EGEC GEOTHERMAL

Key Findings

EGEC GEOTHERMAL MARKET REPORT

14th Edition
July 2025

2024

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KEY FINDINGS

2024: a year of transition

The EGEC Geothermal Market Report offers a comprehensive snapshot of the European geothermal sector, highlighting current trends and projecting future developments.

Reflecting on our previous forecasts, we had anticipated a rise in the number of wells drilled for geothermal district heating and cooling (DHC) systems and power plants, along with increased sales of geothermal heat pumps (GHPs). However, the 2024 data tells a different story. Drilling activity remained steady, and GHP sales actually declined. This stagnation is largely attributed to the lengthy planning, permitting and development timelines typical of geothermal projects and the lack of dedicated policy support to address this.

2024 was a record year for **exploration campaigns**, thanks to the use of 3D seismic survey technologies, and it's why we decided to include a new chapter on exploration in this year's Market Report. The increased number of surveys supports our forecast of an increase in the number of wells to be drilled in the coming years.

The year also saw the commissioning of three new **geothermal power plants**, one in Austria and two in Türkiye, adding a combined 40 MWe of reliable baseload capacity. By the end of 2024, a total of 147 geothermal electricity plants were in operation across Europe.

The **geothermal district heating and cooling** sector experienced steady and geographically diverse growth, with ten new systems launched: three in Poland, two in the UK, and one each in France, Greece, Romania, Spain, and the Netherlands. This brings the total number of operational geothermal DHC systems in Europe to 412, of which 208 are in the EU countries.

Geothermal Heat Pumps (GHP) remain the most efficient and sustainable solution for heating and cooling in buildings, offering exceptional longevity, which often exceeds 50 years. We remain confident that improving market conditions will soon reignite growth in GHP adoption across Europe.

Although the **Underground Thermal Energy Storage (UTES)** market in Europe is still in its infancy, this year's report includes a dedicated chapter exploring emerging technological trends in the field.

Our energy infrastructure analysis emphasizes how local geothermal projects can ease pressure on regional and national electricity grids, especially during peak demand periods. This can reduce the need for costly grid upgrades and enhance overall energy resilience.

As the European Commission prepares the **European Geothermal Action Plan**, we are optimistic that the main barriers to mass geothermal deployment will finally be unlocked, making it easier to invest and reap the rewards of the many direct and indirect benefits that geothermal energy solutions can bring to families, communities, industries, businesses and farmers across Europe.

Discover What's Inside the Full Market Report

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Focus on main markets in 2024
Market outlook to 2030

