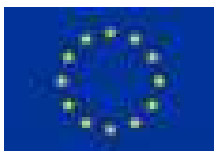




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GeoEnergy Project Business Metrics II

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1) Executive Summary

The purpose of the Business Metrics is to track and quantify achievements and success of the GEO-ENERGY EUROPE (GEE) meta-cluster in relation to its objectives and the activities related to the winning of work in third country markets. The lifetime of project GEO ENERGY EUROPE 2 ran for two years and three months between September 2020 and November 2022. The consortium comprises seven cluster partners forming a meta-cluster of European SMEs in the energy sector supported by Geological Survey Ireland as coordinator and European Geothermal Energy Council as the communications leader.

The clusters involved are:

1. French Geothermal Association of Professionals- GEODEEP (France)
2. Pôle AVENIA (France)
3. Cluster of Applied Earth Sciences- CAPES (Hungary)
4. Jeotermal Elektrik Santral Yatırımcıları Derneği- JESDER (Turkey)
5. European Geothermal Energy Council- EGEC (Belgium)
6. GEOPLAT (Spain)
7. Geo Energy Celle (Germany)
8. Consorzio per lo Sviluppo delle Aree Geotermiche-COSVIG (Italy)
9. Geoscience Ireland- GI (Ireland)

The key aims and objectives of the GEE2 project are listed below and these align with the need to monitor the business metrics of the clusters in the markets of the four target countries: Canada, Chile, Costa Rica and Kenya.

- Presentation of tailored strengths of the member companies to target markets.
- Supporting transition to the green economy, utilising existing skillsets in subsurface geoscience.
- Developing new sustainable services, drawing knowledge from more traditional subsurface activities.
- Supporting the expansion of employment in niche scientific and engineering related disciplines.
- Sustainable application of subsurface knowledge, supporting the harnessing of geothermal energy.
- Enhancement of business development and capacity building activities through engagement.

The present business metrics report covers the period September 2021 to November 2022.

2) Methodology

The determined methodology to collect the needed data was through a survey sent to each business cluster part of the consortium with the aim of evaluation the performance of the meta-cluster member SMEs in third country markets. Under the terms of the grant agreement, the business metrics were scheduled for collection yearly during the project: at the end of the first year (August 2021) and at the end of the project (November 2022); in the first survey it was also asked for the business metrics baseline (September 2020).

The geothermal industry continued to suffer the consequences of the Covid-19 pandemic in 2021. Positive trends from previous years came to a standstill due to health risks and travel restrictions in 20220 and several projects were stopped in their tracks, various others faced delays. For many developers, 2021 continued to be a difficult year, as they faced delays in their ongoing projects and a greater hesitation from investors and potential customers.

Covid-19 fundamentally changed the GEE2 project plans to interact globally and by forcing economies and SMEs to look for local resources and into the local market, including the energy one. It became apparent that member countries needed to refocus on their own natural and in-place energy resources for heating of residential areas and small industries, and for the agrifood and transport sectors.

In the context of the GEE2 project, the World Geothermal Congress 2020 (WGC), was the first relevant in-person international event since the Covid-19 crisis, it was held in October 2021 in Iceland. This offered the first concrete perspective in relation to the organisation of GEE2 capacity building activities and options for market visits. Key contacts were made to aid in the future planning of market visits. During a follow up meeting in Dublin, in November 2021, a first action plan and capacity building activities schedule for 2022 was presented by GEODEEP and validated by all partners. Finally, a clear horizon came into view to structure GEE2 capacity building activities and market visits. The agreed schedule for the training sessions, market visits and reporting periods is summarised in the table below.

	Third Market Country			
	Canada	Chile	Costa Rica	Kenya
March		Training Session		
April		Market Visit		
May	Training Session			
June	Market Visit	Report		Training Session
July	Report			Market Visit
August				Report
September				
October			Training Session	
November			Market Visit & Report	

Table 1: Capacity Building activities in target countries schedule

3) Business Metrics & Capacity Building Content

One of the main goals of the GEE2 project was to give the meta-cluster members tools for capacity building and knowledge to help them export their services to other country markets, especially if member companies were not be successful in the acquisition of businesses in the third country markets (Canada, Chile, Costa Rica, and Kenya). If the member companies should not be successful in the acquisition of business in the third country markets, other types of capacity building content should be delivered to rectify any issues that became apparent throughout the timeline of the project.

