small municipality in the Northeastern part of Iceland with a population of around 3000 inhabitants. Geothermal energy is abundant in the region, which is located near a volcanically active area. The town is supplied with both hot water and electricity from nearby renewable energy sources.

The Icelandic case study aims to use geothermal energy to keep the greenhouses operational all year round. Alongside geothermal utilisation, the project will benefit the municipality. The gains are however not only financial, but mostly social. The greenhouses can be used for educational purposes, crops for restaurants, or activities for senior citizens. The project can also help raise environmental awareness and awareness about the importance of local food production.

4 RECOMMENDATIONS

The community empowerment has a large potential for achieving the objective of 45% of renewal energy in the EU. CROWDTHERMAL identifies three main features which need to be addresses: the social-environmental conditions for citizen engagement, the financial mechanisms, and technical aspects for risk mitigation. For the clarity of the presentation, recommendations on risk mitigation measures are part of the financing aspects of community empowered geothermal energy projects.

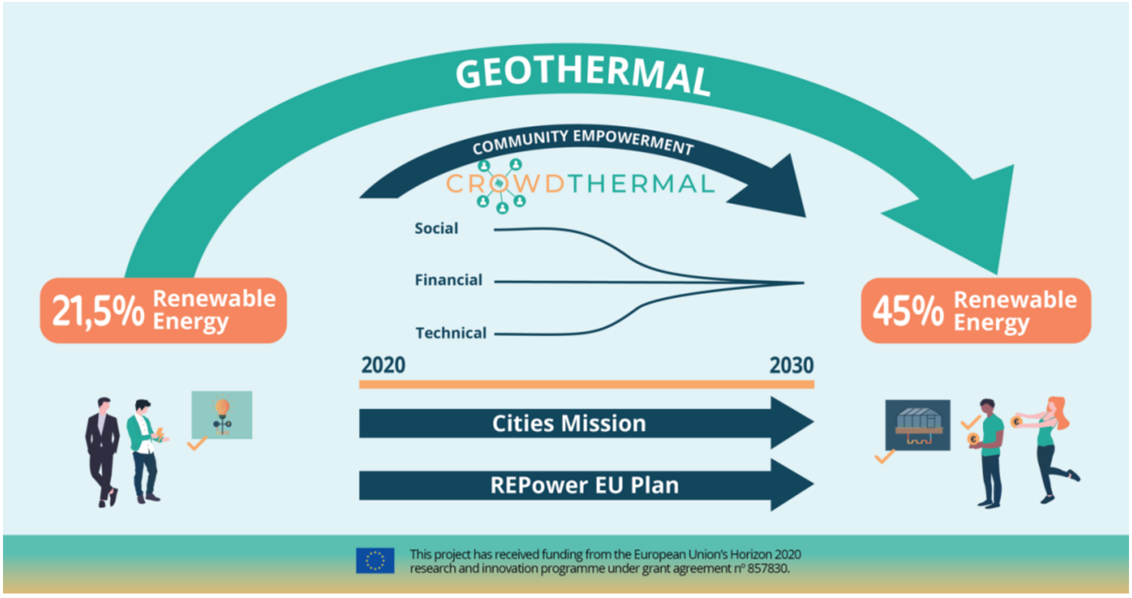

Figure 8: *Infographic on the CROWDTHERMAL Community Empowerment to achive the renewal energy challenges*

Source: CROWDTHERMAL project, 2022

CROWDTHERMAL has developed an **online "Core services" platform**, with tools targeted to the community of geothermal energy, the project developpers, as well as to the local authorities. It includes an online decision support tool algorithm for developers/promoters of geothermal projects to identify the most efficient social engagement strategies and financial instruments to be implemented for their respective scenario and context. There are also implementation frameworks for community-based geothermal development, a guide to integrated finance in geothermal energy, a toolbox for risk evaluation and mitigation, a meta-database of geothermal projects, as well as an information catalogue for self learning.[1]

[1] https://www.crowdthermalproject.eu/crowdthermal-core-services/

The recommendations presented below are very relevant both for the delivery of the European Green deal, the REpowerEU plan and for the implementation of the EU Mission on 100 climate-neutral cities by 2030. There are direct recommendations to the EU and national authorities. However, the heart of the matter is at local level, actions by local authorities, local project developers, and communities.

