

The Global Geothermal Market: A Stronger Focus On Heating And Cooling, Towards Greater Interconnections Of National And Regional Markets?

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ABSTRACT

The global geothermal market has historically been quite fragmented, and dominated by the development of geothermal power plants, with clearly identified exporting countries. The structure of the global geothermal market is however evolving thanks to innovation bringing new technologies to market, and to the global focus on decarbonisation which increased the global interest for a wider range of geothermal applications. For the European geothermal industry, which has long been developing geothermal heating and cooling or electricity projects alike, this global shift is an opportunity to promote its know how and build partnerships with rapidly growing industries in third countries.

This paper will aim at presenting the changing structure of the global geothermal markets, and provide pathways for the growth of the international geothermal markets through the main recommendations issues by the GEO-ENERGY EUROPE project to facilitate the development of international projects for European geothermal energy companies. The paper will notably look at the strength of the European geothermal industry in the global export market, and provide policy recommendations to facilitate internationalisation, as well as best practices for companies looking to explore international markets.

1. INTRODUCTION

In the context of climate change and energy transition, the GEO-ENERGY EUROPE metacluster is a voluntary, open alliance of complementary clusters focusing on sustainability and the transition to a decarbonized and sustainable use of geo-energy. The overarching vision for the GEO-ENERGY-EUROPE metacluster is to develop a stronger and more integrated European sustainable geo-energy sector, especially as far as Small & Medium Enterprises (SMEs) are concerned, with an initial focus on geothermal energy deployment and a two-fold strategy, consisting of helping the European geo-energy SMEs increase their business and export the European know-how and experience outside Europe. Another focus is to contribute to the industrial deployment and market uptake of sustainable & decarbonized geo-energy, starting with deep geothermal, in Europe and across the world.

Globally, we are seeing a shift towards the increased use of all forms of renewable energy sources. Geothermal, although a recent focus in many global markets, is set to grow rapidly as countries are looking to increase the reliability of their electricity systems with baseload renewable energy, or to decarbonise their heating and cooling processes and buildings. European companies have a precious expertise in these aspects, thanks to an innovation geothermal industry within Europe. However, on export markets, non-technical challenges are a barrier to the development of

international projects based on leading European technologies in the geothermal sector.

Thus far, geothermal has not become a major globalized market beyond some specific segments. The work undertaken as part of the GEO-ENERGY EUROPE project was notably looking at the drivers of a greater internationalization of the European geothermal industry – i.e. what would be required to accompany companies which have often limited internationalization capacity beyond their traditional markets. Started in 2016, this work has delivered several conclusions by experience and by an analysis of the evolving market trends since then. This paper will aim to summarise the experience acquired and information gathered as part of GEO-ENERGY EUROPE to outline the best pathway to accelerates exports of geothermal energy.

In a first time, this paper will provide an overview of the global geothermal market and highlight some of the key dynamics of exporting geothermal energy. The paper will they explore some of the barriers, technical and non-technical to exporting geothermal energy technologies. Following a consideration of the impacts of the current global energy price crisis and supply chain disruptions, the paper will then explore some recommendations for policy and financial support to exporting geothermal technologies.

2. OVERVIEW OF THE GLOBAL MARKET

The global geothermal market is first and foremost a geothermal power production market. Globally there are around 15.6 GWe of geothermal power production capacity in 2020, a figure that while significant in itself does not allow the geothermal industry to be considered a major actor of the global energy system. Locally however, geothermal electricity production can be a major factor of energy security, electricity grid resilience, energy independence or providing greater access to modern energy sources to a population yet to have full access to electricity. The contribution of geothermal energy for power production is mostly tied to the availability of high temperature geothermal resources, usually linked to volcanic activity. However, more and more countries are looking at alternative type of geothermal power plants which have the potential to broaden the outreach of this renewable electricity source. While EGS system have yet to be a significant factor in the global geothermal market, binary turbines have been quick to become a mainstay of geothermal power plant development and a very dynamic and competitive global market.

Geothermal power plants are a much more dynamic global market because they tend to represent significant capital expenditure (CAPEX), have a broad array of component and service needs (e.g. turbines, cooling systems) and require a large number of wells. In many countries they have also been a policy priority, and subject to beneficial regulatory and financial frameworks.

