GreetGeo

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Analysis of relevant European public initiatives, best practices and opportunities

Deliverable 2.4

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Authors	Tomislav Đurić, Sanja Živković, Matija Vajdić
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Project partners

Lead partner: Energy Institute Hrvoje Požar (HR)

PP2: LA PALMA RESEARCH CENTRE SL (ES)

PP3: Hungarian Geothermal Association (HU)

PP4: Elso Magyar Energetikai Fejleszto és Szolgaltato Kft. (HU)

PP5: DDRIÜ NONPROFIT KFT. (HU)

PP6: Local Energy Agency Pomurje (SI)

PP7: CONSORZIO PER LO SVILUPPO DELLE AREE GEOTERMICHE (IT)

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PP10: INSTITUTO DE INOVACAO TECNOLOGICA DOS ACORE (PT)

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Executive summary

This report, developed within the framework of the GreetGeo project, provides a comprehensive overview of the European geothermal landscape, with the objective of supporting the accelerated deployment of geothermal energy as a cornerstone of the European green transition. It maps and analyses key public initiatives, funding mechanisms, hubs, platforms, and enabling tools at European level, while highlighting concrete opportunities for engagement, replication, and scale-up across regions. By combining policy analysis, market intelligence, and practical implementation insights, the report positions geothermal energy as a strategic, yet underutilised, solution for decarbonising heat, strengthening energy security, and fostering place-based economic development. In parallel, selected best practices of geothermal utilisation across Europe are presented in detail, with particular attention to technical configurations, governance models, financing approaches, and contextual success factors. These examples aim to increase visibility of proven solutions and to support their transferability and replicability in other European regions with similar territorial, industrial, or socio-economic characteristics.

A dedicated section of the report structures and analyses funding opportunities at European level, providing an overview of the main financial instruments supporting geothermal development, including research and innovation, demonstration, infrastructure deployment, and market uptake. Both ongoing and forthcoming funding possibilities are examined, with key eligibility conditions, strategic priorities, and relevance for different types of geothermal projects clearly articulated. This structured overview is intended to support public authorities, project developers, and other stakeholders in navigating the European funding landscape and aligning geothermal investments with broader EU policy objectives.

Recognising that geothermal projects are often characterised by high upfront capital costs and complex planning and permitting processes, the report also reviews a diverse portfolio of digital and financial tools designed to de-risk project development. These tools are categorised into financial and techno-economic modelling solutions, risk assessment and decision-support systems, resource exploration and digital twin technologies, as well as regulatory frameworks and data repositories. Together, they form a critical enabling ecosystem that can reduce uncertainty, improve decision-making, and accelerate project implementation.

Building on these elements, the report presents an integrated analysis of domain knowledge, niche market opportunities, and interregional and cross-sectoral linkages relevant to geothermal energy in Europe. It highlights geothermal's strategic role in decarbonising heating and cooling, supporting industrial transformation, enabling rural and urban development, and strengthening interregional cooperation through smart specialisation and European territorial instruments. In doing so, the report demonstrates how geothermal energy can act as a systemic driver of the European green transition, connecting energy, industry, innovation, and regional development into a coherent and resilient pathway toward climate neutrality.

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Abbreviations and acronyms

ATES	Aquifer Thermal Energy Storage
BTES	Borehole Thermal Energy Storage
CAPEX	Capital Expenditure
CCU	Carbon Capture and Use
CCS	Carbon Capture and Storage
COP	Coefficient of Performance
DH	District Heating
DHC	District Heating and Cooling
EEA	European Economic Area
EGEC	European Geothermal Energy Council
EIB	European Investment Bank
EBITDA	Earnings Before Interest, Taxes, Depreciation, and Amortization.
EGP	Enel Green Power
EGRISE	European Geothermal Research & Innovation Search Engine
ERDF	European Regional Development Fund
EU	European Union
ETIP	European Technology & Innovation Platform
ETIP-DG	European Technology & Innovation Platform on Geothermal
GeoDH	Geothermal District Heating
GETEM	Geothermal Electricity Technology Evaluation Model
HWG	Horizontal Working Group
ICT	Information and Communication Technology
IF	Innovation Fund
IT	Information Technologies
JTF	Just Transition Fund
NZT	Net-Zero Technologies
RES	Renewable energy sources
RHC	Renewable Heating & Cooling

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R&D	Research and Development
R&I	Research and Innovation
SAM	System Advisor Model
SAPHEA	Sustainable Positive Heating and Energy
SET	Strategic Energy Technology
SRIA	Strategic Research and Innovation Agenda
TP	Technology Panel
UTES	Underground Thermal Energy Storage
5GDHC	Fifth-generation district heating and cooling

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1. Introduction

The European Union's commitment to climate neutrality and energy security requires a profound transformation of its energy system, with particular emphasis on the decarbonisation of heating and cooling. Despite progress in renewable electricity generation, heating and cooling continue to account for a significant share of final energy consumption and remain heavily dependent on fossil fuels. Addressing this challenge is essential for achieving European climate objectives and requires reliable, scalable, and regionally adaptable renewable solutions.

Geothermal energy represents a strategic yet underexploited resource within Europe's renewable energy portfolio. By providing a stable, locally available source of renewable heat and, in certain contexts, electricity, geothermal energy can support the decarbonisation of district heating and cooling systems, industrial processes, and integrated local energy networks. Its baseload character and strong territorial dimension make it particularly well suited to Europe's place-based approach to the green transition, linking energy production with regional development, innovation, and employment.

Despite this potential, geothermal deployment across Europe remains uneven and constrained by high upfront investment costs, geological uncertainty, complex regulatory frameworks, and limited visibility of available support mechanisms. Knowledge related to geothermal technologies, funding opportunities, best practices, and enabling tools is often fragmented, creating barriers for public authorities, project developers, and other stakeholders seeking to initiate or scale geothermal projects.

The GreetGeo project addresses these challenges by strengthening access to strategic information and fostering connections within the European geothermal ecosystem. This report provides a consolidated overview of relevant European public initiatives, funding programmes, hubs, and platforms, alongside selected best practices of geothermal utilisation across different sectors and regions. It also presents structured information on European funding and financing opportunities, as well as digital and financial tools designed to reduce risk and support decision-making throughout the project lifecycle.

By combining policy insight, practical examples, and enabling instruments, the report situates geothermal energy within a broader framework of domain knowledge, niche market opportunities, and interregional and cross-sectoral cooperation. In doing so, it aims to support informed decision-making and to contribute to the accelerated integration of geothermal energy into Europe's green transition.

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2. Analysis of relevant European public initiatives, hubs and platforms

This section analyses key European public initiatives, hubs and platforms that support geothermal energy development and assesses the possibilities for involving stakeholders from the target regions in these initiatives.

