

# Annual report (2020) on execution of the Deep Geothermal Implementation Plan by companies

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**Deep GEOTHERMAL IWG**  
SUPPORT UNIT



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## Introduction

This annual report on the execution of the Implementation Plan (IP) by geothermal companies presents the results of the contribution of geothermal energy industry to the SET Plan activities at the end of 2020.

The objective is to facilitate the execution and monitor the implementation of the IP for the industry part. To keep the IP up to date, EGEC is liaising with the committed companies and with the ETIP deep geothermal members from the private sector.

Information collected in this annual report is then forwarded to activities on overall Monitoring and Synergies and Strategy support (WP6&7) to ensure its treatment and a proper monitoring of the execution of the IP, as well as the improvement to reach the targets. Industry also provides feedbacks on the RD&I public funding programmes available in Europe.

In 2019, the Support Unit started the assessment by collecting quantitative data on EU and, when available, national cofunded projects. It was completed by a qualitative assessment using publications such as 2019 market reports. Moreover, a questionnaire (*Annex 1*) was created and started to be disseminated in 2019 in order to collect data from the private sector on their investments in research and innovation (R&I).

This annual 2021, on 2020 activities, will be **updated in January 2022** in the final report.

## Methodology of the deliverable

Building from the SET Plan Deep Geothermal priorities for ongoing RD&I activities, the deliverable reports on the execution of the Implementation Plan (IP) by companies. It provides also a general presentation of the activities performed by private actors.

Market actors have been regularly briefed about the 10 RD&I actions as set by the IP. They have also received detailed information with factsheets produced on funding instruments (provided in D4.2).

EGEC is monitoring the IP execution by using several tools:

- The annual EGEC Market reports, which present market developments in Europe with details on deep geothermal plants: size, capacity factor, etc.
- The series of events organised every year and largely attended by industrial stakeholders, such as the two-day Geothermal event in Brussels dedicated to geothermal research and innovations
- The ETIP DG and ETIP-RHC (geothermal panel): regular meetings with reporting on R&I results
- EGEC annual innovation award “EGIA”

Only activities started after the IP publication (January 2018), or having started before but still ongoing, are considered.

They include co-funded projects, with a public and private financial contribution, supported by European Commission programmes such as Horizon2020, Interreg, COSME; and other ones supported by National public contributions with co-funding from national funds established for transnational cooperation such as ERANET: Geothermica and GeoERA. Moreover, when available the report covers major national or trans-national research projects with potential input from companies.

The next version of this reporting will be more exhaustive benefiting from data collection operated by the SET Plan and the IWG annual reports. The answer to the questionnaire (see *Annex 1*) from the private sector will complete the data collection.

## Involvement of private actors in the Implementation Plan

The Implementation Working Group (IWG) on deep geothermal, of the SET plan, proposed in 2020 an [update of the Implementation Plan](#) which is currently up for endorsement of the SET Plan Steering Group.

The updated Implementation Plan includes the following **priorities for RD&I actions in the deep geothermal sector**:

1. Geothermal heat in urban areas
2. Integration of geothermal electricity and heating & cooling in the energy system responding to grid and network demands
3. Improvement of overall geothermal energy conversion performance for electricity and heating&cooling generation
4. Closed loop electric and heating & cooling plants integrated in the circular economy
5. Sustainable and efficient production technologies
6. Development and exploitation of geothermal resources in a wider range of geological settings
7. Advanced drilling/well completion techniques
8. Innovative exploration techniques for resource assessment and drilling target definition
9. Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions
10. Risk mitigation (financial/project)

These updated priorities cover a broad range of topics for the deep geothermal sectors and involve all segments of the deep geothermal value chain. Across the different parts of the geothermal value chain, different types of actors are contributing with their own expertise and resources to advancing the priorities for research, development and innovation in the deep geothermal sectors along the lines identified in the SET Plan Deep geothermal Implementation Plan.

For each priority, the scope is briefly described and the typology of actors implementing the SET Plan Deep geothermal RD&I priorities is described.

The listing presents co-funded projects, with a public and private financial contribution, supported by European programmes such as Horizon2020, Interreg, COSME; and supported by national public contributions co-funded by European funds such as ERANET Geothermica and GeoERA. Moreover, the report covers major national or trans-national research projects with potential input from companies.

The list includes also projects without private financial contribution, but with activities performed by industry.