4.1 SOCIAL AND ENVIRONMENTAL FACTORS FOR CITIZEN ENGAGEMENT

Recommendations to local authorities and project developers:

- ***It is essential that citizens and communities can perceive social benefits of the geothermal project***

CROWDTHERMAL has identified several more general factors associated with a successful citizens's and community engagement. The trust between project planners, authorities, and actors in civil initiatives, citizens's perception of the usefulness/necessity of the geothermal project, citizens' familiarity with geothermal energy, citizens' attitudes and values towards the energy transition, and the local socio-political context.

Common positive attitudes are generated by an association with climate protection, renewability of the energy source, the financial benefits for communities through taxes, possible costs reduction for energy and heating, potential for regional energy independency, potential for district heating, potential for job creation.

- ***Projects should seriously address resistance and negative attitudes towards geothermal energy***

These are often related to social perceived cost/risks, such as induced seismicity, high investment costs, noise, landscape changes, negative impact for tourism, negative environmental impact, land subsidence, property damage, and groundwater pollution.

The communication of the project should be transparent (projects basics, timeplan, reasoning, degree of affecting the local level etc.), user-needs oriented and balanced in terms of potential benefits and risks.

- ***Understand the conditions for public acceptance and public engagement***

There are different levels of public engagement, such as formal participation regulated through legal frameworks, and informal participation and communication measures conducted voluntarily by the project owner. “Real” participation starts with the level of cooperation, where the involved people are not just consulted but play an active role in the project’s outcome. However, even if the participation process is designed to be as open-ended as possible, there are limits to what can be negotiated. These limits should be transparently discussed right from the beginning in a sense of realistic expectation management.

- ***When planning public engagement, consider the existing (contextual) preconditions of a project when deciding on public engagement strategies***

Consequently, analyses of the context can consider factors such as place, i.e. it should be brought into experience whether there are protected spaces, nature reserves, national parks or whether there exist directives protecting flora and fauna, whether the project would affect the landscape negatively and what consequences would result from this circumstance. It can be relevant to understand how residents are attached to an area in order to act appropriately. Furthermore, information about the community is crucial for planning public engagement. It is important to know the groups of people and the stakeholders that need to be represented in the engagement process of a geothermal energy project, what the socio-demographic characteristics of a community are, as well as which political attitudes are dominant in the area.

Therefore, the context of the project should be analysed and the possibilities for engagement should be designed accordingly. The results will be different depending on the level, if you have a project on the city level or individual residential buildings, but the questions are the same.

- ***Identifying the relevant stakeholders and their relation to each other is essential when tailoring the different participation measures to the existing target groups***

Therefore, stakeholder maps provide a good overview. Furthermore, it should be researched whether there were any events in the history of the area that could influence the residents’ reactions towards following energy projects, and whether there already exist specific visions in terms of energy solutions, which is closely connected to the political context and should also be taken into account. The mapping of involved stakeholders offers the possibility to illustrate the relationships between them, that can be either good, neutral or conflicting , revealing potential alliances among each other, which might be interesting for a project’s implementation phase.

It is important to learn about the characteristics of the stakeholder group:
- What are their expectations and their needs
- What are their concerns and fears
- Which experiences do they have from former projects which might influence these hopes, concerns and needs
- What knowledge do they have and which knowledge and information is needed

➢ ***Finally, the project should take into account citizens´ knowledge about geothermal energy or energy topics in general, since it determines how engagement strategies are designed***

In summary, four concrete recommendations for public engagement:

- Continuous information and consultation should be applied and opportunities for involvement provided;
- Realistic goals for the engagement activities should be formulated (gaining legitimacy for a procedure, reducing conflicts, financial participation, activations of citizens, acceptance);
- The engagement activities should fit to the resources available;
- The acceptance of the project by the public and different acceptance factors, such as support for renewable energy and the perceived benefits (economic and social) for the region or community should be assessed.

➢ ***The enviromental risk factors must be assessed for the relevant project phases and geothermal technology types. Relevant mitigation measures must be developed to manage above environmental risks taking in consideration the technology types and project phases.***

Geothermal energy is an environmentally friendly and sustainable form of energy, yet a major obstacle to geothermal development is social acceptability with perceived environmental factors being a cause for public concern. A state-of-the-art literature review concluded that some environmental concerns are based on facts, whilst others are mainly perceptions, induced by socio-environmental and psychological processes.

