2019

EGEC GEOTHERMAL MARKET REPORT

Key Findings

Nineth Edition
June 2020

2019
EGEC GEOTHERMAL MARKET REPORT
Key Findings

Nineth Edition
June 2020

ACKNOWLEDGEMENTS

EGEC wishes to sincerely thank all those who submitted data and contributed to the collection of information (in alphabetical order):

Olof Anderson (Lund University); Teppo Arola (Geological Survey of Finland); Fausto Batini (Magma Energy, Rete Geotermica); Carlos Alberto Bicudo da Ponte (SOGEO); Christian Boissavy (GEODEEP); Dario Bonciani (CosVIG); Cannur Bozkurt (Armoni); David Charlet (IDEA, Belgium), Petr Dědeček (Institute of Geophysics of the ASCR); André Deinhardt (Bundersverband Geothermie); Gregor Dilger (Bundesverband Geothermie); Ivan Djokic (GECO-inženjering); Robert Gavriliuc (Romanian Geoexchange Society); Gregor Goetzl (Geological Survey of Austria); Margarita de Gregorio (APPA, GEOPLAT); Rüdiger Grimm (Geoernergie Konzept); Oto Halas (Slovgeotherm); Lars Henrik Nielsen (Geological Survey of Denmark and Greenland, GEUS); Jolanda Kaufhold (Bundersverband Geothermie); Beata Kepinska (Polish Academy of Science); Attila Kujbus (GEOEX); Ben Laenen (VITO); Andrej Lapanje (Geological Survey of Slovenia); Katharina Link (Geothermie Schweiz); Dimitrios Mendrinos (CRES), Sara Montomoli (Enel Green Power), Ric Pasquali (Geoserv Solutions), Sibela Oudech (GECO-inženjering); Paloma Perez (APPA, GEOPLAT); Armand Pomard (AFPG); Sanja Popovska-Vasilevska (Macedonian Geothermal Association); Joachim Poppei (Geothermie Schweiz); Dušan Rajver (Geological Survey of Slovenia); Frank Schoof (Platform Geothermie); Burkhard Sanner; Davide Serra (Enel Green Power); Loredana Torsello (CosVIG); Martin van der Hout (DAGO); Thomas Vangkilde-Pedersen (Geological Survey of Denmark and Greenland, GEUS), Dio Verbiest (DAGO); Sanja Živković (Energetski institut Hrvoje Požar).

The sole responsibility for the content of this document, however, lies with the authors.

EDITORS

Thomas Garabetian (EGEC); Philippe Dumas (EGEC); Consuelo Serrano (EGEC); Valeria Mazzagatti (EGEC); Sanjeev Kumar (EGEC); Reghina Dimitrisina (EGEC); Julie Ruaud (EGEC); Courtney Truong (EGEC).

DESIGN

Consuelo Serrano (EGEC); Valeria Mazzagatti (EGEC).

COPYRIGHTS

Photo: Courtesy of Turboden S.p.A.

EDITORIAL

In these turbulent times, I hope you and your family are safe and well. The COVID19 epidemic has halted the global economy, with repercussions on the European geothermal industry.

As usual during the oil price crises since the seventies, many ask how much it will influence the geothermal market development. This time, the oil price crash has been far, fast and unprecedented. Indeed, the drop in oil prices could help geothermal and thereby support the transition in the oil sector. A first consequence should be the cut of drilling cost for geothermal wells, although drilling contracts are not as flexible as one would expect. The oil price crash will significantly reduce the cost of oil field services, which could in turn benefit the geothermal market.

This is a short-term thinking, but what happens in the long term?

Until 2008, it was rather clear that the drilling price for geothermal was linked to the oil price, as depicted by the drilling index. But now, with many more drilling rigs available, the drilling price is less linked to oil prices.

The issue is then to know if oil market actors will invest in geothermal in the long-term although geothermal is not exactly like oil. Not only temperature, wells depth and wells diameter are different, but also the size of the current market and the Return on Investment is different. For sure, these new actors will further help the geothermal sector to grow with an exponential rate.

Geothermal energy is certainly a sustainable alternative to fossil energy capable of generating wealth for both the users and the operator in the long run.

Where are we today? The market report shows the geothermal sector is developing, but not as quickly as expected some years ago. Indeed, the EGEC Market Report launched in 2011 was envisaging a period of accelerated geothermal

MIKLOS ANTICS, EGEC President

market development until 2020. Now it seems more that the geothermal decade is 2020-2030.

Meanwhile, the geothermal heat pump sector displays continuous growth, with about 2 million units installed, achieved by continued interest in established markets and new fast-growing ones.However, as shallow geothermal systems potential is immense, the installed capacity in GWth should increase more rapidly in the next years.

The pace of geothermal district heating and heat uses in industry, agriculture and other sectors is concentrated to a limited number of countries in Europe. There are already around 30 countries that have operating systems. Finland is developing a project which should be commissioned in 2020, while Sweden is looking at deep geothermal as well. A large European drilling campaign should aim at identifying more resources.

Market and regulatory framework conditions are another crucial factor holding up geothermal energy deployment. The adoption in 2018 of the EU Climate and Energy Package for 2030 should play a key role in paving the way to accelerated geothermal development in the next ten years

by setting overarching objectives on the role of renewables and, by introducing a greater focus on mainstreaming renewables in heating and cooling.

In some markets (Italy, Turkey and France), the geothermal power sector is confronted to uncertainty for short term developments, as a result of upcoming changes in the incentive schemes that threaten the viability of future investments. The utilisation of geothermal electricity is however expanding across Europe. After having seen the first power plants in Hungary in 2017, and in 2018 in Croatia; the newcomers in 2020 should be Belgium and United Kingdom. Greece should be the next one as new exploration programmes have been launched recently.

A new opportunity appears in 2019 with the lithium extraction from geothermal brine. It offers an additional revenue, but also attract new actors to support the development of geothermal.

Market players will have now to embrace these opportunities to see further geothermal market development in Europe. The latest EGEC market report will update you on these developments.

I wish you a nice reading of this 2019 edition.