Clearly, given the prolonged uncertainty around the Covid-19 restrictions, it became more and more apparent that the chances of success in delivering business in third country markets were limited. Hence, it was decided to progress with capacity building content that could be beneficial in cases where clusters could make meaningful progress during the Covid-19 restrictions period. This proved to be particularly successful for some of the consortium clusters more than for others.

The monitored metrics designed to gauge success of the GEE2 activities were:

1. Percentage turnover derived from operations in third country markets (10% minimum threshold),
2. Contracts won in third country markets,
3. Jobs created over the period of the projec, and
4. Number of relevant procurements leads followed up by member SMEs.

In the case of the Turkish cluster, JESDER, there is a clear evidence from the capacity building activities undertaken in Turkey over the reporting period; JESDER also reported a healthy turnover of €65,000 during this 15 month period, with a modest increase in jobs (see Table 1). The COSVIG cluster also performed impressively during this period, generating €200,000 in turnover generating three follow up businesses leads. However, the most successful cluster in the 2nd period of GEE2 was GEODEEP cluster which recorded €500,000 turnover in both Chile and Kenya markets, 1million € in total; this generated two new contracts and four new job positions with a further two supply chain opportunities under discussion at the time of compiling the present report.

The remaining clusters did not perform as well in terms of business metrics but participated in several stand alone and collective capacity building events to engage with potential collaborative partners in the target countries. The under performance in some cases is due to the focus of the clusters being on shallow geothermal energy instead of deep geothermal energy. Table 2 below summarises the business metrics for the complete duration of the project, since its beginning in September 2020 until its end in November 2022.

TABLE2	CAPEX	CELLE	COSVIG	EGEC	GEODEEP	GEOPLAT	GEOSCIENCE IRELAND	JESDER	POLE AVENIA	TOTALS
Geo Energy Business Monitoring Metrics Questionnaire	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 27	Report Month 13
	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22	Sept 21- Nov 22
Turnover from target third country markets	0 €	€ 0	€ 350,000	€ 0	€ 1,000,000	€ 0	€ 0	€ 195,000	€ 0	€ 1,545,000
Contracts won in third country	0	0	2	0	2	0	0	0	0	4
Jobs created over the project period	0	0	1	0	4	0	0	1	0	6
Number of relevant SME procurement opportunities	0	0	3	0	2	0	0	0	0	5

Table 2: Key business metrics for the period of September 2020 to November 2022.

4) Global developments for electricity generation

The dynamic of the geothermal electricity market has not changed significantly during this reporting period. Globally, the deep geothermal power production continued to be the focus of the geothermal industry and is of interest to a growing number of newcomers from the oil & gas sector. It is the segment of the global use of geothermal attracting most discussion in international markets given that geothermal heating and cooling market is more fragmented globally. Turkey continued the scaling up of its capacity by adding 30 MW in 2021 and has potential for high temperature power plants but has an increasing demand of electricity as the economy in these countries is growing.

Geothermal exploration in Chile stepped up in this reporting period. The Chilean Andes host is one of the largest geothermal provinces of the world and occurs in close spatial relationship with active volcanism. Geothermal resources could provide a clean source for electricity generation is estimated around 16,000 MW, according with [CEGA source](#).

Canada has excellent geothermal energy potential by having abundant geothermal resources which are located in the western part of Canada in the area of volcanic belt Pacific Ring of Fire. It has been reported that the western and northern Canada have enough available geothermal resources to generate more electricity than the entire country now consumes. The federal Geological Survey of Canada estimated that there are at least 5,000 MW of geothermal electricity available in British Columbia, Alberta and the Yukon ([NCR source](#)).

Kenya relies on geothermal electricity for nearly 40% of its electricity needs, having added more than 60% of its total capacity in the past 15 years, to accelerate their economic development, improve their energy security and their energy related commercial balance. Most countries of the African Rift region have, for instance, ambitious objectives to build up their geothermal power production.