In contrast, the geothermal heat industry is much less global in appearance. One of the reflections of this fact is that data is much harder to find. By some estimates, geothermal uses for space heating and cooling and uses for process heat in agriculture and industry amounts to an installed capacity of about 18 GWth on top of which an estimated 77.5 GWth of geothermal heat pump capacity. The global use of geothermal energy is therefore more focused on the use for heating, however this segment of the global geothermal market is much less internationalized and more typically projects are carried out by national companies, as well as developed and planned at the local level often by local authorities.

Geothermal companies looking to internationalise their activities therefore often have an easier to data on upcoming project development for geothermal power plants. These projects being larger, often driven top down by national programmes with clear publications of tendering, or even by international organisations such as the World Bank. Being larger and more technically complex, they also require a larger array of technical skills, specific service provision or equipment to be manufactured, they also reserve a wider array of niches for companies to provide services without having to undertake themselves a project, which is especially beneficial to SMEs in the process of internationalization.

Meanwhile, the geothermal heating and cooling sector reflects the broader trends of this segment the energy system: there is a lack of integrated strategy in most countries. We are only recently seeing a global trend towards more proactive planification of the decarbonization of heating and cooling throughout the global geothermal market. An integrated planification of the energy transition in the heating and cooling sector in more global geothermal markets is a key step towards a new wave of export and internationalization potentials for companies of the geothermal industry.

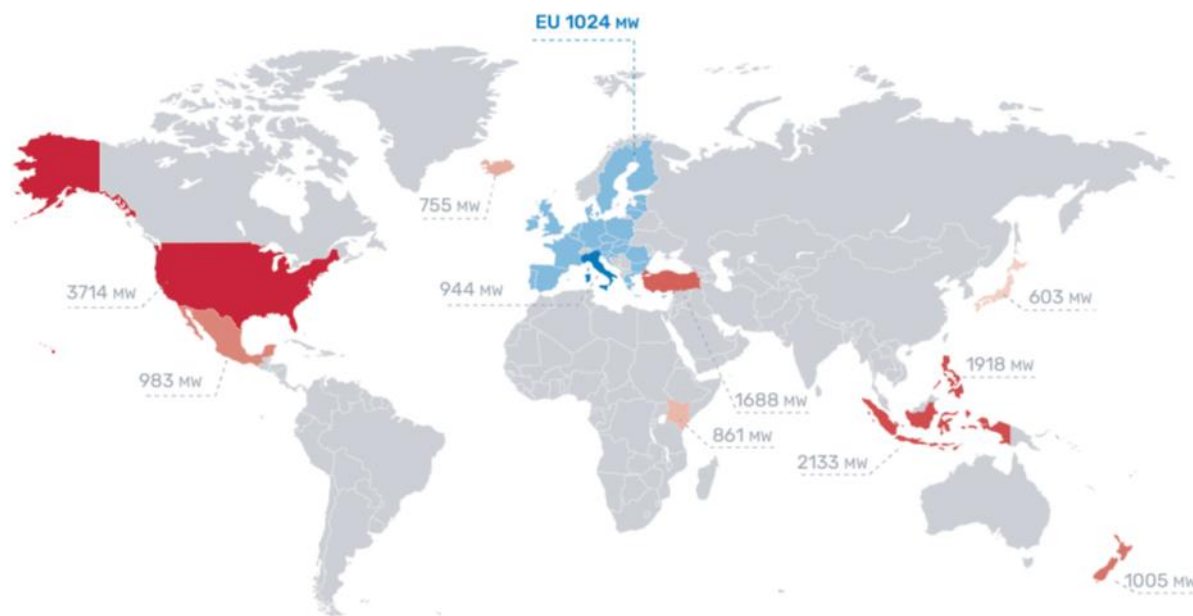


Figure 1: Top 10 countries in the world for geothermal electricity capacity in 2020 (EGEC Geothermal Market Report 2020, Thinkgeoenergy).