Miklos ANTICS (GPC IP),
EGEC President

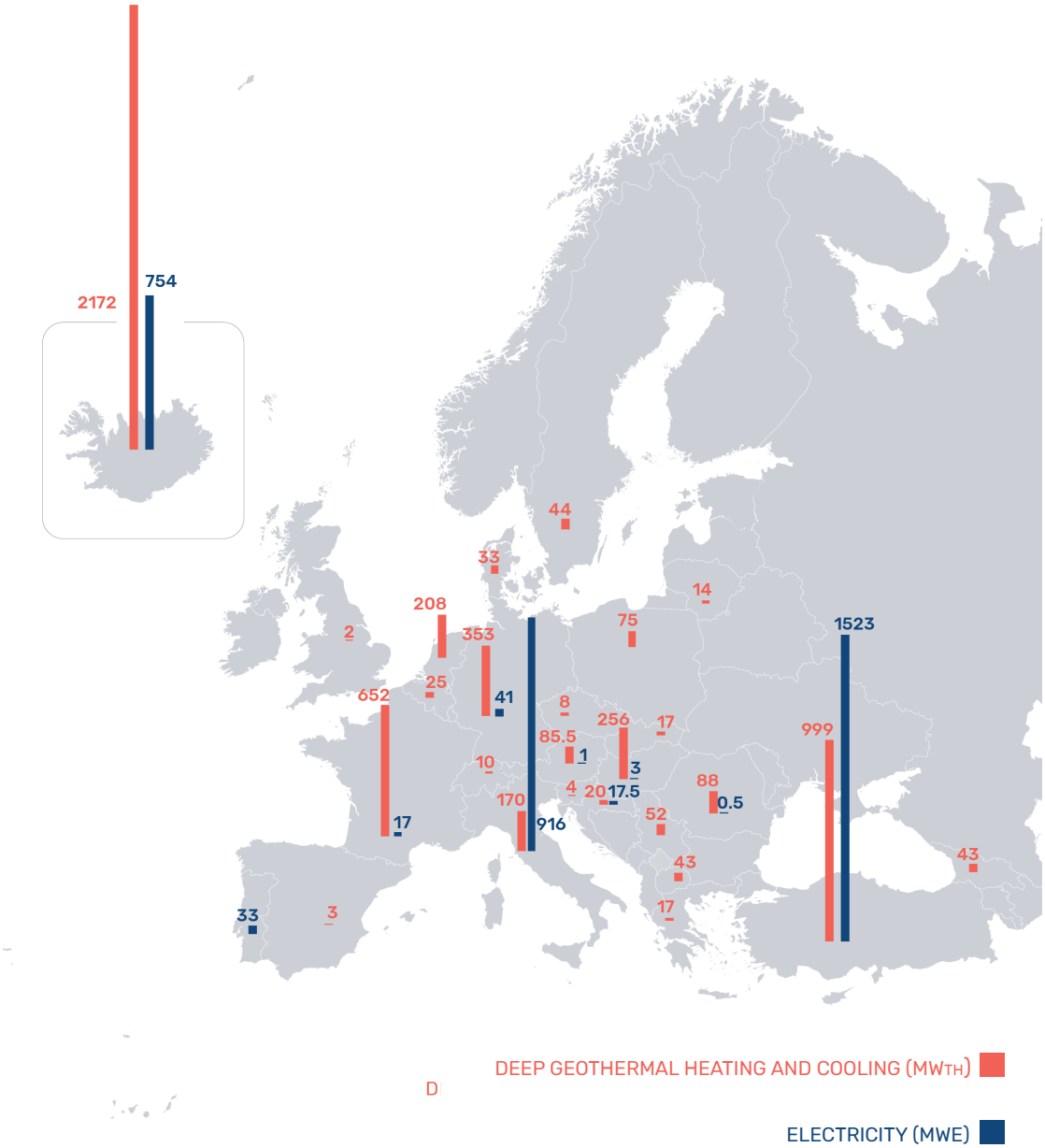
KEY FINDINGS

The EGEC Geothermal Market report is, since 2011, an authoritative publication on the evolution of the geothermal sector in Europe. Covering all segments of the sector – from electricity and geothermal heat pumps to district heating and cooling – the Geothermal Market Report provides a comprehensive picture of the state of the sector in Europe. The report also looks at key trends in the global geothermal market.

Beyond the statistical reporting, it provides insightful analysis of the market trends, policy framework and technology evolutions that shape the geothermal sector. Every year the report also provides an in-depth review on the state of a specific aspect of geothermal technologies. For the year 2019, the technology focus of the EGEC Geothermal Market Report is about drilling and geothermal wells.

The full version of the Geothermal Market Report is available for Members only.

Fig. 1 | Installed capacity for electricity and district heating in 2019 (MW)



Geothermal power

The deployment of geothermal electricity production in Europe has continued in 2019 following the positive dynamic of the previous year. The new developments happened in the highly dynamic market of **Turkey,** in a 'low-temperature country' as **Germany** through a new project commissioned and with a retrofit of an old installation in Iceland.

These new developments brought the European geothermal electricity generation capacity to **3.3 GWe for a total of 130 geothermal power plants across Europe,** a 5% growth from the previous year.

At the end of 2019, there were 130 operating installations in Europe, 36 projects under development, and 124 projects in the planning phase. This predicts that **the number of operating plants could double in the next 5-8 years.**

Moreover, while the European geothermal electricity market remains heavily dominated by 3 countries – Turkey, Italy, Iceland – and exists in only a few more, recent milestones and an ongoing trend draw a different picture for the future.

Fig. 2 | Number and capacity of new geothermal power plants commissioned in 2019

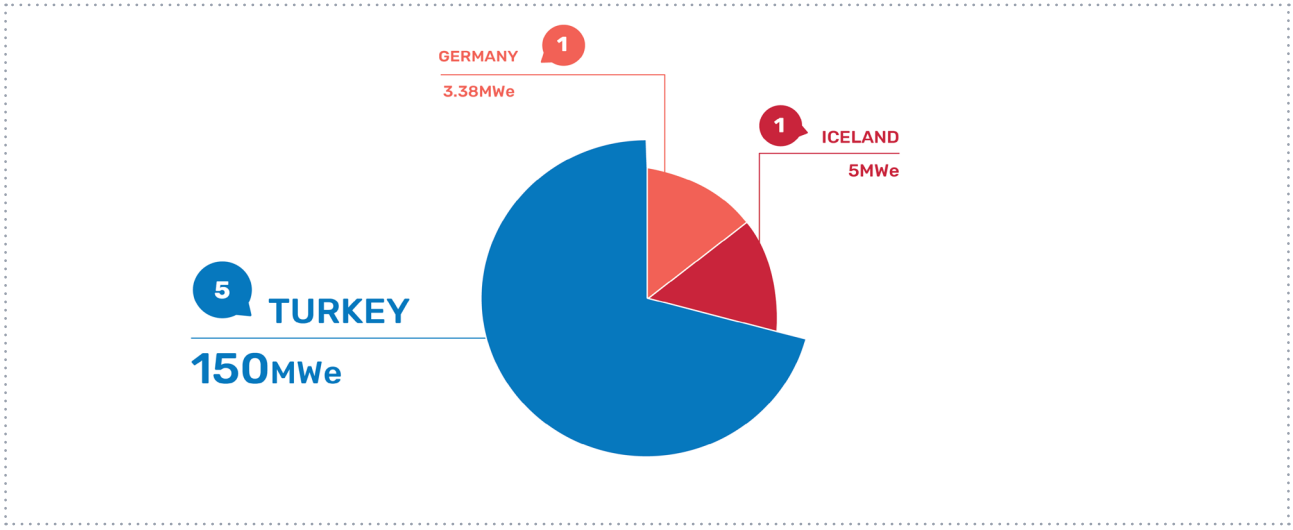
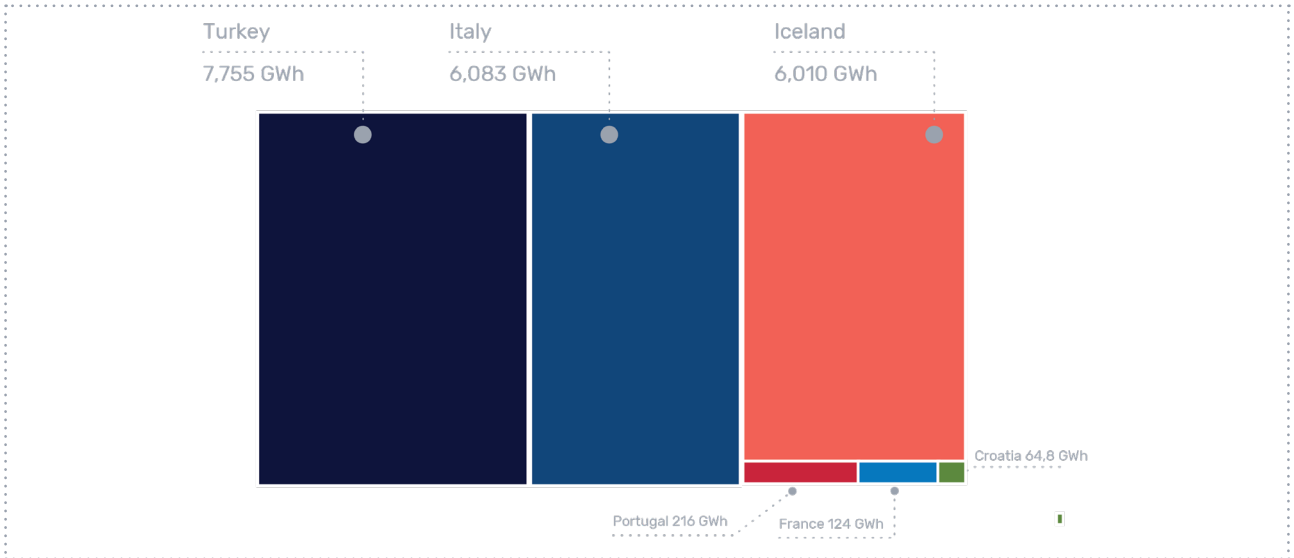