The analysis focuses on initiatives that provide policy support, strategic guidance, research and innovation coordination, market uptake instruments, capacity building, and alternative financing mechanisms relevant to geothermal energy projects across Europe.

The analysed initiatives include European sector associations, technology and innovation platforms, transnational research and funding initiatives, district heating service hubs, and market-uptake and financing platforms, such as EGEC, RHC-ETIP, ETIP-Geothermal, GEOTHERMICA, GeoDH, SAPHEA and CROWDTHERMAL.

2.1. EGEC

The European Geothermal Energy Council (EGEC)[1] 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 200 members from 30 countries, representing the entire geothermal sector, from developers to equipment manufacturers, energy providers, national associations, consultants, research centres, geological surveys, government agencies, departments and public authorities. The main goals are promoting the use of geothermal energy across Europe, shaping policy, improving investment conditions, and steering research.

EGEC's activities are centred on advocating for and accelerating the deployment of geothermal energy solutions—including heating, cooling, electricity, and raw material extraction—to support Europe's energy transition. They include:

- **Policy Advocacy**: EGEC works to influence European Union policy and financial frameworks to favour geothermal energy. A primary focus is advocating for a dedicated "European Geothermal Strategy and Action Plan" from the European Commission to streamline permitting, boost funding, and set ambitious EU-wide targets.
- **Industry Representation:** It serves as a unified voice for over 200 members across 30 countries, highlighting the sector's potential and technical capabilities to policymakers and the public.

[1] https://www.egec.org/

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- **Research and Innovation**: EGEC is involved in various EU-funded research projects (like GEORISK and SAPHEA) to tackle challenges such as mitigating resource risk, developing new technologies (e.g., lithium extraction from geothermal brines), and demonstrating best practices.
- **Market Intelligence:** The council publishes an annual "Geothermal Market Report" and "Geothermal Innovation Trends" to provide a comprehensive overview of the sector's performance, growth, and future forecasts.
- **Events and Networking:** EGEC organises key industry events, including the triennial European Geothermal Congress and annual Geothermal District Heating and Cooling Days, which bring together experts, stakeholders, and policymakers to network and share knowledge.
- **Awareness Campaigns:** EGEC runs campaigns and publishes reports/factsheets to raise awareness about geothermal energy's benefits, such as its ability to provide stable, 24/7 baseload power and heat for industries, agriculture, and buildings.

Through these activities, EGEC aims to position geothermal energy as a foundational element of a sustainable, secure, and competitive European energy future.

Relevance for target regions and stakeholders: EGEC provides an entry point for geothermal developers, district heating operators, service companies, research organisations and public authorities from the target regions to engage in European policy dialogue, access market intelligence, and increase visibility of regional projects and best practices.

2.2. RHC-ETIP

The European Technology and Innovation Platform on Renewable Heating & Cooling (RHC-ETIP or RHC Platform)[2] is an initiative that unites stakeholders from across Europe to jointly define a strategy for increasing the use of renewable energy sources (RES) for heating and cooling.

Heating and cooling account for nearly 50% of Europe's total energy consumption, the vast majority of which is currently met by fossil fuels. The RHC Platform's primary mission is to provide a framework for industry, research centres, and public authorities to steer research and innovation, fostering growth and market uptake of RES technologies to fully decarbonise the sector.

The platform is a consensus-based organisation officially endorsed by the European Commission under the Strategic Energy Technology (SET) Plan. It operates through a collaborative structure of Technology Panels (TP), Horizontal Working Groups (HWG) and the Secretariat.

Technology Panels focus on specific renewable energy sources:

- Biomass
- Geothermal
- Solar Thermal
- Heat Pumps

[2] https://www.rhc-platform.org/

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- District heating and cooling and thermal energy storage

In 2017, RHC-ETIP was restructured to foster its multisectoral and multidisciplinary approach. To this extent, Horizontal Working Groups have been created. Each HWG defines its own programme to achieve its pre-defined goal. The HWGs bring together interested experts from different technology panels to work on common horizontal topics, defined based on the main challenges to be addressed by the RHC-sector:

- 100% RE buildings (individually heated and cooled)
- 100% RE industries
- 100% RE cities
- 100% RE districts

Secretariat is coordinated by a consortium of major European organisations, including the EGEC, Solar Heat Europe, and the European Heat Pump Association, and manages daily operations and acts as the link to the European Commission.

The RHC Platform's activities focus on setting a unified vision and implementing a research and innovation agenda for the sector. These include:

- **Defining Strategy and Roadmaps:** A core activity is the development and publication of consensus-based strategic documents, including a "Common Vision for the Renewable Heating and Cooling Sector in Europe" and a "Strategic Research and Innovation Agenda (SRIA)".
- **Policy Advice:** The platform provides strategic advice and recommendations to the European Commission and Member States on Research and Innovation (R&I) priorities and funding needs, aiming to influence EU legislation and funding programs like Horizon Europe.
- **Networking and Events:** It organises major annual events and expert meetings, bringing together stakeholders to share knowledge, discuss challenges, and promote collaboration.
- **RHC Accelerator:** This initiative helps bridge the gap between research and the market by providing a database of projects, experts, and investors, and offering information on available funding schemes and relevant EU legislation.
- **Knowledge Sharing:** The platform maintains a database of R&I projects and publishes reports, roadmaps, and success stories to disseminate information and raise awareness about RHC technologies and their benefits for energy security and climate goals.

Relevance for target regions and stakeholders: The RHC Platform enables municipalities, DH operators, technology providers and research organisations from the target regions to contribute to EU-level strategic roadmaps, align regional innovation needs with SET-Plan priorities, and participate in cross-sectoral knowledge exchange.

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2.3. ETIP-Geothermal

The European Technology & Innovation Platform on Geothermal (ETIP-Geothermal)[3] is the key forum for driving research and innovation in the European geothermal sector. Endorsed by the European Commission under the Strategic Energy Technology (SET) Plan, its overarching goal is to enable the proliferation of geothermal technology to its full potential across Europe, reducing costs and increasing performance.

Established in its current form in early 2023, the platform resulted from the merger of the former "ETIP on Deep Geothermal (ETIP-DG)" and the "Geothermal Panel of the RHC-ETIP". This integration ensures a unified approach covering the entire geothermal value chain, including deep and shallow systems for power, heating, and cooling. EGEC coordinates its secretariat activities.

ETIP-Geothermal brings together experts from industry, academia, and research centres to develop and implement a shared R&I strategy.