The environmental concerns associated with geothermal energy influence public support to the development and deployment of the technology. The environmental risks, for both deep and shallow geothermal systems, includes the impact on the air pollution; water usage; water pollution; land usage; induced seismicity; land usage; land subsidence and deformation; solid waste; noise pollution; visual pollution, and radiactivity impacts.

This state-of-the-art review of the risks of these environmental factors classifies these factors in terms of environmental matrices, namely:

- Air risks: emissions to the atmosphere from geothermal energy plants and direct use geother- mal heat are much lower than conventional fossil fuel-based energy plants, but still need to be monitored and reduced.

- Water risks: pollution and consumption are issues with geothermal power plants which use considerable amounts of water throughout their lifetime depending on size, technology type, working temperatures, and cooling mechanism. As spent geothermal fluids are neither potable nor suitable for agriculture, they need careful disposal. In high-enthalpy projects, losses of geo-fluid and steam during operations mean make-up water is required.

- Land risks:– as geothermal operations are concentrated in seismic active zones, energy pro- duction by extraction or circulation of geofluids can lead to induced seismicity. Land subsidence can occur from the extraction of fluid and steam from geothermal reservoirs. Land use during the different project phases of a geothermal power plant can be temporal (construction and reclamation) or permanent (operation) and includes changes to landscape and to natural fea- tures. Solid waste is created during drilling and operation phases and waste from geothermal energy production includes activated carbon from abatement systems and chemical deposition in pipes, vessels and in cooling towers.

- Noise and visual pollution and radioactivity risks: Throughout the life of a geothermal energy system, noise is created during the plant operations. Visual disturbances caused by geothermal plants include deforestation, land occupation, and increased road traffic and dust emissions. Radioactivity from leached uranium and thorium can reach the surface in geother- mal fluid and radioactive tracers have been used in doublet well testing.

The environmental risks factors for both deep and shallow geothermal systems should consider each factor's criticality in terms of its influence on public perception and approval. The different enviromental risks factors depend of the project phases and geothermal technology types. An assessment on the enviromental risk factors for each project phase should be performed in order to include mitigation riks mesures. (Deliverable 1.2)

- ***Develop Social Licence to Operate***

A Social License to Operate (SLO) is a theoretical construct that expresses the level of acceptance by local communities and stakeholders of an organization or company's activities in their territories. It is an implicit consent, independent from legal or statutory requirements.

The general aim for a geothermal SLO is to further reduce the risks of public criticism and social conflicts, and, in general, provide a broadly agreed social acceptance framework for the different types of geothermal investment projects. This will result in more transparency, reduced investment risk and more versatile and easier engagement for crowdfunding.

The SLO framework developed through the CROWDTHERMAL project is a first of a kind model in the geothermal energy industry which considers contemporary discussions concerning all stages of geothermal development from exploration to planning and building, and from operations to closure.

From a practical point of view, given that SLO is context-specific, a more comprehensive approach includes a "Factors" element to the framework. These would consider:

- Needs of the stakeholders (especially the local communities) and the relevance of the proposed projects to those communities;
- Relevance of geothermal development projects is intrinsically linked to the national (as well as regional and international) strategic energy utilization;
- Legal and economic licenses;
- Environmental and financial risks;
- Competition and industry perception.

4.2 FINANCIAL MECHANISMS FOR CITIZENS'AND COMMUNITY ENGAGEMENT

- ***Alternative finance can successfully be used for different geothermal projects and technology types as well as various investment sizes.***

Community funding is a useful approach to increase the acceptance and commitment by the community of and to a geothermal project. Community funding can give the community a say in developments, better information about the project, or a share in the potential benefit of the project. Suitable finance tools for geothermal projects (depending on the specific characteristics) can be: grants or donations, crowd funding (reward, equity or loan-based), direct lending, and social or green bonds.

When using innovative finance tools for geothermal projects it is not “one size fits all”. Depending on the characteristics of a specific project, the mix of financial instruments should be chosen. The chosen instruments for community funding should be based on the type of capital required (risk absorbing, risk sharing, debt, reserves), the amount of capital required and the risk appetite and risk absorbing capacity of both the crowd and the project developer.

To match the risk profile of community and project developer, a combination of finance tools and risk mitigation instruments is often required. Successful community funding needs to match the actual technical and financial characteristics of an individual geothermal project, its current project development phase, and the associated investment risk level with the community investors’ risk appetite and motivation for involvement.