3. TECHNICAL AND NON-TECHNICAL BARRIERS TO EXPORTING GEOTHERMAL ENERGY

3.1 Geothermal technologies are typically not a commodity product

The main technical barrier to exporting geothermal energy globally is that it is not a commodity. Unlike many energy products or technologies, geothermal energy cannot be sold across oceans, and it is not possible to produce geothermal power plants in a factory to fixate on roofs. Even geothermal heat pumps are notoriously difficult to standardize because of the challenge posed by geology to the building of the borehole heat exchanger. This complexity, and the segmented geothermal industry that grew from it is a major barrier to the export of geothermal energy. It can however be easily overcome thanks to a standardization of practices and the adoption of suitable models.

The export of specific components of a geothermal project is a more straightforward process, such as for the well casing, heat exchangers, heat pumps or turbines. Many different models exist, and we can find many examples of turbine manufacturing companies being very successful on the export market. Turkey for instance, the world's most dynamic geothermal power plant market over the past decade, has 10 different turbine manufacturers active in the market.

3.2. The geothermal resource risk also impacts export capacity

A large part of the value of a geothermal project however lies in the construction of the wells, as drilling can represent between 40-70% of project development costs

according to the geothermal technology and the maturity of the market. This typically means that many geothermal projects require a significant investment to be undertaken before the actual parameters of the project (temperature, flow rates and therefore capacity) is known.

The geological resource risk therefore is a major barrier to exporting geothermal energy technologies or services. Indeed, for a private company, international activities are usually inherently riskier than activities in their national market for a range of reasons. The geothermal resource risk compounds on the usual risk profile of geothermal project and may be a further barrier to international companies if there is no geothermal risk mitigation scheme available.

3.3. Difficulty for international companies to access the right information in new markets

Access to the right information is a crucial barrier to companies looking to export their technologies and know-how. It can be a challenge for companies, especially smaller SMEs to identify the right trustworthy partners in their target markets. Language and cultural barriers can also add to the difficulty to find this information. This is particularly significant for companies looking to promote the development of a full geothermal power plant, where they would need to navigate the usually complex permitting and licensing procedures, but also the process to benefit from support schemes or secure PPA with local partners. The level of regulatory risk is significant, and few companies are able to absorb it.

Moreover, international companies may be faced with a lack of suitable information about the underground, especially in countries where the exploitation of the underground was until recently the monopoly of a single public company (which also means this company is the only one with access to underground resource data).

Despite these many barriers, and several others, geothermal companies are able to develop international projects, with for instance companies such as Ormat, Engie, Turboden or Exergy developing geothermal plants far beyond their national markets. These companies export specific technologies, notably turbines as mentioned above, but more importantly they export know-how and project development capacity. Along major project developers, SMEs and other service companies can also provide their services and specific expertise either as part of international consortium or by being contracted by national developers in their target markets. Such contracts significantly reduce the risk linked to internationalization by such companies. However, the identification of the right partners or accessing information about the potential needs for their services in the markets they are targeting remains a major issue.

4. THE GLOBAL ENERGY PRICE CRISIS AND GLOBAL SUPPLY CHAINS DISRUPTIONS FOLLOWING COVID 19

4.1. Global supply chains disruption: raw materials increase

During the year 2021, the global economy reignited after the first waves of the COVID-19 pandemic. This meant that all industrial sectors were looking to secure raw materials for their production processes and project development. This led the price of raw materials to explode in 2021, which along the energy price crisis is creating an inflationary tendency throughout the economy. For the geothermal sector, during the year 2021, the prices of many key raw materials have exploded.

As reference, the index price of REBAR steel in Europe for instance increased from a 266.5 in January 2021 to 338.8 in November 2021, with a peak during the year of 349.9 in August. The same is true for all steel products, which saw their demand increase rapidly as several industrial sectors started operation anew simultaneously, including the automotive and the construction industries which are major sector of demand. For various steel products, price increases during 2021 ranged from 27% to 50%

The outlook for 2022 is extremely dire, as Ukraine and Russia represent well over a third of steel supply to Europe, including for dedicated steel products suitable to geothermal power plant construction including steel tube casing for geothermal wells. Moreover, the explosion of energy prices globally, as well as the renewed activity in shale production in the US as activity rebounds, will lead to a rapid acceleration of demand for this specific type of products.

This supply chain disruption has a major impact on the capacity of geothermal developers or equipment manufacturers to access the right raw materials, and by consequence the right equipment and tools to develop their projects. This is compounded by the energy price crisis that started in the summer 2021 and is continuing in 2022 – being intensified by the fallouts of the Russian invasion of Ukraine.