Fig. 3 | Geothermal electricity production in selected countries 2019



KEY FINDINGS | GEOTHERMAL POWER

Fig. 4 | Number of plants in Europe in operation, under development and under investigation

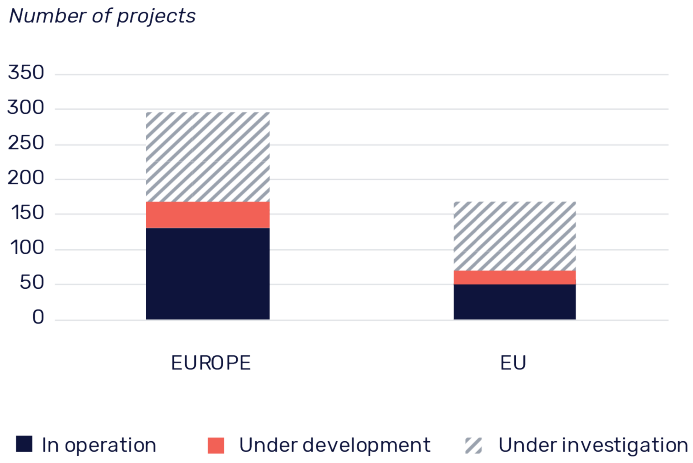


Fig. 5 | Installed capacity by country highlighting 2019 additions (MWe)

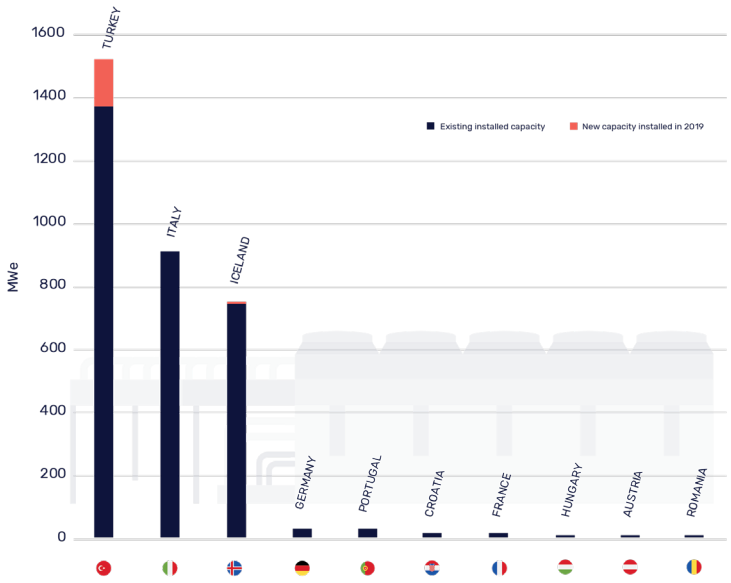
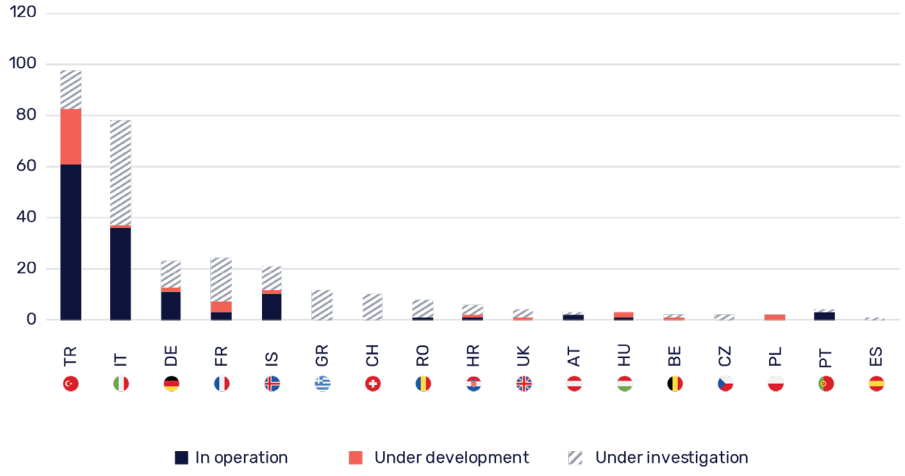


Fig. 6 | Number of plants per country in operation, under development and under investigation (electricity)