Key Activities and Focus Areas include:

- **Strategic Planning**: The platform develops long-term "Visions" and a "Strategic Research and Innovation Agenda (SRIA)" to outline R&I priorities for the coming decades. It also creates detailed "Technology Roadmaps" for implementing these strategies.
- **Policy Influence**: It provides expert recommendations to the European Commission and Member States on R&I needs, funding priorities, and legislative frameworks to accelerate the market uptake of geothermal solutions.
- **Knowledge Sharing:** The platform manages the European Geothermal Research & Innovation Search Engine (EGRISE), a tool for discovering thousands of scientific papers and project deliverables from EU-funded projects.
- **Networking and Events:** ETIP-Geothermal organises workshops, webinars, and annual conferences to facilitate collaboration and disseminate the latest advancements and market trends within the sector.
- **Working Groups:** Expert Working Groups focus on specific topics to drive progress, including Geo-resources assessment, Well Technology, Power Systems, Heating and Cooling Systems, Materials, and Environment and Sustainability.

Ultimately, the ETIP-Geothermal aims to position geothermal energy as a secure, affordable, and local energy source that enhances Europe's energy independence and contributes significantly to climate neutrality by 2050.

Relevance for target regions and stakeholders: ETIP-Geothermal offers a structured framework for industry actors, researchers and public authorities to influence European R&I priorities, access thematic working groups, and position regional challenges and pilot needs within future EU funding agendas.

[3] https://etip-geothermal.eu/

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2.4. Geothermica Initiative

The Geothermica Initiative[4] is a collaborative platform where public authorities from various countries pool national efforts and financial resources to accelerate the research, innovation, and deployment of geothermal energy solutions. It originated as the EU Horizon 2020 project GEOTHERMICA and has since transitioned into a long-lasting international initiative.

The main goal of Geothermica is to make geothermal energy a reliable, safe, and cost-competitive component of the global energy transition. Specific objectives include:

- Combining financial resources and expertise from different nations to fund large-scale, transnational research and development (R&D) projects that go beyond what individual countries can achieve alone.
- Demonstrating and validating novel concepts for geothermal energy deployment, from direct use (heating and cooling) to power generation and integrated systems (e.g., thermal storage).
- Identifying pathways to large-scale commercial implementation of geothermal technologies.
- Fostering knowledge sharing and collaboration among the public sector, research communities, and industry.

Geothermica primarily functions as a funding and coordination mechanism. Its key activities include:

- **Joint Calls for Proposals:** The initiative has launched several joint calls for R&D projects, leveraging combined national and European Commission funds (including from the Horizon 2020 program). These calls have mobilised nearly €90 million in public and private investment for transnational projects.
- **Research & Innovation:** The funded projects cover a broad range of topics, including:
  - Identifying and assessing geothermal resources.
  - Advanced drilling techniques and well completion.
  - Enhanced Geothermal Systems (EGS) and superhot systems.
  - Thermal energy storage and integration with existing energy grids.
  - Risk mitigation strategies and policy instrument development.
- **Policy Support:** Geothermica provides evidence-based information to help formulate effective geothermal energy policies across member countries.
- **Events and Networking:** The initiative organises meetings, workshops, and webinars to connect experts and disseminate project results.

Membership in the Geothermica Initiative is exclusive for national and regional public authorities, such as national funding agencies and government ministries, to ensure alignment with public energy goals. Its members include program owners and managers from over 16 countries and

[4] https://www.geothermica.eu/

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regions, including those in Europe and associated countries like the USA and Norway, enabling broad international collaboration.

2.5. SAPHEA

The SAPHEA (Sustainable Positive Heating and Energy) platform[5] serves as a primary European knowledge hub dedicated to accelerating the market uptake of geothermal district heating and cooling systems. Funded under the Horizon Europe programme, the initiative addresses the technical and economic barriers that currently limit the large-scale deployment of geothermal energy across the continent. At its core, SAPHEA provides a comprehensive digital infrastructure that includes high-resolution geospatial datasets and a curated catalogue of development scenarios, allowing urban planners and investors to assess the geothermal potential of specific regions with high precision.

Technically, the platform facilitates the integration of low-to-medium enthalpy geothermal resources into existing thermal networks, with a particular focus on the synergy between geothermal wells and large-scale industrial heat pumps. This approach is instrumental in decarbonising high-density urban areas where traditional fossil fuel infrastructure is being phased out. Beyond technical data, SAPHEA functions as a strategic advisory body that provides standardised frameworks for risk mitigation, financial modelling, and regulatory compliance. By acting as a bridge between geological research and practical engineering, the platform supports the broader European Geothermal Action Plan, serving as a vital resource for achieving the energy security and net-zero targets established for 2025 and beyond.

Relevance for target regions and stakeholders: SAPHEA is particularly relevant for municipalities, district heating operators, urban planners, energy agencies and project developers in the target regions seeking to assess the feasibility of geothermal district heating and cooling systems. The platform provides practical tools and standardised methodologies for geothermal potential assessment, techno-economic analysis, risk mitigation and regulatory alignment, supporting informed decision-making and accelerating project development at local and regional level.

2.6. GeoDH

The GeoDH (Geothermal District Heating) platform[6] is a specialised European initiative designed to facilitate the expansion of geothermal energy within district heating networks across Europe. Originally launched through a co-funded project by the Intelligent Energy Europe programme, the platform addresses the primary regulatory, financial, and technical barriers that prevent the wider adoption of geothermal heat in urban environments. The central feature of the website is an interactive geothermal map that overlays existing district heating infrastructure with known geothermal potential, allowing users to identify areas where the integration of geothermal energy is most technically and economically viable.

[5] https://gogeothermal.eu/projects/saphea/

[6] http://geodh.eu/

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From a technical perspective, GeoDH provides a comprehensive repository of resources, including best-practice manuals, standardised contract templates, and financial modelling tools specifically tailored for geothermal heat projects. The platform also hosts the National Geothermal District Heating Roadmaps, which outline strategic development goals for individual European countries. In 2025, the initiative continues to serve as a vital database for EGEC, providing the historical and technical groundwork necessary for the current European Geothermal Action Plan. By simplifying the project development process and providing transparent geological data, GeoDH remains a foundational tool for municipalities and energy providers seeking to transition from fossil fuels to sustainable, baseload thermal energy.

Relevance for target regions and stakeholders: GeoDH is primarily relevant for municipalities, district heating utilities, public authorities and energy planners aiming to integrate geothermal energy into existing or planned district heating networks. The platform offers accessible guidance, mapping tools and best-practice resources that support early-stage project identification, strategic planning and communication with decision-makers, thereby lowering entry barriers for geothermal district heating deployment in the target regions.