GEOTHERMAL DISTRICT HEATING & COOLING

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GEOTHERMAL HEAT PUMPS

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GEOTHERMAL POWER

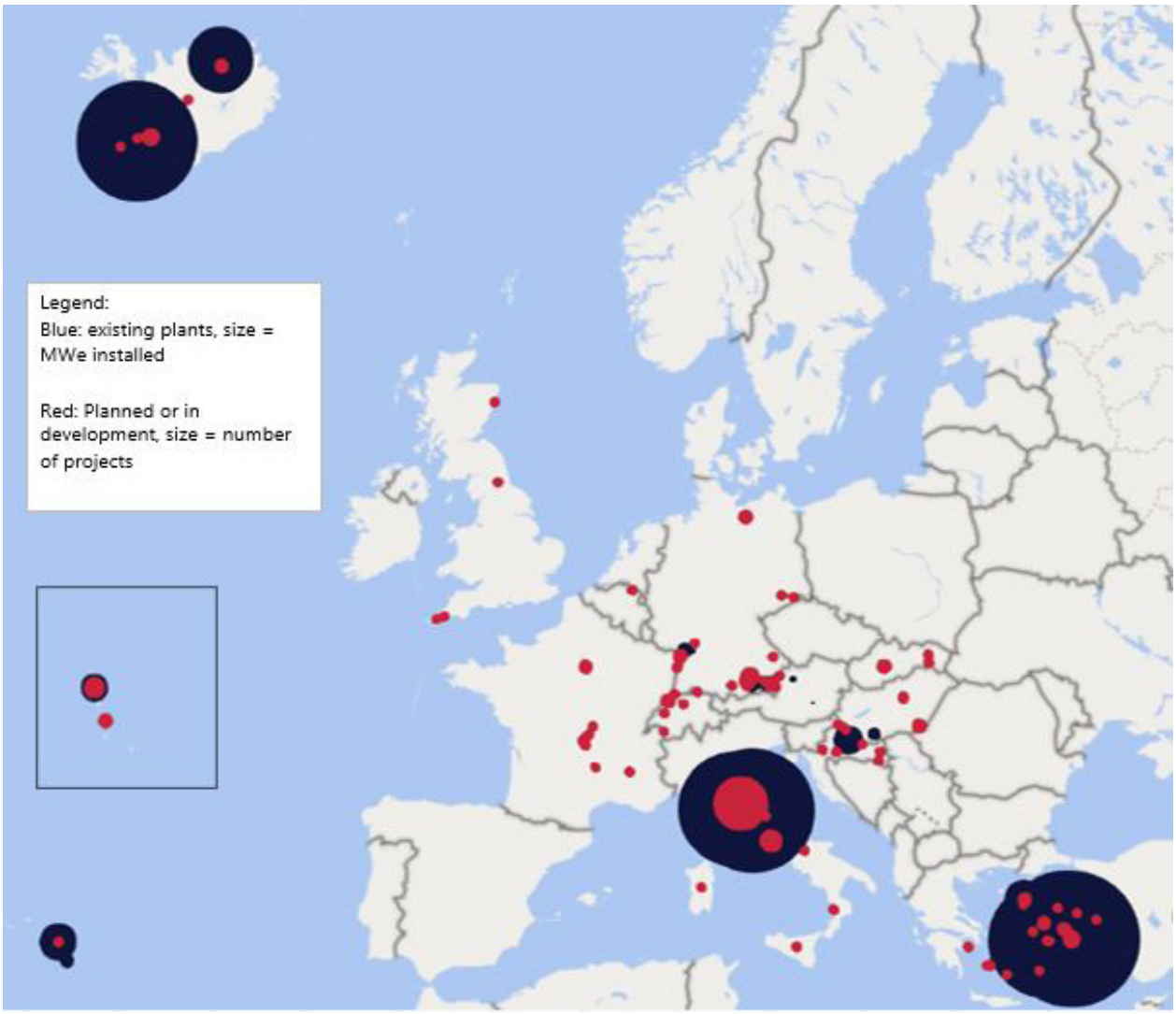
Market Analysis

Europe currently has over 3.5 GWe of installed geothermal electricity capacity (1 GWe in the EU), generating around 20 TWh in 2024 (7 TWh in the EU).

In 2024, three new geothermal power plants were inaugurated: two in Türkiye and one in Austria, adding a combined 40 MWe of base load capacity.

Long operational lifetimes coupled with high volumes of dispatchable electricity, are the main benefits of geothermal power plants. Many have been in continuous operation for decades. The longest serving geothermal power plant in Europe (Rancia plant in Radicondoli, Italy), has been operating since 1986. Three additional plants date back to the 1980s. A further 17 plants commissioned in the 1990s - in Italy, Portugal and Iceland - are still in operation today, and another 32 began operating in the 2000s. At the end of 2024, a total of 147 geothermal electricity plants were in operation across Europe. Some 21 of these plants have been running for more than 25 years, highlighting the durability and long-term value of geothermal investments.

Locations of existing and planned geothermal power plants in Europe



Market Outlook to 2030

Around 50 geothermal power plants are currently progressing through various stages of development — from initial exploration and drilling to preparations for grid connection. As of 2024, two additional projects have entered the development phase. Germany is leading the field with 17 projects in development, and a further 18 projects under preliminary investigation. Türkiye is in second place, with 7 projects in development and 10 under investigation.

Across Europe, proposals for 193 geothermal power plants are currently being studied, primarily in Croatia, France, Germany, Hungary, Italy and Türkiye. However, exploration is also gaining traction in new markets like Greece and Spain.

The projects advancing over the past few years reflect a dual evolution within the geothermal sector. On one side, the growing maturity of binary cycle technologies enables the development of larger-scale facilities. On the other, there is a resurgence of interest in smaller-scale plants, particularly those designed for combined heat and power (CHP) or cogeneration. This shift is accompanied by a strategic turn toward project portfolio models. Developers are increasingly pursuing clusters of projects, either within the same geological basin or diversified across multiple regions, in order to spread risk and streamline development.