KEY FINDINGS | GEOTHERMAL POWER

Fig. 7 | Average capacity factors per country

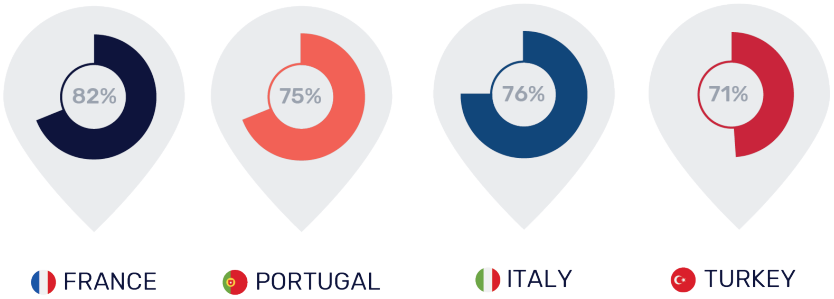


Fig. 8 | Progress towards national geothermal electricity targets to 2020

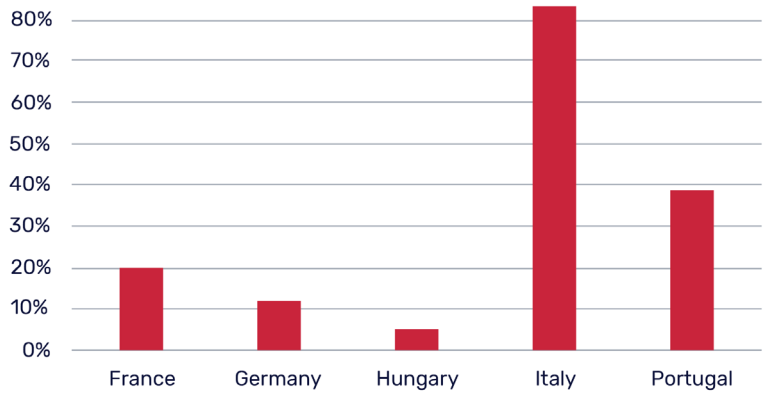
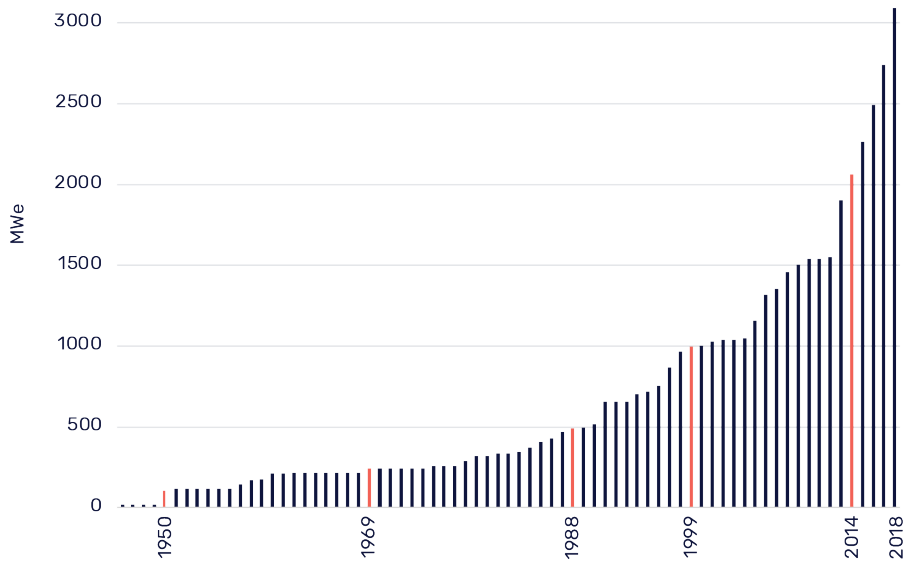


Fig.9 | Growth of electricity capacity in Europe



Geothermal heating and cooling

Europe is a leading global market for geothermal district heating and cooling for buildings, industry, services and agriculture. In 2019, there were 5.5 GWth of installed geothermal district heating and cooling capacity in 25 European countries, corresponding to 327 systems.

The status of geothermal district heating and cooling in Europe reflects a **strong interest for this renewable resource** and the possibility to **implement it almost everywhere in Europe.** The trend of ongoing projects anticipates a rapid acceleration of this dynamics and a diversification in leading markets.

The number of annual installations has also stabilised in the past three years, thanks to the steady deployment of new capacity in the **Netherlands.** This country continues to be the driving European market for deep geothermal heating and cooling, with 6 newly commissioned systems in 2019 (representing 100 MWth).

Fig. 10 | New geothermal GeoDH plants in 2019 (country, number, capacity)

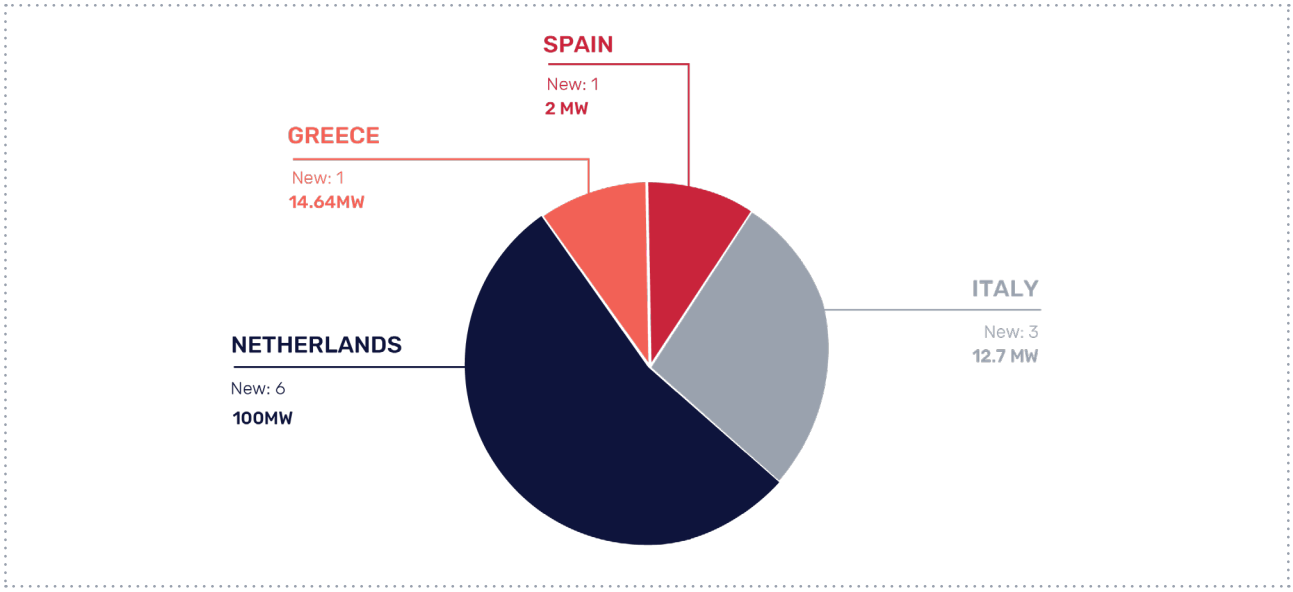
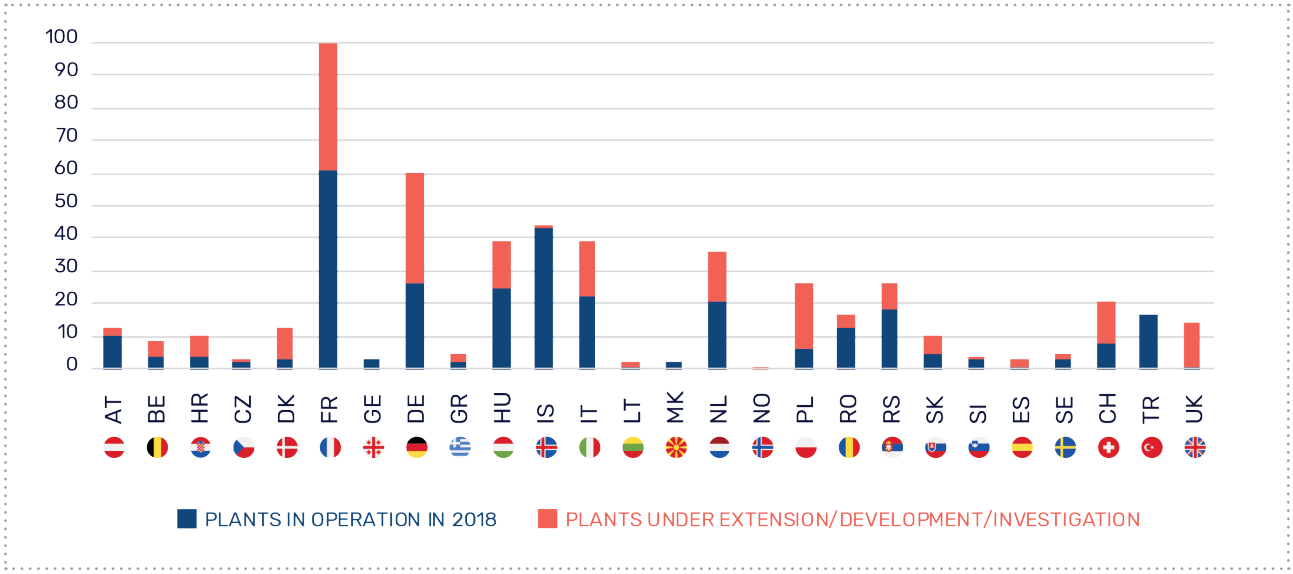