2.7. CROWDTHERMAL

The CROWDTHERMAL platform[7] is an initiative designed to empower the European public to participate directly in geothermal energy projects through alternative financing and social engagement tools. Developed under the EU Horizon 2020 program, the project concluded its initial funded phase in December 2022 and transitioned into the CROWDTHERMAL Alliance to maintain its outputs as long-term consultancy and support services for 2025 and beyond. The platform operates on three primary pillars: social engagement to foster local acceptance, innovative financial modelling for crowdfunding, and technical risk mitigation to protect private and community investors.

The platform offers a suite of Core Services aimed at community investors, project developers, and local authorities. These include an interactive decision-support tool that guides users through environmental and financial risks, a comprehensive toolbox for economic modelling, and a self-learning information catalogue for geothermal professionals. To ensure its methodologies were effective in real-world settings, CROWDTHERMAL validated its frameworks through three diverse case studies: a district heating expansion in Szeged, Hungary, community-based greenhouse heating in Iceland, and shallow geothermal residential heating in Madrid, Spain.

In 2026, the initiative continues to support the European Green Deal by providing a "one-stop-shop" for community-funded geothermal inquiries, helping transform citizens from passive consumers into active co-investors in their local energy transition. By addressing the specific bottleneck of social acceptance and offering alternative capital-raising methods, CROWDTHERMAL aims to accelerate the deployment of geothermal technology across Europe's diverse socio-geographical settings.

Relevance for target regions and stakeholders: The platform is particularly relevant for municipalities, project developers and local communities seeking alternative financing mechanisms and tools to improve social acceptance and early-stage risk management of geothermal projects.

[7] https://www.crowdthermalproject.eu/

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2.8. The Geothermal District Heating Service Hubs

The Geothermal District Heating Service Hubs[8] are specialised regional centres established to provide localised technical, legal, and financial expertise for the expansion of geothermal energy across Europe. These hubs were primarily developed through EU-funded initiatives such as SAPHEA and GeoHEAT to bridge the gap between abstract geological potential and concrete infrastructure development. Strategically located in high-potential regions such as Bratislava, Kraków, and Szeged[9], these centres operate as "one-stop shops" for municipalities and energy companies seeking to replace ageing coal or gas-fired district heating networks with sustainable hydrothermal solutions.

In 2025, these service hubs focus on providing standardised risk mitigation strategies, which are essential for managing the financial uncertainty associated with the initial drilling phase of geothermal projects. They offer access to integrated geological databases that combine historical mining or petroleum data with modern thermal mapping to identify viable aquifers. Furthermore, the hubs facilitate the adoption of fifth-generation district heating and cooling (5GDHC) technologies, which allow the integration of low-temperature geothermal sources with decentralised heat pumps. By offering tailored training programs and facilitating collaboration between local authorities and international engineering firms, these service hubs play an important role in implementing the European Geothermal Action Plan and advancing the broader transition toward urban energy independence.

[8] http://user4geoenergy.net/

[9] https://innogeo.hu/en/gdhsh/

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3. Best practices in geothermal energy utilisation for heating purposes

3.1. Deep geothermal projects

3.1.1. Bad Blumau, Austria

Geothermal resources were originally discovered at depths of 1,800 to 3,200 meters during oil and gas exploration in eastern Styria. Re-evaluated in the 1970s and 80s for their balneological (medicinal) value, these resources led to the establishment of five major thermal spas, significantly boosting regional tourism, revenue, and employment.

A prime example of cascading geothermal efficiency is found in Bad Blumau. Here, the 1,200-meter-deep Blumau-3 well provides 47 °C water directly to the spa's thermal pools.

Figure 1 Geothermal energy utilisation in Bad Blumau, Austria

Source: Domberger, G., 2010, *Overview - Geothermal situation in Austria and Styria, CLUSTHERM – Final Conference - Debrecen, 16th March 2010*

Simultaneously, a production/injection doublet (Blumau-1a and Blumau-2) reaches depths of 2,300 meters to extract 110 °C water at a rate of 80 l/s. This high-temperature water powers a 250

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kWe modular binary plant. Once cooled to approximately 85 °C, the water provides 7.6 MWt of heating for the 1,000-bed Rogner Spa complex and its various pools.

A unique feature of the Bad Blumau project is the separation of dissolved gases (found at a 9:1 ratio); the extracted gas, which is 97% CO_2, is sold to the food industry to create additional value. Launched in 2001, the project was realised through €55 million in private investment, supplemented by €20 million from the Styrian government for drilling and infrastructure.

Styria has successfully leveraged this unique geology to launch the "Styrian Volcanic Region" brand. Through the Auersbach Innovation Centre, local farmers and SMEs develop premium products—such as "Volcano Ham" and "Lava Beer"—allowing small regional businesses to compete effectively across the European market.

3.1.2. Microalgae cultivation, Italy and Greece

Microalgae are already well-known in the food and pharmaceutical industries, and the possibility of using them in biofuel production has recently attracted significant interest worldwide.

For growth, algae require an optimal and constant temperature; specifically, maintaining nighttime temperatures is necessary for optimal growth. This is where geothermal energy comes into focus, as large-scale algae cultivation facilities require vast amounts of CO_2 for growth, as well as heat for the thermoregulation of the culture and the drying of biomass.

Low-temperature geothermal sources are suitable for this purpose, as is the application through cascade usage—meaning utilising the energy after another primary geothermal application.

It is essential to note that algae used in the food industry as dietary supplements, such as Spirulina and Chlorella, as well as those utilised in the pharmaceutical and cosmetic industries, represent high-value raw materials.

Enel Green Power (EGP) partnered in Tuscany, Italy, to create a pioneering project utilising geothermal energy to cultivate spirulina algae. This initiative leveraged waste heat and CO2 from nearby geothermal plants to grow the nutrient-rich algae in greenhouses, thereby creating a sustainable food source and boosting the local geothermal economy. This innovative use of geothermal byproducts for algae cultivation demonstrates direct-use applications, making algae farming more economically viable and reducing emissions by repurposing plant waste.

In the Nigrita region of northern Greece, geothermal energy is used to power large-scale Spirulina cultivation. This facility utilises low-temperature geothermal fluids to maintain a constant water temperature of 30-35°C, ensuring optimal growth regardless of the season. Additionally, naturally occurring CO_2 from the geothermal springs is captured to accelerate photosynthesis, while the heat is also used for the final drying of the biomass. This sustainable approach significantly reduces production costs and carbon emissions, resulting in high-quality Spirulina used worldwide in the pharmaceutical and health food sectors.

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Figure 2 Algae production with geothermal energy - left: Italy; right: Nigrita, Greece

Source: left - https://www.thinkgeoenergy.com/algae-cultivation-in-geothermal-energy-heated-greenhouse-italy/; right -Sanner, B., 2005, Heating and Cooling with Geothermal Energy, 6th Inter-Parliamentary Meeting on Renewable Energy and Energy Efficiency, Edinburgh, Scotland, UK, Oct. 6-8, 2005

3.1.3. Vapori di Birra, Italy

The Tuscan brewery "Vapori di Birra" in Sasso Pisano, in the province of Pisa produces its beers with geothermal energy.