## New European projects in 2020

Project name (min. > € 1 mln)	Website or short description	Start year	End year	Budget / Funding (EUR million)	Relevant activities addressed/ targets achieved	Results open to SET Plan community (Y/N)
<b>GEOHERMICA</b>						
RESULT	<a href="https://www.result-geothermica.eu/">https://www.result-geothermica.eu/</a>	2020	2023	x / 6.1	R&I 1, 6, 7	Y
GRE-GEO	<a href="https://www.gec-co.de/images/Publikationen/PM_E0241_200903_Start_of_Research_Project_GRE_GEO.pdf">https://www.gec-co.de/images/Publikationen/PM_E0241_200903_Start_of_Research_Project_GRE_GEO.pdf</a>	2020	2023	x / 4.0	R&I 7	Y
DEEP	Innovation for De-risking Enhanced Geothermal Energy projects <a href="https://www.unige.ch/res/en/projects/">https://www.unige.ch/res/en/projects/</a>	2020	2023	x / 5.7	R&I 6	Y
SPINE	<a href="https://www.lih.rwth-aachen.de/cms/LIH/Forschung/Ingenieurgeologie/Aktuelle-Projekte/~lovpu/Spannungsprofilierung-in-verbesserten-ge/?lidx=1">https://www.lih.rwth-aachen.de/cms/LIH/Forschung/Ingenieurgeologie/Aktuelle-Projekte/~lovpu/Spannungsprofilierung-in-verbesserten-ge/?lidx=1</a>	2020	2023	x / 4,1	R&I 7	Y
	<i>*Contract negotiations for a few other projects still ongoing</i>					
<b>Horizon 2020</b>						
REFLECT	<a href="https://www.reflect-h2020.eu/">https://www.reflect-h2020.eu/</a>	2020	2022	4.9	R&I 6	Y
GEOPRO	<a href="https://cordis.europa.eu/project/id/851816">https://cordis.europa.eu/project/id/851816</a>	2019 (nov)	2022	4.9	R&I 3	Y
GeoHex	<a href="https://cordis.europa.eu/project/id/851917">https://cordis.europa.eu/project/id/851917</a>	2019 (nov)	2022	5.0	R&I 3&6	Y
REGEN-BY-2	<a href="https://www.regen-by-2.eu/">https://www.regen-by-2.eu/</a>	2020	2024	5.4/ 4.9 EU contr.	R&I 6, 8	Y
OptiDrill	<a href="https://cordis.europa.eu/project/id/101006964">https://cordis.europa.eu/project/id/101006964</a>	2020	2023	3.9	R&I 7	Y
ORCHYD	<a href="https://cordis.europa.eu/project/id/101006752">https://cordis.europa.eu/project/id/101006752</a>	2020	2023	3.9	R&I 7, 8	Y
IANOS	<a href="https://www.ianos.eu/">https://www.ianos.eu/</a>	2020	2024	8.7 / 6.9 EU contr.	R&I 5	Y
GeoUS	<a href="http://geous.vsb.cz/">http://geous.vsb.cz/</a>	2020	2022	0.8	R&I 1	Y
EASYGO	<a href="https://cordis.europa.eu/project/id/956965">https://cordis.europa.eu/project/id/956965</a>	2020	2024	3.4	R&I 3&6	Y
ALIGHT	<a href="https://cordis.europa.eu/project/id/957824">https://cordis.europa.eu/project/id/957824</a>	2020	2024	15.6/ 11.2 EU contr.	R&I 1&2	Y

<b>Multilateral funding opportunities</b>						
<b>SUCCEED</b>	<a href="https://www.imperial.ac.uk/energy-futures-lab/succeed/about/">https://www.imperial.ac.uk/energy-futures-lab/succeed/about/</a>	2019	2022	2.5		R&I 5,6 Y

## NATIONAL PROJECTS

List of relevant national projects that address the targets of the Implementation Plan

Project name (min. > € 1 mln)	Website or short description	Start year	End year	Budget / Funding (EUR million)	Relevant activities addressed/ targets achieved	Results open to SET Plan community (Y/N)
<b>Large national/regional projects</b>						
<b>Warming-up</b>	<a href="https://www.warmingup.info/">https://www.warmingup.info/</a>	2019	2022	9,3	R&I 1	Y
<b>UnLimited</b>	<a href="https://www.geothermal-lithium.org/">https://www.geothermal-lithium.org/</a>	2020		0.7/ 2.7	R&I 5,6	Y
<b>Sense</b>		2020	2023	1.1/ 0.95	R&I 5,9	Y
<b>Mesotherm</b>	<a href="https://www.sandsteinfazies.de/f-e-verbundvorhaben/mesotherm/">https://www.sandsteinfazies.de/f-e-verbundvorhaben/mesotherm/</a>	2020	2024	3.9/ 3.6	R&I 1,5	Y
<b>Sensor ASIC</b>		2020	2023	4.8/ 2.3	R&I 2,4	Y

<b>ATES-IQ</b>	<a href="https://www.gfz-potsdam.de/sektion/geoenergie/projekte/ts-ates-iq/">https://www.gfz-potsdam.de/sektion/geoenergie/projekte/ts-ates-iq/</a>	2020	2022	0.7/ 0.7	R&I 1	Y
<b>Thermowell</b>	<a href="https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/">https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/</a>	2020	2023	0.27/ 0.22	R&I 6	Data will be made available at different stages
<b>ShallowTherm</b>	<a href="https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/">https://renews.biz/59138/ireland-shares-1m-for-geothermal-research/</a>	2020	2020	0.6/ 0.5	R&I 5	Data will be made available at different stages
<b>Dig</b>	<a href="https://www.seai.ie/data-and-insights/seai-research/research-projects/details/dig:-derisking-irelands-geothermal-energy-potential">https://www.seai.ie/data-and-insights/seai-research/research-projects/details/dig:-derisking-irelands-geothermal-energy-potential</a>	2020	2023	0.78	R&I 5	Data will be made available at different stages
<b>Demonstration of test holes for development of Engineered Geothermal Systems</b>		2020	2021	5,1/ 1,2	R&I 1,2,4,5,6,7,8,9	Y