Fig. 11 | Number of GeoDH plants in operation and under development-investigation per country



KEY FINDINGS | GEOTHERMAL HEATING AND COOLING

Fig. 12 | Map of geothermal district heating capacity in Europe

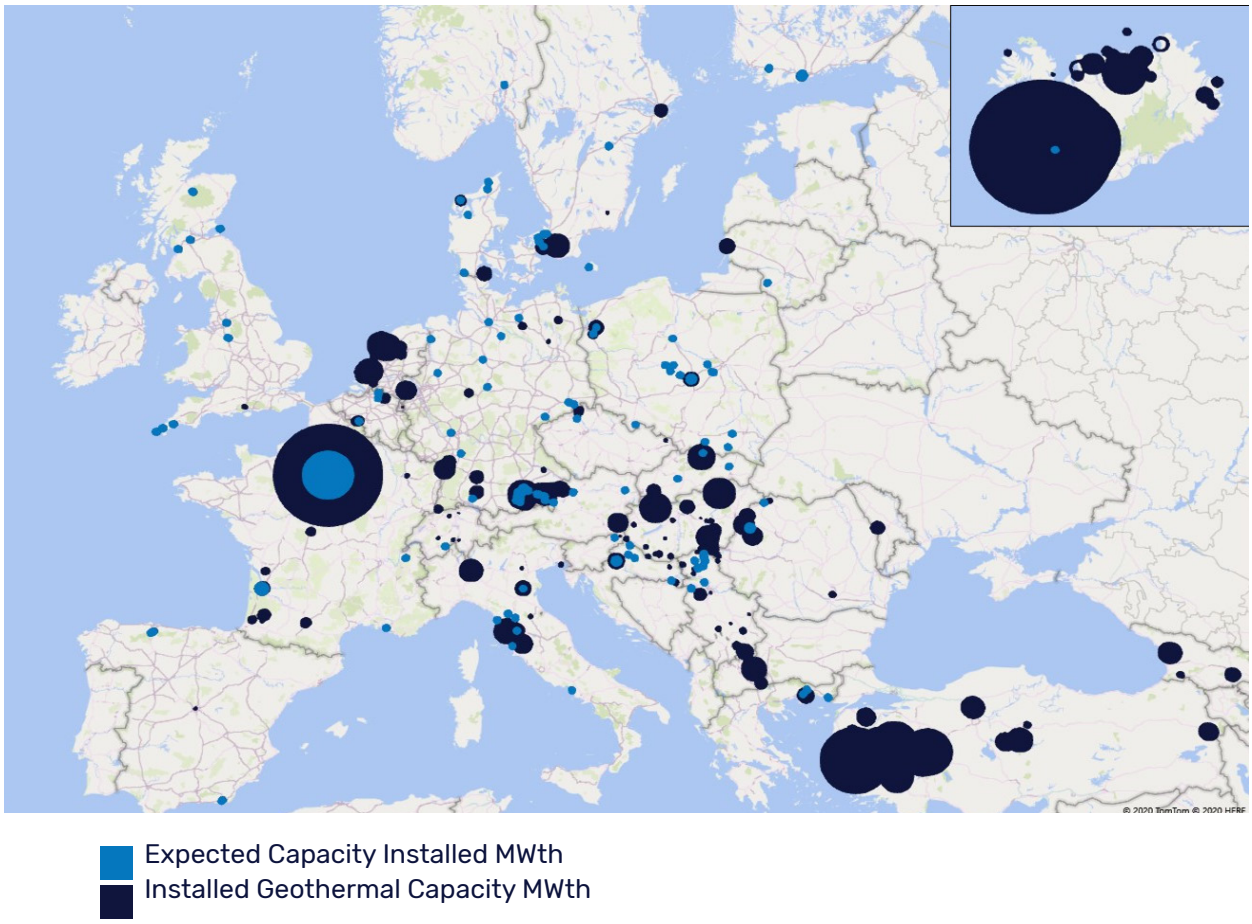
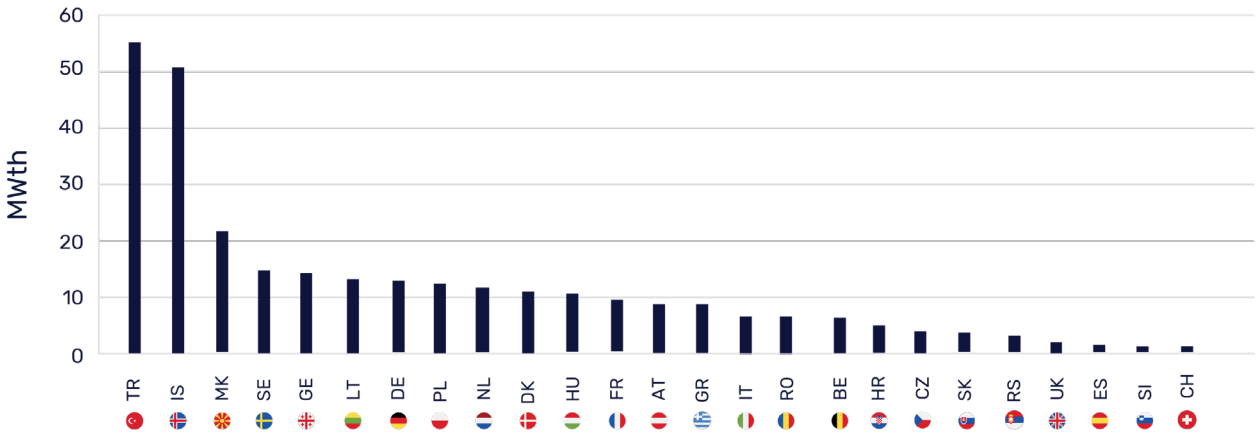
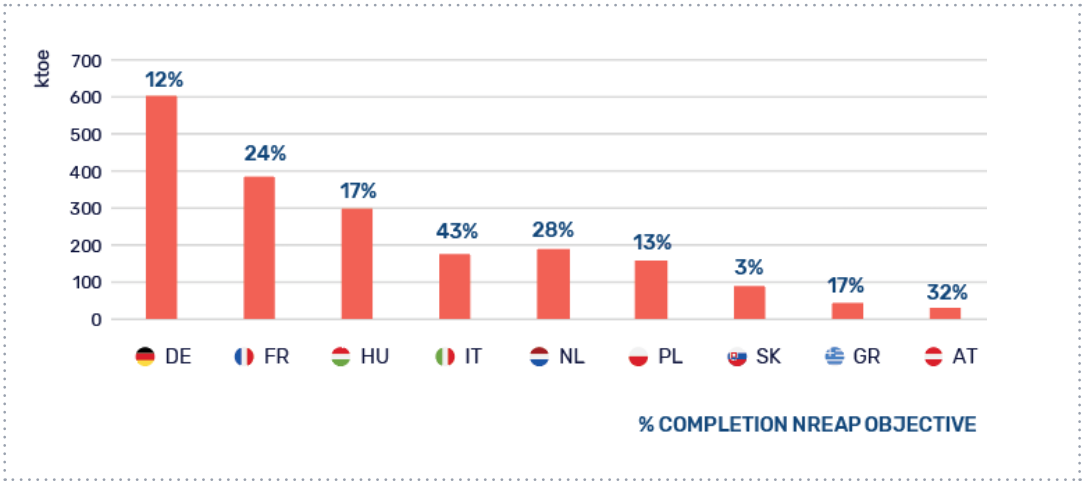