Not far from the brewery is EGP's historical Sasso 2 geothermal plant, remodelled in 2009 and equipped with 20 MW of installed power. The vapor from the plant is routed toward the brewery, which uses it for all the beer production phases that require heat. The vapor gets to the brewery at about 230°C and, with a heat exchanger, is turned into water heated to 136°C and inserted in a closed circuit.

The first step in beer production involves mashing ground malt with water heated to 78°C. The product is then filtered and returned to the press, where geothermal heat brings the water to a boil. Next is the fermenter, where the beer is created, followed by rinsing, which also utilises water heated by geothermal energy. At the end of the process, the brewery "returns" the used-up vapor to EGP, who takes care of cooling it further and returning it to the subsoil, to guarantee the source's sustainability over time.

Thanks to the Earth's heat, "Vapori di birra" is producing 8 different kinds of beer, all with names somehow linked to geothermal energy: from a Weiss called Sulfurea to the red beer Magma, the special honey beer Thera, Pale ale Geysir, white Ipa Ipagea, and a local chilli pepper beer, Fiamma.

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Figure 3 Beers produced by Vapori di Birra

Source: https://www.vaporidibirra.com/en/the-beers/

3.1.4. MTU Aero Engines, Munich

In late November 2025, Aircraft engine manufacturer MTU Aero Engines announced that it had officially started operations of a geothermal heating plant that serves the heating needs of its facility in Munich, Germany. The plant now supplies up to 80% of the on-site heating demand from a geothermal doublet drilled back in 2024.

The system taps into the Malm karst, a hydrothermal system utilising a doublet of production and injection wells drilled to vertical depths exceeding 2,100 meters. The geothermal doublet taps into a reservoir with thermal waters at approximately 71°C. Heat from the thermal waters is transferred to MTU's heating network via heat exchangers, reducing the water temperature to roughly 40°C before it is reinjected into the same geological horizon. This infrastructure provides a thermal output of 10 to 14 MW, effectively covering 80% of the site's heating requirements and eliminating approximately 10,000 metric tons of CO2 emissions annually. MTU plans to further enhance the system's capacity by 2027 with an upgraded pump capable of 150 litres per second, reinforcing the facility's role as a cornerstone of its strategy to reach climate neutrality.

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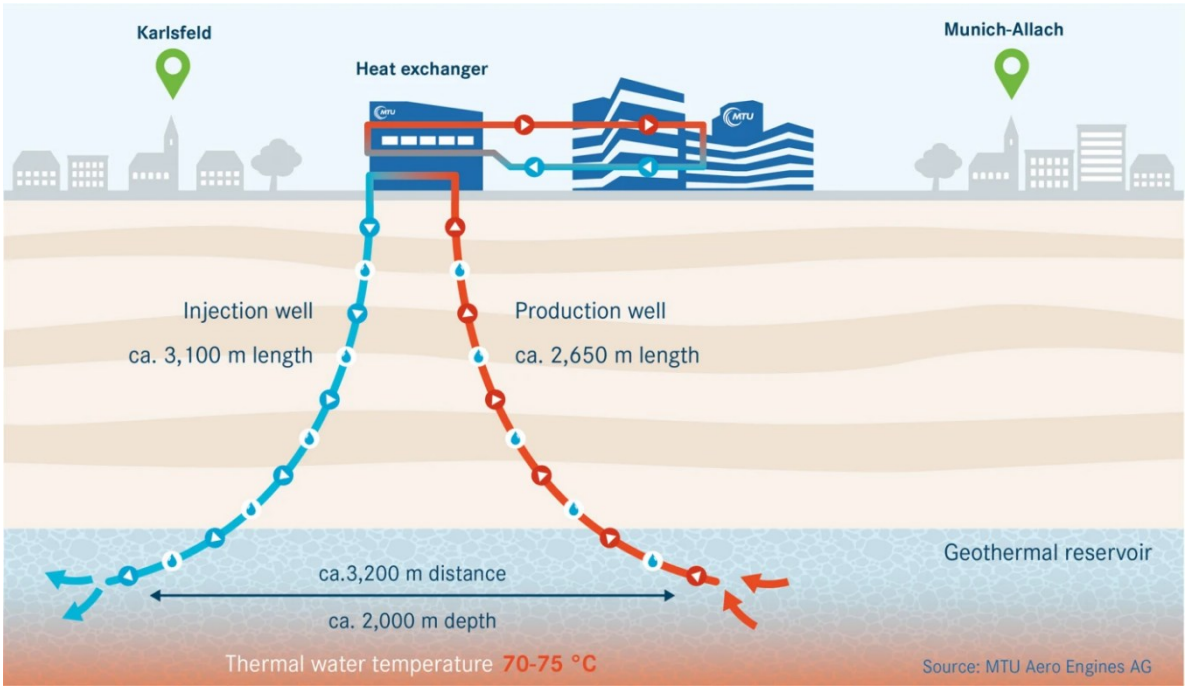

Figure 4 Geothermal system at MTU Aero Engines in Munich, Germany

Source: MTU Aero Engines AG, https://aeroreport.de/en/innovation/a-step-into-the-depths-mtu-goes-geothermal

3.1.5. Fort de L'est, France

A new geothermal heating plant has been inaugurated at the Fort de L'est site in the commune of Saint-Denis in France in late November 2025. The new heating plant has a total capacity of 18 MWth (geothermal and heat pumps) and supplies the heating demand of an equivalent of 7,500 homes.

The project comprised building 9 kilometres of heating network and drilling a geothermal doublet to 1,800 meters depth. The Fort de L'est heating plant now runs on an exemplary combination of biomass and deep geothermal energy with gas as an emergency fuel supply.

The Fort de L'est facility is now the third geothermal heating plant in Saint-Denis, after the launch of geothermal heating in Pleyel in late 2023 and another geothermal heating plant in Villetaneuse, which started operations only earlier this year. According to a recent report by the municipality, about 66% of the heating network in Saint-Denis is being supplied by renewable energies as of 2024.

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Figure 5 The exterior of the geothermal heating plant at Fort de L'est in Saint-Denis, France

Source: Laurent Monnet via LinkedIn

3.1.6. Konin, Poland

The city of Konin in Poland recently held the ceremonial start of operations of the geothermal heating plant located in Pociejewo. The Konin geothermal heating plant has an installed capacity of 8 MW but is currently operating at a capacity of 2 MW.