After 10 years of expectations and slow market development with only three geothermal CHP plants installed during the last 5 years, 2024 could mark the start of new development for geothermal cogeneration in Europe.

Combined heat and power geothermal plants are seeing a renewed interest, both in high temperature fields (e.g. Iceland) and in medium temperature fields - with binary systems in Germany, Hungary and Slovakia.

Greeneco Energy geothermal power plant in Sarayköy (Turkey)

The first unit of the Greeneco Energy GPP-7 plant, with a capacity of 24.5 MWe, has been completed in Sarayköy (district of Denizli, Türkiye). Upon completion, the plant will consist of two units with a total capacity of 49 MWe.

Greeneco Energy geothermal power plant in Sarayköy (source: EXERGY)

GEOTHERMAL DISTRICT HEATING & COOLING

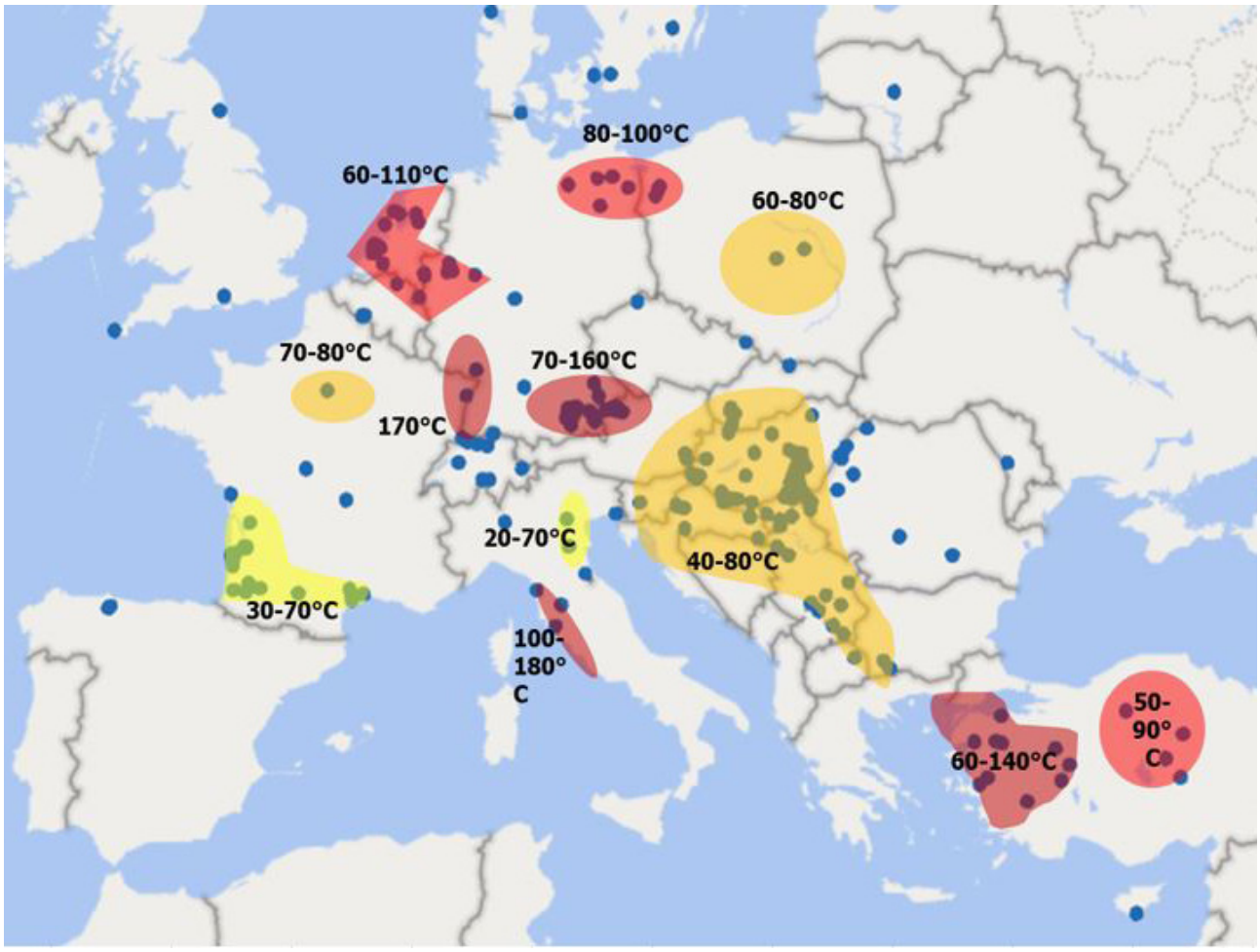
Market Analysis: Overview

In 2024, the geothermal district heating and cooling sector in Europe demonstrated steady and diversified growth, with notable progress in emerging markets, while mature markets saw slow or zero growth. Last year, 10 new geothermal DHC plants were commissioned in Europe, including 3 in Poland, 2 in the United Kingdom, and 1 in each of France, Greece, Romania, Spain and the Netherlands.