4.2. The global energy price crisis

At the beginning of summer 2021, global energy prices started increasing rapidly as the economy catches up from the macroeconomic fallouts of the COVID 19 pandemic, and as geopolitical tensions and technical issues in infrastructure bottlenecks of the fossil fuel production infrastructure add pressure to the supply. For instance, gas prices on the European spot market increased from 5-10 €/MWh in 2019-2020 to 50 €/MWh in September 2021. In February 2022, following the invasion of Ukraine by Russia – which are respectively a key gas pipeline hub and the largest supplier of fossil fuels to Europe – prices spiked further, deepening the crisis globally.

For the geothermal industry the global energy price crisis has a dual set of effect. First, it is driving up the demand for geothermal energy as it is a renewable energy source that provides price stability and independence from the volatility of the fossil fuel market. However, project development is lengthy, and the current crisis will have an impact delayed by a few years. We can expect however that the impact will be long lasting as more focus has been put on the benefits of geothermal projects for energy independence, notably for heating and cooling projects. This is particularly relevant on the global market where geothermal heating and cooling is largely underutilized.

On the other hand, the short-term impact of the global energy price crisis is likely to be an increase in the cost of services for project developers since the increase price of hydrocarbon leads to increased activity in the oil and gas sector. The price of equipment and services relevant for the O&G industry and the geothermal industry alike is going to be increasing significantly at least on the short term, also on the back of global supply chain disruptions.

5. RECOMMENDATIONS FOR POLICY AND FINANCING SUPPORT FOR EXPORTING GEOTHERMAL ENERGY

The experience of the GEO-ENERGY EUROPE metacluster provides some perspective that could be generally applicable to facilitate the internationalisation of European companies involved in the geothermal energy sector. Some of the key recommendations resulting from this experience include:

- Capacity building is crucial to consolidate a “European” geothermal industry: the experience of the GEE projects, as an international metacluster, composed of several national or international clusters, highlighted

that one of the main challenge to the internationalisation of GEE is the fragmented nature of the European geothermal industry. Capacity building, experience sharing, building trust between clusters and their respective members, are crucial to facilitate cooperation and create business opportunities.

- The need to understand the target markets: among the main achievements of the GEO-ENERGY EUROPE metacluster is to provide a better understanding of the target markets to member companies, facilitating the conception of their internationalisation approach. Indeed, for most SMEs in the geothermal sector, there are some additional challenges to their internationalisation linked to the heavily regulated nature of the geothermal industry. The lack of capacity of GEE in terms of international presence however highlights the challenge in understanding the target markets beyond analysing regulatory framework and second-hand knowledge. The organisation of research missions and the establishment of partnerships with structuring organisations in target markets have proven effective in allowing a better understanding of the target markets. The establishment of long-term relationships is essential to facilitate internationalisation, enabling a greater degree of trust.
- The structuring role of innovation from the European geothermal industry: the European geothermal industry is a global leader in innovation, especially in some specific segment of the geothermal markets, notably heating and cooling, productive processes and raw material extraction. In all these market segments, there are tremendous opportunities for internationalisation although supply chains and regulatory framework are usually less established than conventional geothermal power production which continues to heavily dominate the market beyond Europe.

The takeaway of the actions undertaken by the GEO-ENERGY EUROPE metacluster, is that there are important opportunities for internationalisation of the European geothermal industry, and extensive interest to pursue such opportunities within European geothermal SMEs. However, to facilitate this dynamic, and notably to enable the development of project consortia that tap into the full potential represented by the diversity of the European industry, a public structuring of the internationalisation of the industry appears necessary – notably in light of the weight of global competitors.

The European Union can be a catalyst to enable the internationalisation of geothermal SMEs, and more generally accelerate exports from the European geothermal industry. The GEO-ENERGY EUROPE projects, supported by the COSME programme of the EU, is a very important first step in that direction. The impulsion given by GEE has proven effective in

structuring an internationalisation dynamic for geothermal SMEs at the European level. The work of the GEE metacluster during the 2017-2019 period highlighted the many barriers represented by the lack of knowledge of target markets, and the absence of local relays for companies originating from many European countries.