The plant operates on a geothermal doublet system with Konin GT-1 as the production well and Konin GT-3 as the reinjection. The wells extract thermal waters at a temperature of about 90 °C from a depth of around 2600 meters.

Seismic surveys are planned in early 2026 to help identify a location for the drilling of the GT-4 well. There are ambitious plans for further geothermal applications in Konin, including thermal pools and heating for a future housing project.

3.1.7. Lego Factory, Hungary

The LEGO Group has an ambition to reduce its reliance on fossil gas and to reduce absolute carbon emissions by 37% by 2032, compared to 2019 levels. To support this goal, the company has been exploring the use of geothermal energy to heat the factory in Nyíregyháza, aiming to stop the use of natural gas in its heating systems by 2028.

Over the past two years, two wells have been drilled and a potential source of heat found more than two kilometres under the surface. In the next two years, the infrastructure and technology needed to circulate hot water through the factory will be installed. The closed system, where

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extracted water will be pumped back into the ground towards the initial extraction location, is scheduled to be fully functional by 2028.

The geothermal heating project at the LEGO manufacturing facility in Nyíregyháza, Hungary, constitutes a large-scale industrial decarbonization initiative designed to eliminate the site's reliance on fossil fuels for thermal energy. Formally inaugurated in late 2025 following an extensive exploratory phase, two wells exceeding 2,000 meters were drilled tapping into aquifers providing thermal water at approximately 84°C. The well will be used as a production/injection doublet securing the hydraulic balance of the reservoir, thus ensuring the long-term sustainability of the resource. The system will utilise geothermal water circulated through the factory's internal heating infrastructure via high-efficiency heat exchangers.

From an operational perspective, the system is engineered to satisfy the total heating demand of the 232,000 m^2 complex, which includes specialised production areas for moulding and packaging. This transition is a primary component of the facility's strategy to achieve carbon neutrality by 2028, with the geothermal output projected to offset 100% of the natural gas consumption, now required for space heating and industrial processes.

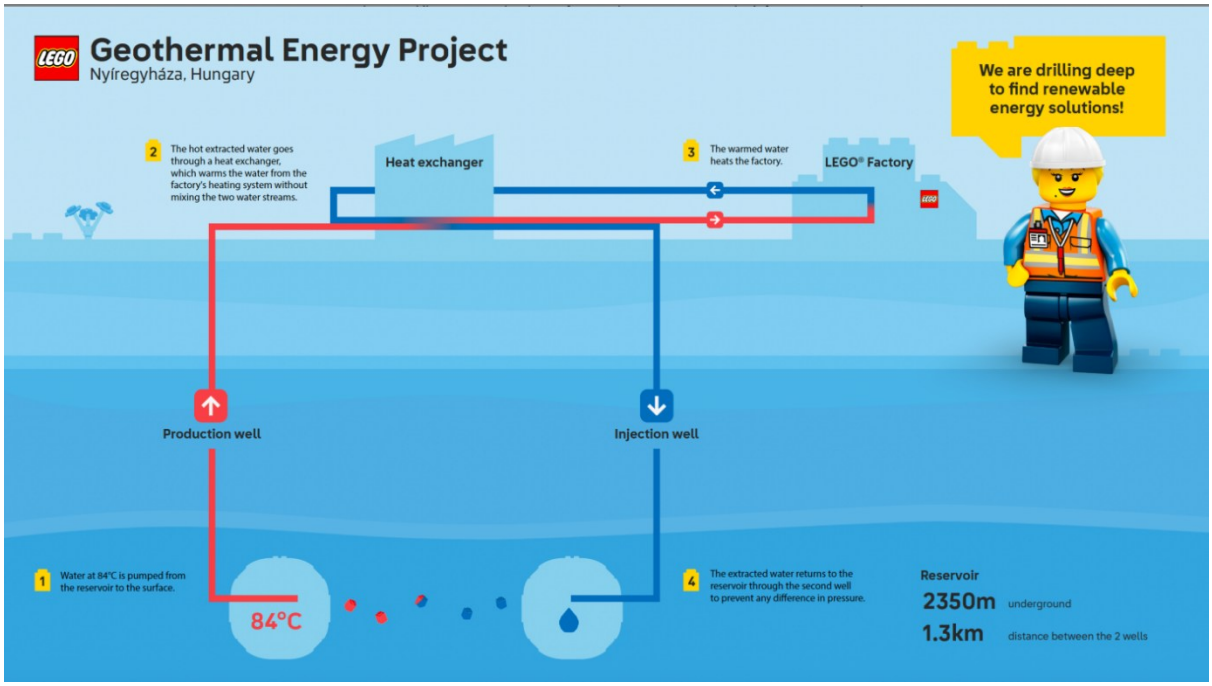

Figure 6 Geothermal system at the LEGO manufacturing facility in Nyíregyháza, Hungary

Source: https://www.lego.com/en-us/aboutus/news/2025/september/the-lego-group-officially-inaugurates-production-capacity-expansion-at-its-hungary-factory

3.1.8. Liszt Ferenc International Airport, Hungary

The geothermal heating project at Liszt Ferenc International Airport in Budapest represents a critical infrastructure initiative aimed at achieving full thermal energy independence for the facility by 2030. Officially commenced in May 2025, the project involves the drilling of exploratory wells to tap into the substantial geothermal reservoirs underlying the Hungarian capital. The

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development is managed by Arctic Green Terv Ltd. and executed by the state-owned drilling company Rotaqua Kft. under a modernised regulatory framework designed to accelerate geothermal utilisation across Hungary.

The system is engineered to replace the airport's existing natural gas-based heating network with a sustainable hydrothermal solution, which is projected to reduce direct carbon dioxide emissions from airport operations by more than 90%. By sourcing heat locally and bypassing global energy market volatility, the installation enhances the airport's operational security and supports the broader national strategy to replace one billion cubic meters of natural gas with geothermal energy by 2035. This infrastructure is a foundational element of Budapest Airport's roadmap to attain Net Zero emissions.

3.1.9. Geothermal district heating project in Szeged, Hungary

The geothermal district heating project in Szeged, Hungary, represents the largest geothermal residential heating renovation in the European Union and the second largest in Europe after Reykjavik. Managed by the municipal district heating company SZETÁV, the system underwent a major expansion completed by late 2024 and early 2025 to transition the city from a total reliance on imported natural gas toward locally sourced renewable energy. The infrastructure consists of a decentralised network of 27 wells—comprising 9 production wells and 18 reinjection wells—drilled to depths of approximately 1,700 to 2,000 meters into the Upper Pannonian thermal reservoir.