## Monitoring of RD&I activities from geothermal industry in 2020

### RUGGERO BERTANI - EUROPEAN GEOTHERMAL INNOVATION AWARD - 2020 EDITION:

- **Bakker Oilfield Supply:** Their endorsed project is “Degasser 2.0 rental”. This rental product is designed for geothermal projects with temperatures up to 150°C. It is used in almost every Geothermal Project in the Netherlands for separation of fluids like water, gas and oils from each other. With this product, developers are able to separate harmful gases and oils from water and steam. After separation they can safely release steam and water to turbines and/or open air. This type of equipment is not available in the rental market for this range of temperature. The product has been used in a few projects already and has proven its reliability.
- **CarbFix:** The EU-funded CarbFix project has been selected as one of the five outstanding finalists of the Ruggero Bertani European Geothermal Innovation Awards 2020. The CarbFix process captures CO<sub>2</sub> and other sour gases from emission sources. In less than two years, 95% of these gases are transformed into rocks underground. The process was designed to help nature rebalance the carbon cycle by mimicking natural mineralisation of CO<sub>2</sub> in favorable rock formations.  
A devoted research and innovation team transformed CarbFix from an idea on paper to a proven, reliable process on an industrial scale in less than eight years; an effort led by scientists at the University of Iceland, Columbia University, CNRS and Reykjavik Energy.  
CarbFix has large global scaling potential in and beyond the geothermal industry. The plans to apply this technology to sites in Italy, Turkey and Germany are well underway. The ambition is to become a key instrument in tackling the climate crisis and slashing global CO<sub>2</sub> emissions.
- **EAVOR-Loop:** Up to now deep geothermal closed systems only produced a small amount of energy from mostly vertical single deep wells. The Eavor Loop project overcomes this disadvantage with a concept of vertical wells being connected by several horizontal wells.  
The systems are designed for 40 MW and above, thus converting individual geothermal projects into industrial projects. New technologies are combined and optimised for geothermal energy exploitation in areas and rocks where it has not been possible before.

- **Vulcan Energie Ressource:** Lithium is currently produced in open pit and underground mines or from salt flats in South America. The environmental impact is huge in terms of carbon footprint, land use and water consumption. Vulcan's concept is different, as the environmental impact should be minimal. Deep geothermal reservoirs are widespread in the Upper Rhine Graben area. The geothermal brines in these reservoirs contain a large amount of lithium. Vulcan's idea is to extract the lithium from the brine using direct lithium extraction. The lithium will be extracted after the energy of the brine has been used for power and heating production. The energy needed for the extraction is generated directly in the geothermal plant. So the lithium can be produced with zero carbon emissions.  
The Direct Lithium Extraction will be implemented in the pilot project based on the requirements of the geothermal brine and to avoid environmental hazards and damages to the brine cycle by scaling or corrosion. But further research must be done to understand the mechanisms in the geothermal reservoirs when the lithium is extracted.
- **ZAE Bayern:** In shallow geothermal systems, the thermal response test is the procedure commonly used to measure thermal underground properties. The research project "QEWS II" developed and tested a test rig to ensure the quality of thermal response test devices.  
The test rig emulates the thermal behavior of a real borehole heat exchanger of different lengths and underground properties.  
The thermal response test unit is connected to the emulated borehole in the same way as it would be to the real borehole. This way, it reproduces the emulated underground properties with accuracy and can determine whether the unit works correctly.  
This project is one of a kind. There is not such a test rig available on the market today. Before this device was developed, the only way to compare different thermal response test units was to test them at the same real borehole where the boundary conditions vary, and the underground properties are not perfectly known.

## EGEC MARKET REPORT 2020

EGEC started the process of data collection to prepare and release its 2020 Market Report. While the process is currently ongoing, EGEC can already highlight the most relevant developments within the geothermal industry in 2020:

- **Further exploration of lithium extraction from geothermal brines:** The demand for lithium is increasing worldwide. Lithium is essential for upscaling the e-mobility industry. To be able to meet the increasing demand, the production of lithium from deep geothermal systems has been discussed for several years, and individual pilot projects are already being implemented – including in the Upper Rhine Rift. The German Federal Ministry for Economic Affairs and Energy is now funding the joint project **UnLimited**, in which EnBW Energie Baden-Württemberg AG, as cooperation leader, will set up a pilot system in the geothermal power plant in Bruchsal together with the Karlsruhe Institute of Technology (KIT) and the partners BESTEC, HYDROSION and the University of Göttingen. In the Bruchsal geothermal plant, which EnBW has been operating together with the Bruchsal municipal utilities since 2010, deep water for heat and electricity is pumped and returned to the reservoir after thermal use. With the water throughput, roughly 800 tonnes of lithium chloride are extracted and returned unused per year of operation. As part of a project, EnBW and KIT developed a process with which the lithium dissolved in deep water can be sustainably extracted on a laboratory scale.<sup>1</sup>
- Greek PPC Renewables has elected ELECTOR as a strategic partner for the exploitation of **4 geothermal fields on Lesbos, Milos-Kimolos-Polyaigos, Nisyros and Methana in Greece: PPC Renewables, the renewable energy focused subsidiary of state energy company PPC**, is now entering the decisive stage for the utilization of the geothermal potential that has been granted to it by the Greek state. According to energypress, the company decided to officially complete the international tender for the selection of a strategic partner for the energy utilization of the four geothermal fields of high enthalpy, a competition that took place but was “frozen” two years ago. The completion was made by awarding the “highest bidder”, the company ELECTOR of the ELLAKTOR group, the position of strategic partner. The second consortium that had submitted a binding tender to the tender, TERNA Energy, had been declared an “alternative bidder”. The object of the cooperation is the energy utilization of the well-known four geothermal fields (Lesbos, Milos-

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<sup>1</sup> Lithium for batteries from the Upper Rhine Graben’s geothermal resources, <https://www.thinkgeoenergy.com/lithium-for-batteries-from-the-upper-rhine-grabens-geothermal-resources/>

Kimolos-Polyaigos, Nisyros and Methana) for which PPC is licensed (the lease period was recently extended by the leases exclusively for the Greek state management in specific areas).<sup>2</sup>