At the end of 2024, a total of 412 geothermal DHC plants were in operation across Europe, including 308 in the EU Member States. Additionally, more than 500 projects were under development at different stages. Some will be inaugurated in 2025, while others have started drilling or are still in the exploration or investigation phases.

Put together, the 10 new geothermal systems added around 110 MWth to Europe's geothermal heating and cooling capacity. At the end of 2024, the total installed capacity across Europe was more than 6 GWth across 29 countries (including 21 of the EU Member States).

Map of main geothermal district heating and cooling reservoirs with existing systems and temperatures



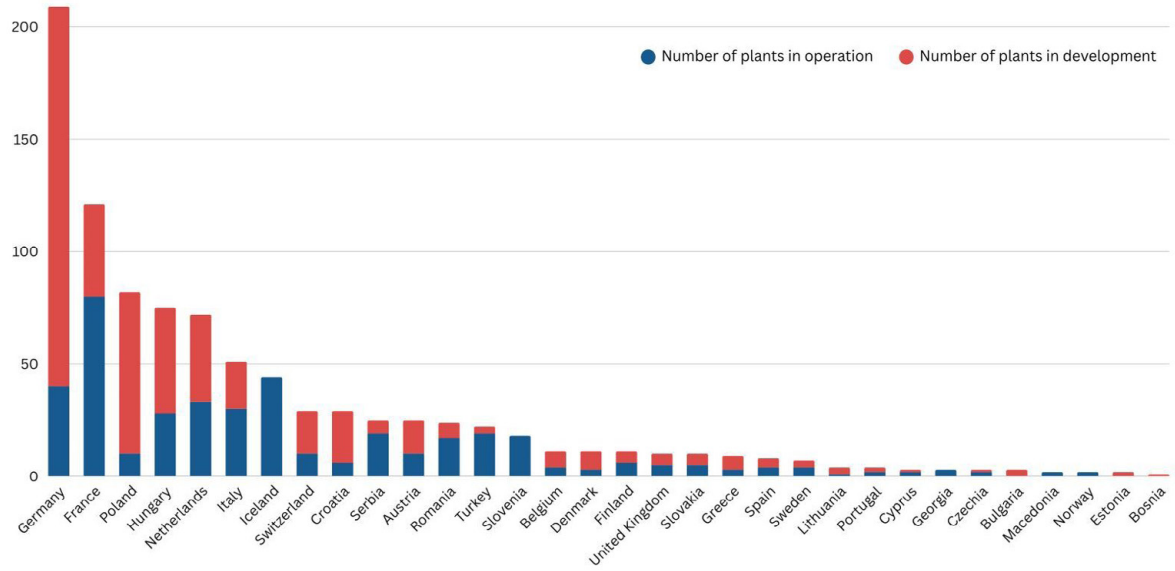
Market Outlook to 2030

Across the whole of Europe, some 400 geothermal district heating and cooling systems are currently in development, in some 27 different countries. Implementing all these projects would lead to a doubling of the total number of systems in operation, and it would increase the total capacity of geothermal DHC systems by more than 100%.

Germany is seen as the hottest market for geothermal DHC with around 170 systems under development. New market conditions, with de-risking schemes and heat infrastructure funding, convince project developers. The city of Munich is a model for such development.