Fig. 13 | Average plant size per country



KEY FINDINGS | GEOTHERMAL HEATING AND COOLING

Fig. 14 | Progress towards national 2020 target for geothermal district heating and cooling



Geothermal Heat Pumps

In 2019, the European geothermal heat pump market reached the **milestone of 2 million heat pumps installed.** This milestone is an important part of this technology's story, as it becomes a mainstream heating and cooling solution in some regional or national markets.

This success is driven by several factors, from higher efficiencies to decreasing costs due to the deployment of larger systems in big buildings. Regulations reflecting a carbon price on fossil technologies - especially gas - have proven very effective, as have regulations to phase out fossil heating and cooling.

Regarding the **market dynamics,** we can distinguish mature, established and emerging markets. While **Sweden** is the only country that clearly qualifies as a **mature market** (with over 13 geothermal heat pumps for 100 households on average), other countries show high penetration rates. In colder climates, geothermal heat pumps are closer to market maturity.

Fig. 19 | Stock of GSHP per country highlighting sales

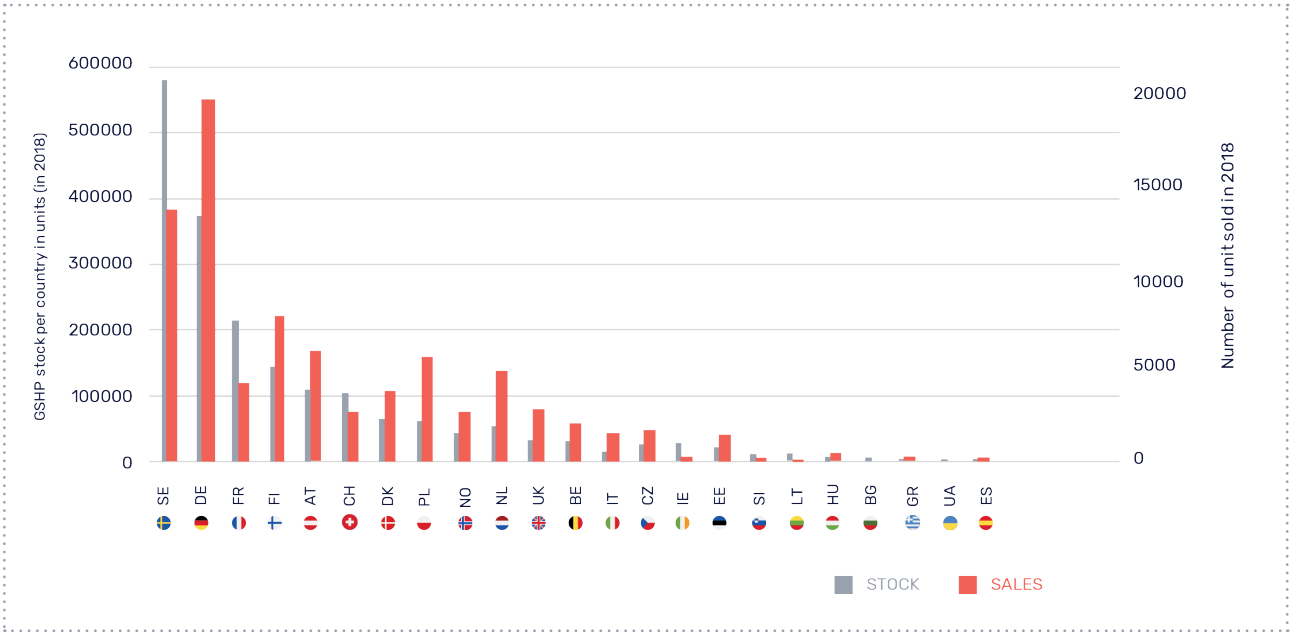
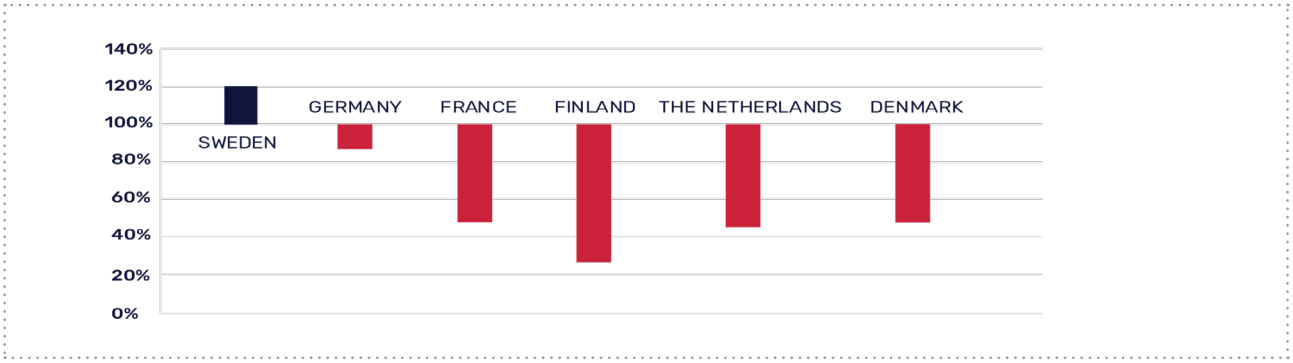


Fig. 20 | Progress towards national geothermal heat pump objectives to 2020



Conclusions

In Europe, the **geothermal electricity market** is growing, with a sustained development in established markets like Turkey, access to new markets like Croatia and Hungary, and ground-breaking innovations such as Enhanced Geothermal Systems (EGS).