- **UK's first district heating scheme using mine water energy now in development:** Construction of a district heating scheme utilising mine water energy is set to begin in spring at development in County Durham. The scheme is close to existing commercial buildings, a supermarket and the coastal village of Seaham, with a population of around 21,000. The new development will be supplied with geothermal heat from the Coal Authority's nearby Dawdon mine water treatment scheme, which treats water abstracted from an extensive network of flooded abandoned coal mines in the area.<sup>3</sup>
- **Applying the expertise of the oil and gas industry for geothermal exploration.** The most recent example is The Rijswijk Center for Sustainable Geo-energy in the Netherlands. It builds upon a former drilling laboratory of Shell that now explores technologies that could help propel the oil and gas technology for geothermal development projects, under the leadership of TNO. Shell has conducted years of research into both the drilling and completion of wells at this research base in the Netherlands. This knowledge is indispensable for oil and gas extraction, but also for geothermal energy: there must be one well in the ground from which to extract hot water and a second well to inject hot water. There is a way to properly optimise the technologies that have been developed for oil and gas for geothermal drilling.<sup>4</sup>

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<sup>2</sup> PPC Renewables to partner with ELECTOR on up to four geothermal projects in Greece, <https://www.thinkgeoenergy.com/ppc-renewables-to-partner-with-elector-on-up-to-four-geothermal-projects-in-greece/>

<sup>3</sup> UK's first district heating scheme using mine water energy now in development, <https://www.gov.uk/government/news/uks-first-district-heating-scheme-using-mine-water-energy-now-in-development>

<sup>4</sup> Working on drilling technology for geothermal in Rijswijk, Netherlands, <https://www.thinkgeoenergy.com/working-on-drilling-technology-for-geothermal-in-rijswijk-netherlands/>

## NEW R&I PUBLIC FUNDING INSTRUMENTS FOR INDUSTRY

To facilitate the access of geothermal industry to EU public funding opportunities, the Support Unit prepared and published a series of [factsheets](#) on EU funding instruments. These factsheets are accessible on the DG-IWG website.

Over 2020, the EU policy makers have been preparing the legislation for a series of new funding instruments for R&I and upscale of new technologies within the renewable energy industry.

The largest EU programme that focuses specifically and primarily on Research and Innovation is the [Horizon Europe programme](#). The new Horizon Europe framework has been agreed in December 2020, when a political agreement between the European Parliament and the Council has been reached. The new EU research and innovation programme will have a budget of **around €95.5 billion for 2021-2027 (current prices)**. This includes €5.4 billion (current prices) from NextGenerationEU to boost EU recovery and make the EU more resilient for the future, as well as an additional reinforcement of €4.5 billion (current prices).

The most important feature of the Horizon Europe programme is the establishment of partnerships that will also provide a framework and calls for funding for innovative clean energy projects. [European Partnership for Clean Energy Transition](#) is one of the key opportunities for geothermal industry. This is a transformative research and innovation programme across Europe, that will boost and accelerate energy transition in all its dimensions. It will enable joint research and innovation programmes from regional to national and global level, co-supported by industry, public organisations, research and citizens' organisations to make Europe a frontrunner in energy innovation and eventually the first climate-neutral continent.

One of the most important funding instruments for innovative geothermal technology projects is the [Innovation Fund](#) - the world's largest funding programmes for demonstration of innovative low-carbon technologies. It focuses on highly innovative technologies and big flagship projects with European value added that can bring on significant emission reductions.

A briefing session on the Innovation Fund was already organised and conducted in September 2019, as well as highlighting this instrument during online events and meetings over 2020.

**The first call for large-scale project proposals closed on 29 October 2020.** The next step in the first call is the admissibility and eligibility checks of all submissions. Applicants will be informed about the results of the evaluation in the first quarter of 2021. The best

ranked 70 projects will be invited to submit a full application for the second stage by 23 June 2021. Rejected proposals that have the potential to improve their maturity may be invited for the project development assistance provided by the EIB. The information on the evaluation results from the second stage will be provided in the fourth quarter of 2021. Grants will be awarded at the end of 2021.

**Currently, the European Commission opened a second call of the Innovation Fund that focuses on small-scale projects.** This one will be open until 10 March 2021 for applications. More details [here](#)

**LIFE Programme** focuses on environmental and climate objectives. It supports rather smallscale projects that aims to share best practices, test small-scale technologies, and speed up the implementation of relevant EU legislation and policy. The programme has a total of €5.45 billion budget to finance the two main portfolios and its **sub-programmes: Environment and Climate Action**. The new version of LIFE Programme encourages investment and activities focusing in particular on energy efficiency and smallscale renewables, which can be beneficial to geothermal heating and cooling market uptake projects.

By the end of 2020, another important milestone in terms of financing R&I has been the adoption of the EU's next long-term budget 2021-2027, along with **NextGenerationEU** instrument. This is a temporary financing instrument designed to boost the EU recovery after COVID 19 crisis. It is the largest stimulus package ever financed through the EU budget where more than 50% of the amount will support modernisation, including through research and innovation.

Finally, the **Recovery and Resilience Facility** will make €672.5 billion in loans and grants available to support reforms and investments undertaken by Member States. The aim is to mitigate the economic and social impact of the coronavirus pandemic and make European economies and societies more sustainable, resilient and better prepared for the challenges and opportunities of the green and digital transitions. R&I investments are not the primary focus of this instrument, but Member States can highlight in their proposals R&I projects that have been impacted by the COVID crisis or the ones that can directly benefit their economy in the process of recovery. More details [here](#)

## Assessment of private sector investment in R&I (2020)

As highlighted in D4.2, **private financing is leading the investments race in R&I on the European level**. According to the European Commission's *Report on the progress of clean energy competitiveness*, the EU has invested in recent years an average of **nearly EUR 20 billion a year on clean energy R&I** prioritised by the Energy Union<sup>5</sup>:

- EU funds contribution - 6%
- Public funding from national governments accounts - 17%
- **business contribution estimated - 77%**

To support the statement above, the case studies below provide a few examples of successful private sector investment in R&I within geothermal energy industry.