We then see Poland (with 72 geothermal DHC projects in development), Hungary (47), France (41) and The Netherlands (39) as especially promising markets, with potential to double or triple their respective geothermal DHC sectors by 2030. Other growing and emerging markets worth highlighting include: Croatia (23), Switzerland (19), Austria (15) and Denmark (8).

European geothermal district heating and cooling markets: Number of systems operating and in development in 2024



Geothermal heating plant in Konin, Poland (source: Geotermia2030.pl)

GEOTHERMAL HEAT PUMPS (GHPS)

Market Analysis

Taking data from the 27 Member States of the European Union, we see that only around 111,000 geothermal heat pump units were sold in 2024. This represents a 29% decrease since 2023.

- 2.43 million geothermal heat pumps operating in Europe in 2024.
- More than 111,000 units sold in the European Union in 2024.
- Unit sales decreased by 28% since 2023
- Total installed GHP capacity = 37.6 GW of heat

  35 GW supplied by small GHPs (< 50 kWth)

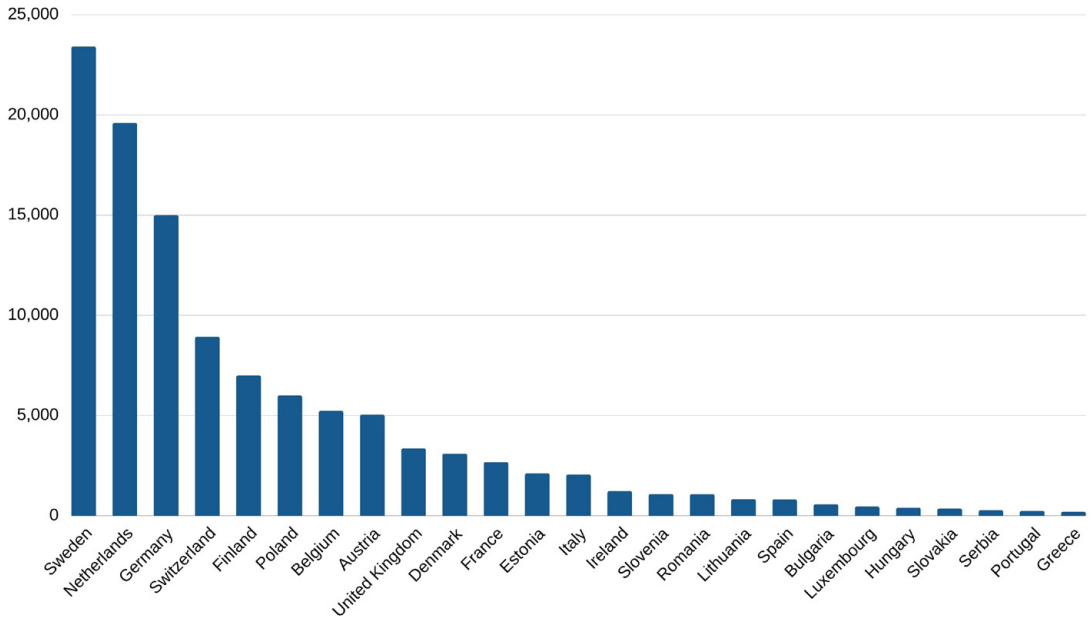
  2.6 GW supplied by large GHPs (> 50 kWth)
- Geothermal heat pumps provided 85 TWh of heat in 2024.
- Supplying heat and cooling to more than 10.5 million people.

All countries in Europe, except Switzerland, followed a similar trend with significant declines in the sales of geothermal heat pumps (GHPs). According to our analysis, the reasons for this contraction range from macroeconomic factors to regulatory issues.

The lack of regulatory and policy support continues to undermine GHPs by undervaluing and not remunerating the energy system benefits that GHPs deliver. These benefits include: the lowest impact on electricity grids; the most efficient active and passive cooling systems; higher operational efficiencies; considerably longer lifespans and lower operational costs.

Macro-economic factors, such as higher interest rates, inflation, excessive taxation of electricity and the lack of meaningful carbon pricing on fossil gas, coupled with extensive subsidies to fossil gas and combined with low electrification rates, continue to provide headwinds for GHPs and other renewable heating solutions.