All the countries that are global leaders for geothermal power production are high temperature countries, and beyond Europe, low temperature geothermal power plants have seen very little development. Recently, the market changed greatly, driven by the economic development of countries such as Turkey and Kenya. Although it remains primarily focused on the development of high temperature resources, the global geothermal market is also evolving from a technological standpoint. In all countries, geothermal developers are driven to adopt new technologies to improve the economics of their project, in the face of stronger competition from other renewable energy technologies and incentives to move away from fossil fuels.

Social acceptance is another force driving the adoption of new technologies, as developers are looking to reduce the various impacts linked to project development, from local air emissions to water use. We are seeing the impact of this concern on the design of geothermal projects throughout the entire global market, although the granularity of local environmental regulation leads to some degree of differentiation in the solutions adopted. Recent experiences in Turkey, and the conclusions of the [GEOENVI](#) project delivered in 2021 do however highlight the importance of designing projects around high environmental performance for the long-term perspectives of the industry. Once lost, the social license to operate is difficult to acquire again, especially for an industry that is as dependent on a favourable government framework. This is particularly important in Costa Rica, where striking the balance between maintaining the optimum geothermal resource contribution and minimisation of environmental impacts is under regular review.

A symbol of this trend towards geothermal plants with better community integration is the binary turbine, which has quickly become the mainstream solution for geothermal power plants. Binary turbines are already a mainstream technology for geothermal power plants in Europe, since they allow to develop a greater range of resources and mitigate the issues linked to emissions from non-condensable gases in the brine. All geofluids contain a fraction of non-condensable gases, which either are dissolved or exist as gaseous components. These gases are released when

steam is flashed, but do not condense at the normal condensing temperature of steam. As a result, they collect in the condenser of flash and steam systems, raising the backpressure on the turbine exhaust (thereby lowering power output) unless they are pumped out. The release of non-condensable gases does not occur in binary systems because the gases remain dissolved in the pressurized geofluid and are reinjected into the reservoir.

5) Global development for geothermal heating and cooling use

We are seeing a global trend towards a greater use of geothermal heating and cooling. The use of geothermal heat, either as a by-product of power generation, or for purely heat focused project, is increasingly an integral part of project developments and business models. Kenya for instance, where geothermal development was first focused on power generation, is looking at geothermal heat production to contribute to the growth of its agrifood industry, for example, for drying food products. This same trend was observed in Canada.

Kenya and Costa Rica have tropical or desert climates. In these markets, emphasis is being put in a first time on the use of geothermal heat for industrial process heat. The agrifood sector is an area of focus in many developing economies because it allows a better connection of the geothermal industry with local communities: it is easier to partners with SMEs or family-owned business, thereby solving some of the public acceptance issues linked to the usually top-down implantation of geothermal power plants. Interest into geothermal heat is now going much further than as a co-benefit of geothermal power plant development, and more projects for district heating, agrifood and industrial process heat are being developed in the GEE2 target countries.

Markets such as Canada, which did not have geothermal district heating and cooling to date, have recently announced ambitious developments. Chile is another country looking at geothermal district heating, notably for the capital city of Santiago.

6) Geothermal lithium

The demand for lithium is expected to greatly increase in coming years. The geothermal industry is now being acknowledged as one of the high potential sources of sustainably produced lithium globally, and companies and public authorities are investing to bring this technology to market. In Europe, the Commission have a proposal for a Regulation on the Sustainable Batteries value chain as part of the Circular Economy Action Plan, as well as own initiative reports in the European Parliament on the topic. Meanwhile, several countries are positioning themselves as leading lithium exporters, including Chile which may be looking to graduate through the global lithium value chain from exporter of raw materials. Globally, the geothermal industry is looking carefully at developments in Europe and looking through exploration to identify potential resources. The coming years will be crucial to the global geothermal industry, as the perspective of lithium production from brine has proven to be a boost to the industry with the attention of public authorities on the perspective to source a core mineral of the modern economy while actively contributing to the energy transition.

7) Conclusions

The results of the business metrics survey were reviewed and used to refine the collection of procurement information of relevance to the member SMEs in the second period of the project. There has been significant activity and employment in the geothermal space across the globe; this is apparent after 27 months of the GEE meta-cluster carrying out extensive market research, following a successful first phase of GeoEnergy Europe, and having made connections in target countries throughout the first year of GEE2. Geothermal energy is on the radar of governments across the world and is presenting development opportunities across the entire range of the skill sets that GEE2 has to offer.