### Case studies

**BrainHeart** is a group of both business and non-profit organizations with BrainHeart Capital AB as the main owner, focusing on technology, energy and education. In 2007 BrainHeart started looking into the opportunities of technologies bringing sustainability and environmentally friendly solutions to our society. From 2011 BrainHeart started to look for more mature companies and established renewable technologies. Their investment portfolio includes geothermal for renewable heating and cooling. Within this area, BrainHeart is interested in both service and product companies. After detailed studies and analyze, **BrainHeart Energy** was set up in 2013 in Sweden.

**BrainHeart Energy** is a group of companies that was formed in 2015, as an industry group within CO2-free energy solutions and has since worked with the mission to make renewable energy cost efficient to implement. Vattenfall has acquired 35% ownership. Its main focus is to facilitate the transfer over to alternative renewable energy sources by providing simple to install, efficient and economically feasible solutions. The base research is done in the premises of the main company BrainHeart Energy. However, as soon as a solution is ready to go to market it moves into a separate legal entity. This allows the company to keep doing the base research at the same time as it can run the business in an efficient and clean way.

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<sup>5</sup> Report from the Commission to the European Parliament and the Council on progress of clean energy competitiveness,  
[https://ec.europa.eu/energy/sites/ener/files/report\\_on\\_clean\\_energy\\_competitiveness\\_com\\_2020\\_953.pdf](https://ec.europa.eu/energy/sites/ener/files/report_on_clean_energy_competitiveness_com_2020_953.pdf)



The company group BrainHeart Energy is today one of Sweden's leading companies with a focus on sustainable energy solutions with considerable resources being allocated to research and development of innovative new solutions.<sup>6</sup>

**MegaWatt Solutions Nordic AB** is a Swedish renewable energy solution company that was founded in 2016. The company is a wholly owned **subsidiary of BrainHeart Energy Group**. MegaWatt Solutions seeks to disrupt the traditional energy market and provide a secure, efficient and inexpensive supply of renewable energy, while also helping society to massively reduce its reliance on fossil fuels and support national and global climate targets. It provides large, industrialized technology, by harvesting the sun's energy and using bedrock as a heat reservoir that is accessed via drilled boreholes. It uses traditional ground source/geothermal heat pumps (GSHP), if needed, combine with photovoltaic thermal (PVT) system to provide industrial sized energy solution. Its system is completely decentralized, modular, highly efficient and stand-alone. It is called the "EBox" (*Energy in a box*) – a pre-manufactured, a "plug and play" megawatt-level renewable energy solution with high performance and long life span. The EBox connects to boreholes, delivers heating and hot water to large real estate properties. It is equipped with numerous control features that monitor the energy performance of entire system. The control system in the EBox is connected with MegaWatt cloud SCADA system. The key feature of their technology is the fact that it decentralises traditional heating grids and provide stand-alone energy centres that are all securely connected to the internet.<sup>7</sup>

Switzerland-based **Geo-Energie Suisse (GES)** announced having succeeded in obtaining technical proof of the **multi-stage stimulation concept patented by the company**. The successful demonstration took place in the Bedretto Underground laboratory for Geosciences and Geoenergy of the ETH Zurich in the Canton Ticino in late 2020. Geo-Energie Suisse hopes that the achievement in the Gotthard massif will give new impetus to the pilot project in Haute-Sorne (JU) and to the production of electricity and heat from geothermal energy throughout Switzerland. With the support of the Werner Siemens Foundation, ETH Zurich has established a new research infrastructure to investigate such questions. In the «Bedretto Underground Laboratory for Geoenergies», ETH Zurich studies in close collaboration with national and international partners, techniques and procedures for a safe, efficient, and sustainable use of geothermal heat. GES demonstrated as an external partner in the Bedretto Laboratory within the framework of the DESTRESS, ZoDrEx and IASS projects how a heat exchanger can be carefully created in the underground.

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<sup>6</sup> BrainHeart Energy, <https://brainheart.energy/about/>

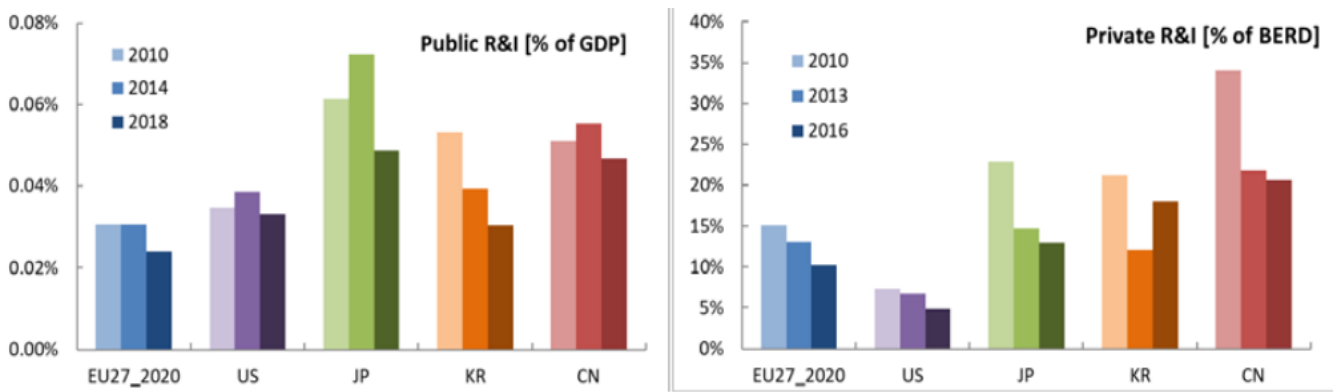
<sup>7</sup> New Member - MegaWatt Solutions Nordic AB, <https://nordicshc.org/our-news-kategori/341-new-member-megawatt-solutions-nordic-ab.html>