Technically, the production wells extract thermal water at temperatures ranging from 90°C to 94°C, which is then circulated through titanium heat exchangers to provide thermal energy to the city's 23 heating districts. This configuration ensures that the geothermal fluid remains in a closed loop and is reinjected into the ground to maintain reservoir pressure, while the secondary heating circuit distributes warmth to over 28,000 households and 400 public buildings via 250 km of pipeline. In late 2025, the project was further enhanced by a specialised initiative to capture and utilise methane gas from the thermal water, providing additional energy while preventing greenhouse gas emissions.

From an environmental and economic perspective, the system has successfully displaced approximately 20 million cubic meters of natural gas annually, resulting in a 60% reduction in air pollution and an annual decrease of roughly 35,000 to 39,000 tons of CO_2 emissions. By providing 50% of the city's total heating demand from geothermal sources, the project serves as a strategic blueprint for urban decarbonization and energy independence across Central and Eastern Europe.

3.2. Shallow geothermal energy

3.2.1. Wine cellar of Orschwiller-Kintzheim, France

In the **wine industry**, geothermal energy is also used to maintain temperatures during the winemaking process. The graph on the right displays a scheme of energy consumption by process in wine production.

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In France, the wine cellar of Orschwiller-Kintzheim has begun to utilise geothermal energy. Founded in 1957, the winery wanted to maintain its traditional way of making wine. However, they also wanted to reduce their energy costs as well as their carbon footprint.

WEYH SAS, a company specialising in geothermal installations, developed an innovative process that achieves an annual Coefficient of Performance (COP) of 8. This result doubles the savings compared to a heat pump system and triples them compared to a traditional system (gas, oil, or electricity).

This new technology, called "BROTS" (patented with the INPI), is based on new hydraulic principles coupled with Vertical Geothermal Probes. Heat pumps connected to the vertical geothermal probes and specific buffer tanks allow for the storage, distribution, and optimisation of all fluids, as well as monitoring of the installation via the internet. Two reversible HPs are designed for operation with a cold source between 15°C and 25°C and are capable of delivering 110 kW of heating and 90 kW of cooling, with a COP ranging from 7 to 10 at 45°C. A patented hydraulic system (BROTS) and process management enable the simultaneous and direct production of heating and/or cooling in a heat pump/refrigerator system.

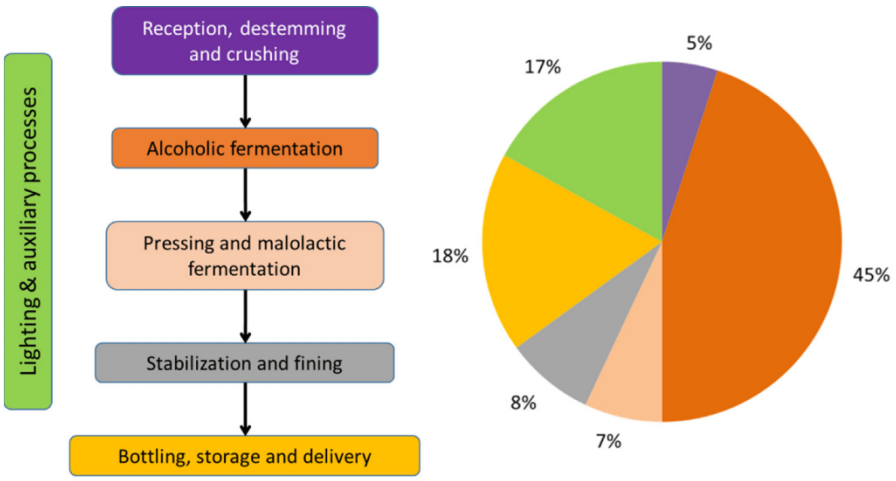

Figure 7 A simple schematic of winemaking processes and the energy consumption distribution

Source: Alimonti, Claudio & Pecci, Gabriele. (2021). Back Analysis of a Horizontal Geothermal Plant Implemented in a Wine Production Process. Sustainability. 14. 157. 10.3390/su14010157.

3.2.2. Communal geothermal heating system in Randalstown, Northern Ireland

The communal geothermal heating system in Randalstown, County Antrim, serves as a premier model for sustainable social housing infrastructure within the United Kingdom[10]. Managed by the Rural Housing Association and engineered by Daly Renewables, the installation provides carbon-neutral heating and hot water to a nine-apartment residential complex. The system's primary

[10] *https://b4brenewables.com/communal-geothermal-heating-system-in-randalstown/*

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thermal source consists of six 140-m-deep vertical boreholes drilled into the local Sherwood sandstone, which provide a consistent year-round temperature for energy extraction.

The heat is processed through two 22kW Ecoforest ground source heat pumps located in a centralised plant room and delivered to individual units via high-efficiency underfloor heating and mechanical heat recovery ventilation (MHRV). From a technical performance perspective, the system maintains a Coefficient of Performance (COP) of 4.8, indicating that it generates nearly five units of heat for every unit of electricity consumed. This high level of efficiency has resulted in significant economic benefits for residents, reducing weekly energy costs by over 50% while contributing to Northern Ireland's broader net-zero carbon objectives for the built environment.

3.2.3. Recinte Modernista de Sant Pau, Barcelona

The geothermal infrastructure at the Recinte Modernista de Sant Pau in Barcelona stands as a premier example of large-scale shallow geothermal integration within a UNESCO World Heritage site. Developed during the complex's 2009–2016 rehabilitation, the system was engineered to provide sustainable climate control while preserving the architectural integrity of the historic pavilions by eliminating the need for external HVAC equipment. The primary energy source is a closed-loop subsurface heat exchanger consisting of 360 vertical boreholes drilled to a depth of 120 meters, which utilises stable ground temperatures to facilitate high-efficiency thermal transfer.

This captured energy is processed through a centralised network of geothermal heat pumps that distribute heating and cooling via underfloor systems and mechanical ventilation. From a performance standpoint, the installation achieves a remarkable Coefficient of Performance (COP) of 5.58 and an energy efficiency ratio of 5.6, representing an efficiency gain of approximately 300% to 500% over conventional air-source alternatives. These technical specifications result in an annual reduction of 486 tons of CO_2 emissions and a minimum 30% decrease in electricity consumption.

3.2.4. Mechelen, Belgium

The communal geothermal infrastructure in represents a sophisticated application of renewable energy designed to decarbonise entire urban districts. The MALT project utilises a closed-loop network featuring 90 boreholes drilled to depths of 150 meters, totalling approximately 11.7 km of piping that circulates a water-glycol mixture to extract or store thermal energy in the soil.

Technically, these installations often function as part of a 5th-generation heat network, frequently combining geothermal energy with other local sources like riothermal energy (heat recovered from sewage systems) or aquathermal energy from the Canal Leuven-Dyle. By utilising the ground as an underground "heat battery," the systems provide 100% green heat in winter and passive cooling in summer, which recharges the soil's thermal reservoir for the following season. This infrastructure is a cornerstone of Mechelen's strategy to achieve climate neutrality by 2050, serving as a scalable template for residential and commercial developments that eliminates reliance on fossil fuels for climate control.