The Clean Energy Industrial Forum (CEIF), established in 2017 as a European Commission initiative to promote the renewable energy industry in Europe, highlighted the need for the EU to contribute to the internationalisation of strategic renewable industries such as geothermal energy. Among the key recommendations of the CEIF relevant to the objectives of the Geo-Energy Europe project are notably proposals to reinforce the protection of intellectual property of the European industry, and highlighting the role of the EU “to help export such products [renewable technologies] and business models in third country markets, by removing trade barriers and strengthening the cooperation with third countries.” Moreover the role of the EU is also important in structuring global financial flows, and the Sustainable Finance Regulation and the Sustainable Finance Taxonomy it includes are quite important features for allowing the European geothermal industry to secure private financing for international projects.

Meanwhile, in Europe, the energy price crisis that started in the summer of 2020 highlighted the role of renewable heating and cooling solutions to reduce the exposure to global supply disruptions. The fossil gas market is nearing completion globally, with the diversification of supply routes by Russia towards Asia, the consolidation of global LNG infrastructure. Geothermal technologies, alongside renewable energy sources that contribute to the European energy transition, have been clearly identified as resources to promote resilience against rising energy prices. This benefits, alongside the significant expertise of European geothermal companies in the sector of heating and cooling, as key factors that drive the internationalisation of the European economy. There is however a lack of a policy and finance infrastructure to accompany geothermal project developers, notably from Europe. The decentralisation of the geothermal industry – with smaller scale projects compared to gas for instance – makes it harder to focus on by policy makers. The EU has a key role to play if it wishes to remain a “world leader on renewables” in promoting the flourishing of its leading industries. According to CEPS/Prognos/COWI for instance, exports from European geothermal companies account for 42% of the total globally. However, European companies do not benefit from the same support structures as competitors from other key markets such as China or the USA, which threatens the consolidation of the European industry’s leading position. The study emphasises the need for a more robust European framework, for instance via the implementation of a European renewable export agency.

In the experience of Geo-Energy Europe metacluster, and the internationalisation actions already undertaken – which highlighted the importance of reliable relays in target markets for the success of the internationalisation strategy of a geothermal SME – aligns with the recommendations of the Clean Energy Industrial Forum. National export agencies are a crucial relay for geothermal companies looking to develop projects internationally. There are however major differences in the capacity of the national agencies of the various EU Member States. Meanwhile, the EU's weight as a global economy, its role as a structuring force in supporting innovation in renewable energy technologies – notably geothermal – can make it a relevant actor to supplement national agencies and maximise synergies. The diplomatic service of the EU could be a relevant channel to facilitate the internationalisation of geothermal SMEs, for instance by enable the set up of a European Export Agency. The role of European trade agreements in shaping the global economy should also be noted in that regard, as they could be used as a lever to accelerate the global implementation of the Paris Agreement, and several EU Member States are calling for it. The geothermal industry could stand to benefit from a restructuring of global trade towards the accelerate implementation of the Paris objectives.

6. CONCLUSION

The experience of the GEE metacluster allows to draw several conclusions as to the relevance and limits of the Geo-energy Europe internationalisation strategy. The metacluster structure, loosely bringing together a wide array of companies involved in the geothermal sector presents its share of benefits, allowing for a large pool of skills, know how and technologies to tap from. This structure is a vulnerability at the same time, which requires internal capacity building to create the necessary trust relationship between companies to enable business opportunities between them.

With regards to the internationalisation of SMEs involved, GEO-ENERGY EUROPE remains at an early stage, but many lessons can be taken out from this experience. The metacluster has proven that a proactive stance on facilitating internationalisation for SMEs can yield result. The layout of GEE's internationalisation strategy and roadmap have identified the key relays to facilitate it: the understanding of target markets, the establishment of trust with key actors in these markets, and the role of relays to facilitate internationalisation. While at a modest scale, GEE can provide some of these services for European SMEs, there is a role at the European level for a public framework facilitating the joint internationalisation of European geothermal companies.

The access to the right information, the reduction of the internationalization risk are key features of accelerating the globalization of the geothermal market. The current global energy market and supply chains disruptions are a significant challenge on the short term, but are likely

to accelerate the market uptake of geothermal energy in the longer term and outlines a positive outlook.

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