At the same time, despite the fact that private financing is leading the investments race in R&I on the European level, according to the 2020 report on the State of the Energy Union, **the estimated private investment in Energy Union R&I priorities has been decreasing in recent years.**

**R&I investment in the activities set out in the European Strategic Energy Technology Plan**, agreed between Member States, industry, the research community and the Commission, **represents only 15% of the estimated needs up to 2030.**

(Figure 1: Estimated public and private R&I financing in the Energy Union priorities)



(source: 2020 report on the State of the Energy Union pursuant to Regulation (EU) 2018/1999 on Governance of the Energy Union and Climate Action, pag. 13)

In comparison with the global outlook, [the Report on Global Trends in Renewable Energy Investment 2020](#) (elaborated by UNEP’s Economy Division in cooperation with Frankfurt School-UNEP Collaborating Centre for Climate & Sustainable Energy Finance and BloombergNEF), shows a time series and average growth rates over the period of **2004-2019** (Figure 2). The lower half of the table shows total renewable energy investment broken down, first by sector and second by country group.

The trends on the global overall corporate R&I scale is rather encouraging, as it shows a constant growth in R&I investments in renewables. Corporate R&I has also overtaken government spending in the last three years, again in contrast to the general picture in the previous decade. **In terms of investments in geothermal energy however, we notice from the figures below a rather decreasing trend in the latest years.**

(Figure 2: Global trends in renewable energy investment 2020 data table, \$BN, pag. 62)