Number of geothermal heat pumps sold in European countries in 2024



Looking to the future, EGEC is hopeful that the upcoming European Geothermal Action Plan will contribute to creating more favourable conditions for the growth of the GHP market, including simpler rules and permitting procedures for the installation of new GHP systems.

Are GHPs competitive and affordable sources of heating and cooling?

Geothermal Heat Pump systems supply hot water, space heating and cooling. They typically operate for between 2,000 and 3,000 hours per year, depending on local climatic conditions. Passive cooling can be provided with extremely low running costs.

For a small scale GHP system with a capacity of less than 20 kWth, purchasing and installation costs can vary between €25,000 and €35,000. For larger systems, the upfront costs will typically amount to around €1,500 euros per kWth.

The current assumption for GHP in the residential sector, is an efficiency of 4.5 for closed loop systems, and 5.5 for open loops. This means that only 1 kWh of electricity is required to deliver up to 5.5 kWh of heat, irrespective of outside air temperatures. This high and consistent level of efficiency enables geothermal heat pumps to position themselves as a competitive option for heating and cooling all types of buildings.

During the lifetime of a GHP system, operation and maintenance costs are generally low. Boreholes can be expected to remain useful for more than 100 years, and during this time only the heat pump unit itself has to be replaced, typically once every 20 to 25 years.

According to analysis carried out by France's Agency for the Ecological Transition (ADEME), GHPs are more economic and affordable that other renewable energy solutions (such as biomass boilers or solar thermal systems) when it comes to providing clean heat for collective housing (e.g. apartment blocks) and buildings in the tertiary sector (including shopping centres, hotels, schools, hospitals, etc.).

The key reasons for the low cost of GHPs compared to other renewable energy solutions are: (a) the high levels of efficiency for heating, cooling and heat storage; (b) an extended lifetime of more than 50 years to amortize investment costs; and (c) scalability, which allows networked geothermal to operate on a utility business model with multiple consumers incorporated into a renewable heating and cooling network.

UNDERGROUND THERMAL ENERGY STORAGE (UTES)

Underground Thermal Energy Storage (UTES) is a technology focused on storing heat below ground for short and long-term periods. Heat from various sources is stored underground during times of low demand and retrieved when there is a need for heating or cooling.

As of 2024, low-temperature systems, particularly Borehole Thermal Energy Storage (BTES), continue to dominate the European market for Underground Thermal Energy Storage (UTES). Thousands of BTES installations are operational across Europe, primarily serving small-scale heating and cooling applications for buildings. Sweden and Germany remain leaders in the geothermal heat pump sector and, by extension, in BTES deployment. All EU countries have implemented UTES systems, with the Netherlands notably advancing in Aquifer Thermal Energy Storage (ATES) technologies. Minewater energy storage, while still a niche factor, shows high potential for replication in coal regions.

A significant trend is the development of high-temperature UTES systems to cater to district heating and industrial processes. In 2023, Norway achieved a milestone with the Tromsø project, testing UTES at injection temperatures of 140°C and return temperatures between 65–100°C. This High Enthalpy Aquifer Technology (HEAT) concept involved drilling 11 wells to a depth of 300 meters, aiming to store 20 GWh and retrieve over 10 GWh. The system utilises a network of injector and production wells drilled into bedrock, creating an underground fracture system to maximize contact between circulating water and bedrock, using only sand and water without chemicals. The test production period spanned from October 2023 to April 2024, with full-scale storage anticipated in summer 2024.

UTES systems are pivotal in addressing the mismatch between energy supply and demand. They provide flexibility and reliability in a sustainable manner. They are among the few long-duration storage technologies capable of storing vast amounts of energy, up to tens of GWh per cycle, with minimal impact on land use. High-temperature UTES systems can directly supply heat for various applications making them suitable for industrial heating networks.

UTES contributes to the electricity sector through sector coupling, allowing the absorption of electricity surpluses via power-to-heat solutions. This decouples electricity production and heat demand over short to seasonal timescales.

As of December 2024, the European Union has taken the first steps to establish a regulatory framework to bolster energy storage, including UTES, as a cornerstone for enhancing grid flexibility and supporting the integration of renewable energy sources.