The new **European Crowdfunding Service Provide**r (ECSP) regime will create more opportunities for raising funds from local communities.[2]

Recommendations to local authorities and project developers:

- ***Introduce alternative finance mechanisms for geothermal energy***

Community funding (or community financing) is a tool to financially involve stakeholders around a geothermal project. By making them a part of the project through funding, they can:

- Be more directly involved in the decision-making around the project;
- Be actively involved in the realization of the project and its sustainability goals;
- Be better informed about the project;
- Receive some of the financial or other benefits (cleaner or cheaper energy) of the project.

[2] https://www.crowdthermalproject.eu/crowdthermal-core-services/

There are different alternative finance instruments that can be used to attain community funding for geothermal projects. Alternative finance in general can be defined as all finance methods that are not through traditional channels (like commercial banks). These instruments can be combined with risk mitigation instruments to obtain the right mix of risk and return for both the project owner. The involved community and other stakeholders would comprise local governments or other investors. The right mix of instruments depends on the risk appetite of the community and the project owner and on the project phase in which the community funding will be used.

- ***Combine crowdfunding and risk mitigation for deep-geothermal***

New approaches to finance, however, also bring about new types of risks. This is especially relevant with regard to sector-specific exploration risk (also known as geological, resource or discovery risk), as the risk of not finding an economically viable amount of energy is defined by temperature and productivity of a geothermal reservoir.

Due to the high-risk profiles of deep geothermal projects, applying crowdfunding usually means having to pay high interest rates to investors. It is thus a relatively expensive option for project developers.

Transparent communication of opportunities and risks however is a key aspect and needs to be sought. We stress the importance of risk mitigation strategies such as trust funds, guarantees, or earmarked insurance mechanisms. Sufficient knowledge of the legal framework of national and EU fundraising regulations is crucial to decide on the most appropriate form of business model, alternative finance method and overall financial mix.

When applying community funding for deep geothermal projects, the resource/exploration risk needs to be mitigated by appropriate mechanisms. Especially when a financial participation of the public is intended, mechanisms to reduce the resource risk exposure of community investors need to be in place.

- ***Consider the interdependencies between technical, financial and social dimensions***

Understanding and developing a project in a holistic way, taking into consideration technical, financial and social dimensions as well as their interdependency is another important risk mitigation measure for project developers (Figure 9). It reduces the risk of interface problems and increases the chances for a Social License to Operate and for both technical and economic project success.

The development of public engagement with the community and local authorities is facilitated when differentiating between the different phases in a geothermal project (Figure 9):

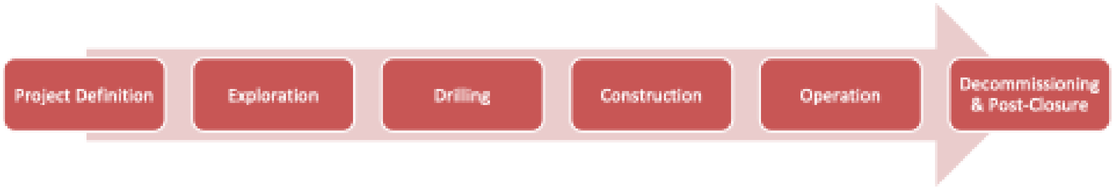

Figure 9: Geothermal Project phases, CROWDTHERMAL D1.2

The mapping of involved stakeholders offers the possibility to illustrate the relationships between them (that can be either good, neutral or conflicting). This enable the project and the stakeholders to reveale potential alliances among each other, which might be interesting for a projects´ implementation phase.

Recommendations to national authorities and to the EU:

- ***Mobilize national support actions to community funding***

  a. Create government incentives for community funding in geothermal projects.
  b. Create a capacity building program for geothermal projects to receive hands-on support.
  c. Promote knowledge sharing and peer-learning amongst geothermal community project owners, by launching/supporting an European network of geothermal community projects

- ***Create new EU funding mechanisms incentivizing community funding***

A number of instruments could be created at European level to support community funding for geothermal projects. For example the European commission could create:

a. A European match-fund to match local and community investments.
b. A European risk-mitigation scheme for (community) funding in geothermal projects.
c. A European Green bond to invest in geothermal projects with community involvement .

d. A European pay-it-forward scheme where countries get a quota of geothermal energy they have to create (relative to the local possibility), to which they can trade the right among each other.
e. Create a European fund to provide grants in very early startup phases to community geothermal projects. Only to be paid back (with premium) if project is finally developed.