Category	Year Unit	2004 \$bn	2005 \$bn	2006 \$bn	2007 \$bn	2008 \$bn	2009 \$bn	2010 \$bn	2011 \$bn	2012 \$bn	2013 \$bn	2014 \$bn	2015 \$bn	2016 \$bn	2017 \$bn	2018 \$bn	2019 \$bn	2018-19 Growth %	2004-19 CAGR %
<b>1 Total Investment</b>																			
1.1 New investment		36.8	69.0	103.4	147.4	177.9	167.8	238.5	286.6	253.7	231.7	288.1	317.3	293.9	331.4	296.0	301.7	2%	15%
1.2 Total transactions		45.2	95.2	136.9	204.3	236.2	229.3	295.8	361.6	319.3	298.7	376.9	425.4	427.8	477.7	437.4	402.4	-8%	16%
<b>2 New Investment by Value Chain</b>																			
<b>2.1 Technology development</b>																			
2.1.1 Venture capital		0.4	0.6	1.2	2.1	3.3	1.6	2.6	2.6	2.4	0.8	1.0	1.4	0.8	0.8	0.2	1.2	508%	9%
2.1.2 Government R&D		1.9	2.0	2.2	2.7	2.8	5.4	4.9	4.8	4.7	5.2	4.5	4.4	5.1	5.1	5.5	5.7	4%	8%
2.1.3 Corporate R&D		1.9	1.9	2.2	2.3	3.3	3.3	3.8	4.3	4.1	4.0	4.3	4.1	4.3	6.9	7.8	7.7	-1%	10%
<b>2.2 Scale-up</b>																			
2.2.1 Private equity expansion capital		0.3	1.0	2.9	3.5	6.7	3.0	5.3	2.4	1.6	1.3	1.7	1.8	1.7	0.7	2.2	1.8	-22%	12%
2.2.2 Public markets		0.3	3.6	8.9	19.7	10.5	11.7	10.6	9.9	3.8	9.8	14.9	12.0	6.2	5.6	6.0	6.6	11%	24%
<b>2.3 Projects</b>																			
2.3.1 Asset finance		32.1	50.0	79.2	106.3	133.5	111.8	152.2	189.6	170.1	171.5	228.4	267.7	247.5	272.6	242.0	230.1	-5%	14%
Of which re-invested equity		-0.1	-0.2	-2.2	-3.1	-4.4	-3.7	-1.8	-2.1	-2.9	-1.2	-3.5	-6.7	-4.1	-2.9	-5.8	-3.4	-41%	26%
2.3.3 Small distributed capacity		8.0	10.1	9.0	13.9	22.2	34.7	60.9	75.1	69.9	40.2	36.7	32.6	32.5	42.5	38.2	52.1	37%	13%
<b>Total Financial Investment</b>		<b>32.9</b>	<b>55.0</b>	<b>90.0</b>	<b>128.5</b>	<b>149.6</b>	<b>124.4</b>	<b>169.0</b>	<b>202.4</b>	<b>174.9</b>	<b>182.2</b>	<b>242.6</b>	<b>276.1</b>	<b>252.1</b>	<b>276.9</b>	<b>244.6</b>	<b>236.3</b>	<b>-3%</b>	<b>14%</b>
Gov't R&D, corporate RD&D, small projects		11.9	14.0	13.4	18.9	28.4	43.4	69.5	84.1	78.8	49.4	45.5	41.1	41.8	54.5	51.4	65.5	27%	12%
<b>Total New Investment</b>		<b>44.8</b>	<b>69.0</b>	<b>103.4</b>	<b>147.4</b>	<b>177.9</b>	<b>167.8</b>	<b>238.5</b>	<b>286.6</b>	<b>253.7</b>	<b>231.7</b>	<b>288.1</b>	<b>317.3</b>	<b>293.9</b>	<b>331.4</b>	<b>296.0</b>	<b>301.7</b>	<b>2%</b>	<b>14%</b>
<b>3 M&amp;A Transactions</b>																			
3.1 Private equity buy-outs		0.8	3.7	1.8	3.3	5.1	1.9	1.9	2.9	3.0	0.5	4.1	3.6	3.2	10.6	13.0	3.2	-76%	10%
3.2 Public markets investor exits		0.4	2.3	2.6	3.9	0.9	2.4	4.8	0.2	0.4	1.7	1.6	1.5	6.4	2.8	0.1		-100%	-100%
3.3 Corporate M&A		2.2	7.6	10.3	19.8	16.5	22.4	18.7	29.6	9.3	16.2	11.2	18.4	29.5	13.3	14.6	13.7	-6%	13%
3.4 Project acquisition & refinancing		5.1	12.5	18.7	29.9	35.8	34.9	32.0	42.3	53.0	48.7	71.9	84.6	94.8	119.6	123.8	83.8	-32%	21%
<b>4 New investment by Sector</b>																			
4.1 Wind		18.4	26.3	35.4	58.8	73.9	72.5	97.8	83.3	78.3	83.3	111.1	119.7	123.5	133.4	132.7	142.7	8%	15%
4.2 Solar		10.7	15.3	21.6	37.5	60.5	63.6	102.0	160.1	144.0	120.4	147.8	176.6	145.9	180.8	143.5	141.0	-2%	19%
4.3 Biofuels		3.9	9.8	26.3	26.4	17.6	9.4	10.1	10.5	7.7	5.1	5.5	3.6	2.1	3.3	3.3	3.0	-10%	-2%
4.4 Biomass & w-t-e		7.9	9.3	12.0	15.9	16.4	13.4	17.3	20.9	15.4	14.6	13.1	10.4	15.2	7.4	11.5	11.2	-2%	2%
4.5 Small hydro		2.8	2.5	6.8	6.5	7.6	6.0	8.2	7.7	6.3	5.7	7.4	4.2	4.3	4.0	2.3	2.5	6%	1%
4.6 Geothermal		1.1	0.8	1.3	1.7	1.7	2.5	2.8	3.8	1.7	2.4	2.9	2.5	2.7	2.4	2.5	1.2	-50%	1%
4.7 Marine		0.0	0.1	0.1	0.7	0.2	0.3	0.3	0.3	0.3	0.2	0.4	0.2	0.2	0.2	0.2	0.2	-8%	12%
<b>Total</b>		<b>44.8</b>	<b>69.0</b>	<b>103.4</b>	<b>147.4</b>	<b>177.9</b>	<b>167.8</b>	<b>238.5</b>	<b>286.6</b>	<b>253.7</b>	<b>231.7</b>	<b>288.1</b>	<b>317.3</b>	<b>293.9</b>	<b>331.4</b>	<b>296.0</b>	<b>301.7</b>	<b>2%</b>	<b>14%</b>
<b>5 New Investment by Geography</b>																			
5.1 United States		6.0	11.3	28.5	30.5	34.7	23.0	34.6	50.3	40.7	36.1	38.4	46.9	44.4	48.6	47.1	59.0	25%	16%
5.2 Brazil		0.7	2.4	4.1	9.9	11.1	6.9	7.2	10.2	7.8	3.9	7.7	6.4	5.7	6.2	3.8	6.8	78%	16%
5.3 AMER (excl. US & Brazil)		1.7	3.7	3.5	4.8	5.6	5.0	12.0	9.8	10.4	12.5	15.2	11.5	6.5	13.2	10.7	12.8	20%	14%
5.4 Europe		23.3	31.6	40.7	64.5	79.1	76.5	112.2	131.7	91.1	57.7	68.7	61.1	71.5	49.1	60.8	58.4	-4%	6%
5.5 Middle East & Africa		0.6	0.8	1.2	1.8	2.2	1.5	4.0	3.1	9.9	7.2	8.4	11.6	7.1	10.7	16.5	15.4	-7%	24%
5.6 China		3.0	8.5	10.5	17.2	25.8	36.7	42.4	45.7	56.6	63.4	88.7	121.1	105.6	148.4	95.9	90.1	-6%	25%
5.7 India		2.7	3.0	4.8	6.1	5.3	4.3	7.7	12.4	6.7	5.0	7.4	8.0	12.5	13.7	11.6	11.2	-4%	10%
5.8 ASOC (excl. China & India)		6.7	7.6	10.0	12.6	14.1	13.9	18.5	23.5	30.4	45.8	53.7	50.6	40.7	41.6	49.6	48.2	-3%	14%
<b>Total</b>		<b>44.8</b>	<b>69.0</b>	<b>103.4</b>	<b>147.4</b>	<b>177.9</b>	<b>167.8</b>	<b>238.5</b>	<b>286.6</b>	<b>253.7</b>	<b>231.7</b>	<b>288.1</b>	<b>317.3</b>	<b>293.9</b>	<b>331.4</b>	<b>296.0</b>	<b>301.7</b>	<b>2%</b>	<b>14%</b>

## ESTIMATION – YEAR 2020

From the figures outlined above, and despite some great R&I breakthroughs performed by the geothermal industry, such as the exploration of geothermal lithium or the patented multi-stage stimulation concept, it is clear that the private contribution in Energy Union R&I priorities has been decreasing last year. In particular, in 2020 a big part of reasoning for this trend was also the economic aftermath of the COVID crisis.

Nevertheless, in order to better understand the private R&I investment trends within the geothermal industry, the SU DG IWG drafted a questionnaire that aims to collect data on R&I investments within the geothermal private sector.

The Questionnaire is available at the end of this report, in *Annex 1*.