The GEE meta-cluster is diverse and highly skilled, considering the expertise and scope of the nine clusters that compose the meta-cluster. The services and expertise among its members, as well as the geographical reach and range of experience globally, across the entire value chain and in all aspects of deep geothermal energy, gives GEE an excellent opportunity to promote and export European know-how and services. Going forward, GEE2 consortium partners will continue to engage with and seek opportunities within Kenya, Costa Rica, Canada and Chile. GEE2 will also continue to exploit relationships made and progress connections with potential partners to promote its objectives.

The meta-cluster has faced unforeseen challenges throughout the Covid-19 pandemic, mainly its implications around travel. In terms of Market Study Visits, which were planned as essential objectives of GEE2, the cluster has delivered these in a compressed time period with results and business agreements still as work in progress. The Covid-19 pandemic has also caused economic difficulties across the globe which will continue to pose problems for the foreseeable future, making some markets potentially more difficult to enter. In the past 15 months of GEE2, project partners successfully:

- Continued to deliver on its objectives and report GEE activity,
- Promoted and exported EU SMEs to its target markets,
- Continued to monitor the geo-energy market across the globe,
- Successfully delivered all four market visits,
- Sought to obtain and maintain cooperation agreements with entities in its target markets.

We have witnessed a shift in the political framework for heating and cooling in 2020, where geothermal energy has been put at the centre of many strategies for building decarbonization and competing fossil energy technologies are being pushed out of the market. For the geothermal electricity industry, however, despite positive signals are coming out of Turkey with the long-awaited extension of the feed in tariffs, uncertainty remains the key word in many markets where support to geothermal power projects lacks stability. The geothermal electricity sector is faring much better thanks to Turkey, which is carrying on the build-up of its geothermal power capacity, adding 165 MW of new capacity. The progress noted in Turkey is reflected in the business metric results with strong turnover and job creation potential with a strong performance in capacity building events (see annex 1). The number of capacity building events for all cluster members has been impressive throughout the reporting period. The Italian cluster, Cosvig also reported strong turnover and exceeded the project threshold of 10% by 50%. Elsewhere in the meta-cluster partnership, progress was strong in the GEODEEP cluster also exceeding the target turnover.

For other clusters, progress has been slower, mainly since such members have been unable to significantly advance their domestic business or international network, during this period Covid-19 restrictions.

ANNEX 1

Capacity Building activities promoted or attended by the meta-cluster partners:

Cluster	Date	Event Host	Details of the issue it sought to rectify.
JESDER	14-Sep-21	DENA	energy Efficiency
JESDER	15-Sep-21	İYTE	Energy finance
JESDER	16-Sep-21	EGEC	EU Projects Matchmaking
JESDER	21-Sep-21	MAPEG	Turkish geothermal congress
JESDER	28-Sep-21	DENA	Turkish-German Cooperation
JESDER	15-Oct-21	EIF-Antalya	Geothermal Sector
JESDER	09-Dec-21	İçişleri Bakanlığı	STK Çalıştayı
JESDER	15-Dec-21	JESDER	CONTINUOUS EMISSION MEASUREMENT SYSTEMS
JESDER	12-Jan-22	TKD	Cogeneration
JESDER	10-Feb-22	JESDER	H2S
JESDER	18-Mar-22	IICI	Renewable energy rad map
JESDER	20-May-22	JESDER	environmental impact assessment
JESDER	03-Jun-22	ETKB	Lithium
JESDER	15-Jun-22	EİB	Renewable energy
JESDER	16-Jun-22	Chamber of Petroleum Engineers	workshop
JESDER	21-Jun-22	İYTE	REFLECT project meeting
JESDER	23-Jun-22	IRENA	Geothermal Agriculture
JESDER	27-Jun-22	Groningen Uni.	Geothermal Turkey
JESDER	19-Jul-22	GGA	Geothermal Agriculture
JESDER	19-Sep-22	ORMAT	ORMAT workshop
JESDER	24-Oct-22	EKB	geothermal Panel
JESDER	15-Nov-22	Dünya Bankası	Geothermal Congress
JESDER	15-Nov-22	Dünya Bankası	Geothermal Congress