Geothermal district heating and cooling has emerged as a cost-effective solution to meet the challenge of decarbonising heating and cooling, notably in urban areas. On top of the progress in established markets, this renewable solution is picking up also in markets where the use of geothermal district heating and cooling was only marginally developed.

As the **geothermal heat pump market** hits the milestone of 2 million heat pumps installed in Europe, the undeniable success of Sweden is a powerful example that geothermal heat pumps can be a mainstream solution for heating and cooling. It is also a testimony of how policies can shift the heating and cooling market away from fossil fuels towards renewable sources such as geothermal heat pumps.

Overall, the use of **geothermal energy can scale up very rapidly with the right policies and market conditions**: stable policy framework, proper insurance schemes, sound Research & Development & Innovation policies, carbon price and stopping the support for fossil fuels, including gas.

On the contrary, the **stop-and-go policies** witnessed in certain countries (notably Germany and France) **represent a huge disruption for geothermal technologies**, hinder the market and ultimately slow down the uptake of urgently-needed solutions to decarbonise the European economies.

Taking a look at the **global geothermal market**, geothermal electricity keeps being the driving sector for growth. However, there is an increasing interest in geothermal district heating and cooling, and the use of geothermal energy for industrial processes and agriculture. Moreover, new opportunities are arising with the extraction of geothermal lithium, which not only is an environmentally friendly solution, but also a lucrative financial stream for geothermal companies.

With so many different applications, vast untapped potential and the high growth rates of the last years, geothermal energy is bound to become the bedrock of energy transition. 2020 to 2030 will be the **“Geothermal Decade”.**

The Ruggero Bertani European Geothermal Innovation Award 2020

This year the Ruggero Bertani European Geothermal Innovation Award 2020 was earned by the Icelandic Carbfix project and German company Eavor on equal merit.

The Carbfix process captures CO2 and other sour gases from emission sources, transforming them into rocks underground in less than two years. This overturns the common view that mineral storage in Carbon Capture & Storage projects takes hundreds to thousands of years. Carbfix has global scaling potential in and beyond the geothermal industry for decarbonising the economy.

Eavor's innovation is a novel and scalable closed-loop geothermal system of several deep horizontal wells connected to vertical wells. This overcomes the limitation of deep geothermal systems, which normally rely on vertical single wells only. By running on thermosiphon, it also enables the geothermal industry to offer both a baseload and dispatchable energy source.

Traditionally, the award is handed out at GEOTHERM Expo & Congress. This year the event has been cancelled due to the Covid-19 outbreak, so the winners have been announced during an online ceremony on 27 May 2020.

Miklos Antics, President of the European Geothermal Energy Council (EGEC) and member of the jury, said *"The choice has been so hard that for the first time we had to award two winners. These projects demonstrate that the geothermal community keeps innovating in so many different ways, from technical improvements that increase energy production, to climate change mitigation measures. We encourage companies to keep up with this standard and are sure to see as many excellent applications for next year as we did this year. The pace at which the geothermal industry is developing is unprecedented and so we believe this will be the 'geothermal decade'."*

Edda Aradóttir, Chief Executive Officer at Carbifix, said *"We are honored to receive this award and the recognition it entails. It reflects the increased interest and belief that the Carbfix process can be applied to significantly reduce the level of greenhouse gases in the atmosphere and help our battle against climate change. Highlighting all the top-level research and innovation which is ongoing in the European geothermal sector and beyond is of great importance and supports the commercialization of new and improved technologies."*

Robert Winsloe, Executive Vice President at Eavor, added that *"On behalf of my colleagues at Eavor and our partners around the world, I would like to thank the jury and the EGEC for this very prestigious award. I would also like to congratulate Carbfix and the other finalists, all of whom would have been worthy winners. Despite the challenges in the current environment, the recognition that comes with this award encourages us to continue building on the excellent progress we've made to date with both our commercial projects and the development of our Eavor-Loop technology."*

As every year, the competition was very high-level. The finalists included: **BAKKER OILFIELD SUPPLY** (Netherlands), for Degasser, which consists in a product to separate harmful gases and oils from water and steam; **VULCAN ENERGIE RESSOURCEN GMBH** (Germany), that aims to extract lithium from geothermal brine with a zero-carbon process; and **ZAE BAYERN** (Germany), for their test rig that emulates the thermal behaviour of a real borehole heat exchanger of different lengths and underground properties.

The jury for 2020 was composed of Miklos Antics (France, representing EGEC), Adele Manzella (Italy, research expert), Sandra Kircher (Germany, representing Messe Offenburg), Fausto Batini (Italy, representing ETIP-DG, industry expert), and Javier Urchueguia (Spain, representing RHC-ETIP geothermal panel).

The Ruggero Bertani European Geothermal Innovation Award is an initiative of EGEC, the European Geothermal Energy Council, in collaboration with Messe Offenburg, organisers of the GeoTHERM fair and congress. It is given to companies which have made an outstanding contribution towards the field of geothermal energy in the form of innovative products, scientific research and project initiatives.

RUGGERO BERTANI
European Geothermal
Innovation Award 2020

ENDORSED
NOMINATION

DATA COLLECTION AND METHODOLOGY

GEOTHERMAL ELECTRICITY

Data for the chapter on geothermal power is collected yearly for each country through input from national data coordinators. For the classifications of geothermal power plants as either 'existing', 'under development', and 'under investigation', please refer to the table below, which serves as an approximate and simplified way of classifying the different steps in a deep geothermal project.

Existing plants

Each geothermal power plant is connected to the grid and already in operation. For each power plant, contributors submitted available information regarding:

- Locality (region, province, of municipality),
- Power plant name and type (hydrothermal or EGS),
- Year of commissioning (in case of refurbishment or upgrading, coordinators reported the most recent date)
- Turbine type (dry steam, single, double, or triple flash, ORC, Kalina)
- Turbine manufacturer (in case of two or more manufacturers, coordinators provided the name of all of them)
- Capacity installed (in MWe and MWth, in case of CHP)
- Gross electricity production in 2018 (in GWh)
- Operator and service companies, drillers and equipment manufacturers
- Number and depth of wells (in meters)

Power plants under development

Power plants under development refer to projects for which financing has been announced and/or contracts for drilling services signed. For each project contributors submitted available information regarding:

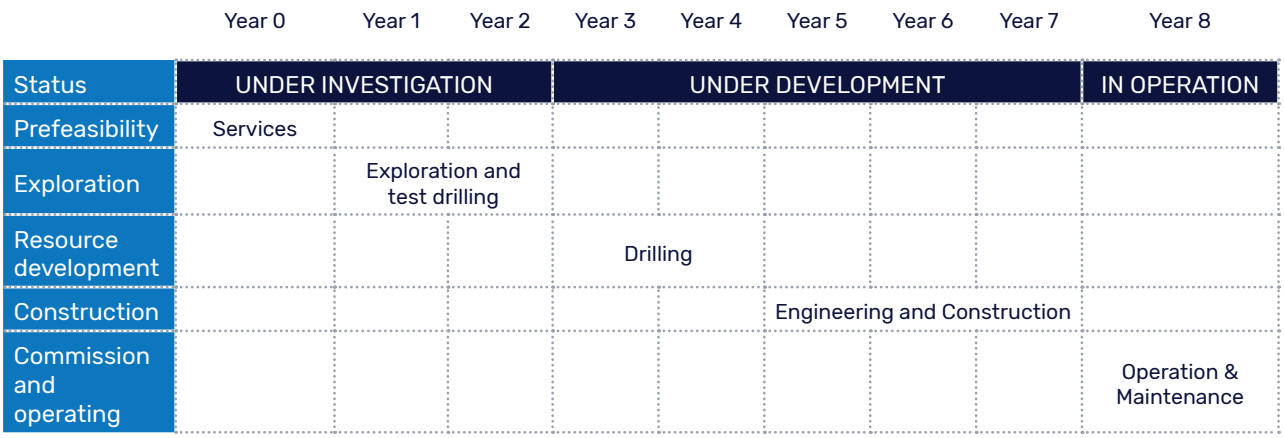
- Locality (region, province, municipality),
- Power plant name and type (hydrothermal or EGS),
- Expected year of commissioning
- Expected capacity installed (in MWe and MWth (in case of CHP)
- Project developer/consortium and, when possible, drillers and equipment manufacturers
- When possible, planned number and depth of wells

Power plants under investigation

Power plants under investigation refer to projects for which a research permit has been issued but financing has not been announced and/or contracts for drilling services not been signed. For each project contributors submitted available information regarding:

- Locality (region, province, municipality),
- Power plant name and type (hydrothermal or EGS),
- Expected year of commissioning
- Expected capacity installed (in MWe and MWth (in case of CHP)
- Expected Gross electricity production (in GWh)
- Project developer/Consortium

Gross electricity production: "Gross electricity production is the sum of the electrical energy production by all the generating sets concerned (including pumped storage) measured at the output terminals of the main generators." (Eurostat, IEA, UNECE & OECD, 2012).



GEOTHERMAL DISTRICT HEATING

Data for the chapter on geothermal district heating is collected yearly for each country through input by national data coordinators.

'Geothermal district heating or district cooling' is defined as the use of one or more geothermal production fields as sources of heat/cold to supply thermal energy through a network to multiple buildings or sites. It includes greenhouses and geothermal heat projects above 500 kWth supported by heat pumps if the heat is distributed via a pipe network to more than one building or site. In this case the capacity of heat pumps should also be released.

Existing plants

For each plant already in operation, contributors submitted available information regarding:

- Locality (region, province, of municipality),
- Year of commissioning (in case of refurbishment or upgrading, coordinators reported the most recent date)
- Capacity installed (in MWth)
- Gross heat production in 2018 (in GWh)
- Operator and, when possible, service companies, drillers and equipment manufacturers
- When possible, the depth of the wells

Planned plants

For each plant under planning contributors submitted available information regarding:

- Locality (region, province, municipality),
- Status (under construction, planned, negotiations)
- Expected year of commissioning indicating if the project is an extension/upgrading
- Expected capacity installed (in MWth)
- Project developer/Consortium and, when possible, drillers and equipment manufacturers

Gross heat production: "Gross heat production is the total heat produced by the installation and includes the heat used by the installation's auxiliaries that use a hot fluid and losses in the installation/network heat exchanges. As only heat sold to third parties is reported, gross heat production for autoproducers will be equal to net heat production." (Eurostat, IEA, UNECE & OECD, 2012).

GEOTHERMAL HEAT PUMPS

EGEC undertook a data collection exercise for geothermal heat pumps for the first time in 2012, as a complement to the deep geothermal market report. The lack of official statistical data on geothermal heat pumps has not yet been resolved sufficiently. Eurostat has started to provide data, but not for all countries, and on several occasions a distinction between heat sources is not made, but rather just 'heat pumps' are reported.

So often the figures are based on:

- Estimations provided for conferences (EGC 2019 Country Update, and WGC 2015)
- Sales data for heat pumps as recorded by some heat pump associations
- The bi-annual (geothermal) heat pump barometer prepared by EurObserv'ER, or the EurObserv'ER annual overview of the state of renewable energy in Europe.
- EUROSTAT SHARES results 2018

In combination with data from other publications, information provided by companies, and original research, a consistent picture (with some irregularities) could be achieved. Most data is for 2018.

IN THE FULL REPORT

EDITORIAL

GEOTHERMAL POWER
Policy framework for geothermal
Turbines
Electricty demand in Europe
Decarbonisation of the power sector
Smart Sectoral Integration

GEOTHERMAL HEATING & COOLING
Newly commissioned systems and projects development in 2019
A forward-looking and stable framework is needed
Just Transition Fund

GEOTHERMAL HEAT PUMPS
Market dynamics: mature, established and emerging markets
The importance of clear support policies and communities
Renovation Wave

GEOTHERMAL ENERGY GLOBALLY
The Global Geothermal Lithium Race

TECHNOLOGY FOCUS: GEOTHERMAL WELLS

THE RUGGERO BERTANI INNOVATION AWARD

DATA COLLECTION AND METHODOLOGY

LIST OF ABBREVIATIONS

EGEC, THE VOICE OF GEOTHERMAL IN EUROPE

ANNEXES: TABLES
Geothermal power plants in operation, under development, under investigation
Geothermal district and cooling heating plants in operation, under development
Large geothermal heat pumps

ABOUT EGEC, THE EUROPEAN GEOTHERMAL ENERGY COUNCIL

REPRESENTING THE EUROPEAN GEOTHERMAL INDUSTRY

EGEC, the European Geothermal Energy Council, is a non-profit international organisation founded in 1998 to promote the European geothermal industry and enable its development both in Europe and worldwide, by shaping policy, improving business condition, and driving more research and development.

Based in Brussels, we work with our members on policy, market intelligence, and communication for both deep and shallow geothermal, providing a link between the industry and European institutions. More than 120 members from 28 countries, including developers, equipment manufacturers, electricity providers, national associations, consultants, research centres, geological surveys, and public authorities, make EGEC a unique network, uniting and representing the entire geothermal sector.

THE EGEC GEOTHERMAL MARKET REPORT

Every year, the EGEC Geothermal Market Report analyses market trends and developments in the geothermal sector in Europe.

Since its first edition in December 2011, it has come to be seen as the authoritative overview of the entire geothermal sector in Europe. The report is compiled each year using data from various statistical analyses, local experts, utilities, energy agencies, and national associations. It includes details of all major projects in operation, under development, and under investigation, as well as an analysis of market development, the regulatory and public policy environment, financial tools and incentives, the market forecast, and key players. Every edition also offers an in-depth review of different geothermal technologies.

EGEC
GEOTHERMAL

The Key Findings of the report are made publicly available, while the full report, complete with supporting data and tables, is only available to EGEC members. For more information, visit www.egec.org

EGEC GEOTHERMAL

The voice of geothermal in Europe

European Geothermal Energy Council
Place du Champ de Mars 2, 1050 Brussels, Belgium
+32 2 31 84 065 / com@egec.org
www.egec.org