It started to be disseminated at the end of 2020. However, due to the lack of active engagement of private stakeholders in data collection process, the Secretariat will need to extend the deadline and treatment of data **in the final report**.

This data collection process will allow the SU DG IWG to explore the granularity of the private sector investments and analyse the main trends especially within the context of economic recovery. It will also provide the opportunity to evaluate better the R&I spending of private actors and complete this data gap that currently exists within the R&I geothermal landscape.

The final data and main trends/results will be outlined in the annual reporting in **year 3 (2022)**.

## Conclusion

The report concludes that the global and European landscape of private investments in geothermal and other renewables is showing a rather decreasing trend. The COVID crisis has also an impact on the overall investment rate in geothermal energy and had also affected the R&I aspects of technology development.

Despite this trend, the IEA has rightly highlighted that **the EU should act to avoid the scaling back of private investment in the clean energy industry**. It needs to better evaluate the impact of EU energy R&I funding, notably in the context of the EU economic recovery, ensure the alignment of EU and national priorities (under the Strategic Energy Technology Plan) in the NECPs, and boost private capital and innovation.<sup>8</sup>

An effort to reverse this trend will have to be made by both: public and private sectors. This report also includes an overview of EU funding instruments that are available across the entire innovation value chain, with programmes for energy research, development and innovation (RD&I). This information is crucial for private actors that want to co-finance European or national R&I projects.

To sum up, aligning the SET Plan priorities with the economic recovery and involving private companies in delivering new geothermal technologies is key.

That is why the Secretariat will continue its work on data collection and will report the private companies' spending for geothermal R&I in Europe in the **final annual report (year 3)**. This will provide a more detailed analysis of prioritisation of R&I operations/projects by the private sector.

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<sup>8</sup> IEA, European Union Report 2020, <https://www.iea.org/reports/european-union-2020>

## Annex 1: Questionnaire 2020 on 2019 activities

### Questionnaire

#### OBJECTIVE

This questionnaire is addressed to private companies that are working in geothermal Research & Innovation (R&I). The goal is to collect data on the annual expenditure of geothermal private actors on R&I activities and projects. This information is crucial for understanding the funding needs of the European geothermal industry and its contributions to the 10 RD&I actions set by the revised SET-Plan - Deep Geothermal Implementation Working Group's [Implementation Plan](#).

#### Company's background

1. Total number of employees in your (geothermal) research department in 2019?
2. On how many R&I projects are you currently working on? How many of them are focused on geothermal?
3. What is the geographical coverage of these research activities: only in your country, in several countries in Europe, globally?

#### R&I investment level

1. What triggers innovation projects in your company today? (possibly of multiple choices)
  - Emergence of new technologies
  - Emergence of new business models
  - Market changes (e.g. demographics, macroeconomics)
  - Need to expand to new markets
  - Need to improve cost efficiency
  - Change in regulations
  - Government incentives
  - Other (please specify)
2. What was your R&I investment in the year 2019? (if available, also for previous years)
  - Amount in €
  - % of the turnover



3. How much of this R&I investment would fall into the following categories?  
Basic research (including exploratory activities) \_\_\_\_\_ %  
Applied research/technology development \_\_\_\_\_ %  
Development for market launch/uptake \_\_\_\_\_ %  
other (please specify): \_\_\_\_\_ %  
Total %
  
4. At what average rate do you expect the company to change (increase or decrease) its overall R&I investment over the next 5 years (2020-2025) (if relevant)?  
About \_\_\_\_\_ % per year
  
5. At which technology readiness level (TRL) level do you focus?
  
6. What is for your company the most important element when designing new technologies?
  
7. Did your company already co-financed any national or European geothermal R&I project?  
- Yes  
- No  
  
If yes, what was the share of your contribution (in EUR or %) for such projects? Can you provide any examples?
  
8. Did you apply for any national private financing schemes/funds to support your geothermal R&I projects?  
- Yes  
- No  
  
If yes, can you provide information on the share (in EUR or %) of these national private financing schemes/funds for your geothermal R&I projects

## Market uptake

1. Did you already commercialise some of your innovation project results/technologies?
2. If yes: on which markets did you commercialise these?

## Barriers

1. What are the main obstacles to foster innovation within your company today?
2. Have your R&I projects been impacted by the COVID-19 lockdown in your country?

## Your contribution to the 10 RD&I actions as set by the revised Implementation Plan of the SET Plan IWG on deep geothermal<sup>9</sup>

Please indicate below (in % or in € million) to which extent your R&I activities and projects are contributing to the 10 RD&I actions of the revised Implementation Plan of the Deep Geothermal IWG:

- Geothermal heat in urban areas
- Integration of geothermal heat and power in the energy system and grid flexibility
- Improvement of overall geothermal energy conversion performance for electricity, heating and cooling generation
- Closed loop electric, heating and cooling plants integrated in the circular economy
- Methods, processes, equipment, and materials to ensure the steady availability of the geothermal resources and improve the performance of the operating facilities
- Development and exploitation of geothermal resources in a wider range of geological settings
- Advanced drilling/well completion techniques
- Innovative exploration techniques for resource assessment and drilling target definition
- Increasing awareness of local communities and involvement of stakeholders in sustainable geothermal solutions
- Risk mitigation (financial/project)

➤ Other comments/input

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<sup>9</sup> In the SET plan, Europe has set its renewable energy ambitions, including for geothermal. A specific geothermal Implementation plan has been released and is now executed. In order to reach the goals of placing Europe at the forefront of the low carbon energy scene, an [Implementation Working Group \(IWG\)](#) is created to move forward the [Deep Geothermal Implementation Plan \(DG-IP\)](#), currently revised and under consultation.