Amsterdam's Schiphol airport in the Netherlands is installing a heating and cooling system using Aquifer Thermal Energy Storage (ATES) technology

Amsterdam Schiphol Airport
(source: Schiphol Airport)

EXPLORATION AND DRILLING MARKETS

EXPLORATION ACTIVITIES

The last two years have seen steady growth in the number of 3D seismic exploration activities being undertaken in Europe.

In 2024, a record of more than 17 seismic surveys were conducted, compared to only 10 in 2023. At least 10 3D seismic campaigns started in the first half of 2025, with multiple surveys announced for later in the year. This is a positive sign for the future growth of Europe's geothermal sector.

Now that the most accessible resources have already been tapped into, new geothermal projects are being developed in lesser-known areas, and so more surveys are required before drilling. Moreover, with a growing level of interest in geothermal energy, more projects are being developed and newcomers are joining the geothermal sector. We are also seeing the transfer of exploration technologies that were already used by the oil and gas industries.

A selection of nodes used for seismic surveys
(source: Tim Dean)

DRILLING ACTIVITIES

With regard to drilling, we expect that some of the planned activities that were delayed in 2024 will finally be undertaken in 2025 and 2026, proving that new geothermal projects are in development. However, market growth also depends on having a favourable financial, regulatory and policy framework that encourages investments in geothermal projects. Therefore, the highly anticipated European Geothermal Action Plan will be vital.

Across Europe, around 50 geothermal power plants are currently progressing through various stages of development, from initial exploration and drilling to preparations for grid connection. Meanwhile, more than 500 geothermal district heating and cooling projects are also in development.

Taking all of these ongoing projects together, we expect that around 230 new wells will have to be drilled during a two-year period, up until the end of 2026.

Based on our survey of planned and ongoing exploration campaigns in Europe, EGEC anticipates that around 120 wells will have to be drilled for exploration purposes before the end of 2027.

Both analyses indicate an exponential increase in the number of wells to be drilled. Doubling or trebling the annual drilling rate will require a more efficient permitting process to issue drilling approvals, along with improved project management to ensure rig availability.

ENERGY GRID INFRASTRUCTURES

In the context of the EU's transition towards a decarbonised and climate-neutral economy by 2050, the costs of making necessary changes and improvements to energy grid infrastructures are increasingly a source of concern. During the last decade, not enough investments were done to integrate new electricity capacity, whereas many investments have been made in gas infrastructures that only serve to extend our dependency on fossil fuels. Now the EU is looking at infrastructure for hydrogen, but there is a lack of support for investments in geothermal and other renewable heating and cooling grid infrastructures.

In 2023, the European Commission adopted a European Grid Action Plan that promised to invest €584 billion in electricity grids across the EU. This plan responds to an expected increase in electricity consumption of around 60%, driven by the electrification of sectors such as heating and transport. It also answers the need for renewal, as 40% of the current EU distribution grids are over 40 years old. However, EGEC regrets that the announced plan fails to address the need for smart energy system integration with geothermal energy solutions.

A stable electricity system needs to be based on a mix of sources and technologies, producing power close to demand centres, where it has the highest value. This approach can alleviate the need for additional transmission and distribution infrastructure as well as costly storage.

The deployment of geothermal solutions will result in reduced system costs, a benefit which should be highlighted when comparing geothermal to other electricity technologies. There is an urgent need to develop mechanisms which reward the flexibility geothermal can provide. For example, geothermal power plant operators can offer ancillary services to system operators and provide valuable short and long-term flexibility at a regional level.

How can geothermal solutions reduce the need for costly investments in electricity grids?

- Geothermal power plants can provide base load electricity on a 24-7 basis, but they can also be operated flexibly, to help manage fluctuations in demand for electricity.
- Geothermal combined heat and power plants can contribute to meeting heat demand by directly supplying industry and district heating networks.
- Geothermal district heating and cooling systems and geothermal heat pumps also make significant contributions to reducing electricity demand.
- UTES enables excess energy to be stored underground as heat and then utilized during periods of high demand, thereby reducing electricity demand at peak times and providing additional flexibility to the energy system as a whole.

THE FULL MARKET REPORT

The publication of the EGEC Market Report provides a unique in-depth assessment of the geothermal industry's evolution during the year 2024.