➢ ***Establish a pan-European geothermal exploration risk mitigation scheme for deep geothermal projects that use community funding***

We recommend to establish a pan-European geothermal exploration risk mitigation scheme for deep geothermal projects that use community funding[3]. An ideal framework for such a tailored risk mitigation scheme would unite project financing and risk mitigation components. It should include:

1. a grant-based, co-financing component in the form of matchfunding of the amount of funds that can be raised from the public. Public matchfunding encourages successful community funding, helps projects become economically feasible and can increase trust in a project;

2. a risk-sharing component in the form of guarantees to mitigate the short- and long-term subsurface risks. Such guarantees considerably reduce the financial risks associated with subsurface uncertainties, both for project developers and for community investors. They are expected to lead to more positive funding and project realisation decisions.

In the light of the deep geothermal market status in Europe, a high involvement of public aid-granting entities in the (co-) funding of such a geothermal de-risking scheme is important. Ideal funding sources include transnational financing bodies, national governments, and public support mechanisms like EU-level public funds.

The access to a public geothermal risk mitigation fund should not be restricted to traditional banks, as this has proven a potential pitfall for risk mitigation schemes in the past. It is rather suggested to establish an earmarked risk mitigation facility to which project developers and/or crowdfunding platforms could directly apply.

[3] Further details on the proposed CROWDTHERMAL Risk Mitigation Framework can be found in Baisch & Wolpert 2021 (https://www.crowdthermalproject.eu/wp-content/uploads/2021/03/CROWDTHERMAL-D3.4_GeoT_Final.pdf).

Financing and establishing such a geothermal risk mitigation facility for geothermal crowdfunding can act as an important stepping stone to stimulate geothermal market development in Europe with all associated benefits for the environment and for society.

➢ ***Revise the regulatory framework for community funding***

The CROWDTHERMAL analysed the "Regulative Framework for Community Funding" and the effect of the legal and financial infrastructure on the possibilities for community finance for geothermal projects. These studies also considered the findings and lessons learned from the three case studies that have been performed within the CROWDTHERMAL project: in Spain, Hungary, and Iceland.

On this basis, CROWDTHERMAL identifies two major areas of infrastructure and legislation that affect the choices and possibilities of community finance: Governance and ownership structures (who can own a geothermal site?); Legislation of the generation and supply of electricity and heating (who owns the distribution network and at which price?).

Table 1: *Regulatory framework recommendations for governments and project developers*

Obstacle	Recommendation for Project Developers	Recommendation for Governments
Fixed price for electricity or heating makes it difficult to generate positive returns for community investors for participating in sustainable energy projects.	Aim for other rewards for community investors such as extra access to heating or electricity or a reward-based benefit participation in a unique benefit, for example, heated spa, etc. for investors.	Allow price differentiation or profitable sale back of self-generated energy to the grid.
A monopoly or oligopoly for energy companies may make private initiative in developing sustainable energy difficult.	Involve a government or one of the large companies to support the community initiative.	Create more room for private initiatives that can keep rewards of the project to stimulate private initiatives. Support with grants or guarantees. Make sure the market remains accessible to small initiatives.
Strict rules about crowdfunding initiatives make community funding expensive or unusable.	Try to involve a bank or other party with a license to facilitate the community funding. After new crowdfunding directive, this can be an international platform.	Allow the development of local crowdfunding or direct lending initiatives.

Financial legislation can form great obstacles to raising money.	Involve a legal financial specialist to help you navigate the different rulebooks. Try to access investment through equity, while avoiding banking license or investment fund activities, as this means extensive costs for yourself.	Try to keep room in national legislation for private initiatives, and do not increase the regulatory burden already in existence in European legislation.
Difficult to combine community funding with governmental funding.	Use international examples to show potential with local/national government and co-create public-private investment models.	Use funding from European Structural Funds or local funding to create guarantees or co-funding instruments for early phases of geothermal projects.
If the demands from different legislation are not compatible, the effect can be that experimental drilling or research to find new geothermal locations is blocked (Iceland's example).	Start conversation with the government as they may not be aware this is the effect of the combination of different legislation.	Make sure different legal schemes are compatible and do not lead to rules that hinder the development of new geothermal sites.
Insufficient room in policy for initiatives from small users can hamper the development of new geothermal initiatives.	If necessary, combine small projects to realize necessary size for sufficient possibilities or discounts.	Make sure there is enough room for small initiatives to grow and enter and compete in the market.

Source: CROWDTHERMAL, 2022