The Key Findings of the report have been made publicly available, while the full report, complete with supporting data and tables, is only available to EGEC members.

The Full Market Report is only available to EGEC Members (240+ members), to the 500+ entities that EGEC represents at the european level, and upon request to journalists and policy-makers at the European and national levels.

For more information, visit www.egec.org

THE RUGGERO BERTANI INNOVATION AWARD

On 21 February 2025, EGEC announced that the **Ruggero Bertani European Geothermal Innovation Award for 2025** had been awarded to **EnBW Energie** for its pioneering CASCADE project, an innovative approach to lithium extraction from geothermal brines. The EGIA award recognises outstanding companies that have made outstanding contributions towards the development of the geothermal field in Europe.

The CASCADE project represents a breakthrough in sustainable lithium extraction made in Europe, a critical element for the energy transition and the growing electric vehicle market in Europe and the world. The process schemes currently use AI-based adsorbents in single reactors, but the resulting preliminary product still contains a relevant level of impurities. The technology, tested at the Bruchsal geothermal plant (Germany), offers a scalable and environmentally friendly solution for lithium production, strengthening Europe's position in the global battery supply chain.

Thomas Koelbel, representing EnBW, expressed gratitude for the recognition, saying, *"It was a severe competition, and all the other nominated companies had excellent projects. We are very happy to have received this award."* **Laura Herrmann**, representing EnBW, added that they *"really want to continue with this project to bring it to the next level."*

Miklos Antics, President of EGEC, praised the project, stating: *"The CASCADE technology is a game-changer for the geothermal and battery industries. EnBW's innovation demonstrates how geothermal resources can go beyond energy production to support critical raw material supply in a sustainable manner. This award highlights the role of geothermal energy in enabling Europe's energy independence and climate goals."*

EnBW Energie's CASCADE project stood out for its innovation, sustainability, and potential to revolutionise the future of lithium production. EGEC congratulates EnBW Energie Baden-Württemberg on this remarkable achievement and looks forward to further advancements in geothermal sustainable energy innovations.

ABOUT EGEC, THE EUROPEAN GEOTHERMAL ENERGY COUNCIL

REPRESENTING THE EUROPEAN GEOTHERMAL INDUSTRY

The European Geothermal Energy Council (EGEC) is a not-for-profit organisation promoting all aspects of the geothermal industry. Founded in 1998, its objective is to facilitate awareness and expansion of geothermal applications across Europe by shaping policy, improving investment conditions and steering research.

It has over 240 members from 30 countries, ranging from developers to equipment manufacturers, energy providers, national associations, consultants, research centres, geological surveys, government agencies, departments and public authorities. This allows EGEC to represent the entire geothermal sector.

EGEC is listed in the **European Transparency Register No. 11458103335-07**

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.

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**

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EGEC would like to thank the sponsors of our Geothermal Market Report 2024.

Green Therma was founded in February 2023 by experienced Danish geologists with the purpose of revolutionizing geothermal energy for heat production worldwide. Our commitment to renewable energy and technological innovation is embodied in our groundbreaking geothermal technology and unique Heat4Ever™ solution. Our mission is to offer competitive, reliable, and renewable heating to industries, infrastructure, communities, and cities through deep geothermal energy with a minimal environmental footprint and very low emissions.

greentherma.com

Unlike other start-ups in the geothermal industry, we do not focus on a single technology or opportunity, but rather manage a risk balanced portfolio of different power producing opportunities around the globe in high enthalpy environments. This provides a broader diversification while applying proven technology and allowing shared learnings from our esteemed panel of geothermal experts across the portfolio. **Ignis H2 Energy** benefits from an existing support structure in most countries through its sister company Geolog International.

ignisenergy.com

INOVATERM is a highly skilled manufacturer and contractor company based in Turkey with international activities and consultancy around the globe. We provide industrial solutions in the fields of Power Plants, Waste Heat Recovery Plants, Energy Storage Plants, Oil & Gas Refineries, Petrochemical & Chemical Refineries, Nuclear Power Plants, Biodiesel Plants, Hydrogenation and Energy Plants, Cement, Mining, and Drilling, etc. INOVATERM's strength is based on highly qualified and experienced professionals with expertise in engineering fields.

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EGEC GEOTHERMAL

The voice of geothermal in Europe

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