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3.2.5. IKEA, Ireland

The geothermal installation at the IKEA Ballymun store in Dublin represents one of the largest and most established closed-loop geothermal systems in Ireland and Europe. Integrated into the 30,600-square-meter facility since its opening, the infrastructure was designed to meet a planning mandate for high renewable energy use, ultimately delivering 65% annual carbon savings—a reduction comparable to taking approximately 300 homes off the grid.

The technical core of the project consists of 150 to 158 boreholes. Most reports confirm these are drilled to a depth of 120 meters beneath the store's car park, creating a total drilling network of approximately 18,000 meters. This subterranean circuit feeds three high-capacity geothermal heat pumps in the central plant room with a total thermal capacity of 1.5 to 2.0 MWth. This capacity allows the system to manage 100% of the building's space heating and cooling loads without relying on traditional fossil fuel boilers.

Operating as a part of a wider fossil-free ecosystem, the geothermal system is complemented by a 650 kW biomass boiler and intelligent building management systems to ensure maximum efficiency.

3.2.6. The Melina Orosa Hospital, Canary Islands

The Melina Orosa Hospital (El Hospital Molina Orosa) in Lanzarote in the Canary Islands has launched a 1002-kW geothermal facility that provides air conditioning, heating, and domestic hot water to the facility. It supplies the hospital with approximately 2.7 GWh of thermal energy annually – roughly 1.87 GWh for heating, 0.58 GWh for cooling, and 0.22 GWh for domestic hot water. The installation multiplies by more than a factor of 5 the energy obtained compared to the electricity consumed, making it a very efficient heating and cooling solution and displacing substantial emissions related to the use of fossil fuels.

The project was built in two phases. The first phase consisted of drilling four wells equipped with pumps located sixty meters deep, capable of recirculating flows of up to 230 cubic meters of water per hour. The second phase involved upgrading the thermal installation, which includes two high-efficiency heat pumps to utilise this geothermal energy in the air conditioning, heating, and domestic hot water systems.

A total of EUR 1.23 million was invested for the project, about EUR 651,000 of which was co-financed by the Regional Ministry of Ecological Transition and Energy through a grant program announced in 2022 for renewable thermal energy installations across various sectors of the economy. The SCS then contributed around EUR 582,000 to realize the project.

With the commissioning of this plant, the Molina Orosa Hospital has made significant progress towards improving the building's energy rating and positioning itself as one of the pioneering hospitals in Spain in the field of geothermal energy utilization. The SCS also describes the project as a full replicable installation that can be deployed in other hospitals in the Canary Islands.

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4. Funding opportunities to foster geothermal project development

The European Union provides several major funding instruments to support geothermal energy, ranging from research and innovation to industrial-scale deployment.

1. Horizon Europe (Research & Innovation)

Horizon Europe funds earlier-stage R&D and pilot projects through the "Cluster 5: Climate, Energy and Mobility" work program.

2. Innovation Fund (Industrial & Commercial Scale)

The Innovation Fund is the primary tool for deploying innovative low-carbon technologies at a commercial scale.

3. LIFE Program (Market Uptake & Environment)

The LIFE Program supports the transition to clean energy, primarily through its "Clean Energy Transition" (CET) sub-programme. It funds "market uptake" activities such as policy support, capacity building, and removing regulatory barriers rather than large infrastructure.

4. Financing & Structural Funds

- **European Investment Bank** (EIB) provides large-scale loans and financial instruments for geothermal infrastructure.
- **Cohesion Policy Funds** -Programs like the European Regional Development Fund (ERDF) often provide regional grants for geothermal district heating projects, particularly in countries with significant potential, such as Croatia or Germany.
- **Modernisation Fund**: Available to 13 lower-income EU Member States to support the modernisation of energy systems, including geothermal investments.

4.1. Horizon Europe 2026 Cluster 5 Call 11-2026

HORIZON-CL5-2026-11-D3-06: **Resource assessment for deep sedimentary and basement reservoirs**

Budget: €18.00 M, €4.50 M per project

TRL 4-5

Opening: 04 Aug 2026 - Deadline: 01 Dec 2026

Expected Outcome:

- Major exploration challenges relate to predicting deep sedimentary and basement reservoir structures and properties to identify suitable locations for reservoir-independent

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approaches, capable of overcoming the low permeability obstacle, such as Enhanced Geothermal Systems (EGS) or closed-loop geothermal systems.

- Increased knowledge base for developers to unlock unexploited geothermal resources, increase drilling success rate, increase geothermal sources' performance and reduce the risk of induced seismicity and deploy geothermal energy in a sustainable way in environmental (notably on biodiversity and pollution) and socioeconomic terms.
- Citizens and local communities are engaged and benefit from local, more secure and affordable renewable energy sources.

Scope:

- Advanced methods, technologies and conceptual models, for different geological settings, to identify suitable conditions for geothermal resource exploitation.
- Contribute to the assessment of environmental and social impacts and to unlock geothermal resources marked by low natural permeability at depths between 2000-6000m.
- Cover advances beyond the state of the art in equipment, methods and models; take into account the impact of reservoir conditions and parameters on the development and performance of the geothermal resources

HORIZON-CL5-2026-11-D3-07: **European Union Contest on Lithium production from geothermal plants in Europe**

The Contest is expected to be launched in Q1 2027.

Winners to be selected in Q4 2031.

The Contest reward will be distributed as follows:

- 1st winner: €3 M
- 2nd winner: €1 M
- 3rd winner: €0.5 M

Expected Outcome:

- Facilitate the wider uptake of geothermal energy systems (RES) in the energy, industrial and residential sectors, leading to an increased share of renewable energy in the final energy consumption by 2030 and beyond.
- Contribute to the development of a new renewable-based energy system and industries.
- Establishing a solid long-term dependable European innovation industrial base for renewable energy technologies.

Scope:

- Support the European Union Contest for the most efficient and innovative on-site demonstration of lithium production (lithium carbonate – Li_2CO_3 or lithium hydroxide – LiOH) from geothermal brines in a geothermal plant subject to meeting the eligibility requirements outlined below.

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- Contest competition is expected to stimulate progress in the field by advancing DLE technologies, and to commence and increase the amount of lithium produced in Europe's geothermal plants

HORIZON-CL5-2026-03-D3-01: **Targeting key value chain components for increasing the competitiveness of renewable energy technologies in Europe**

Budget: €9.00 M, €3.00 M per project

TRL 4-5

Opening: 18 Dec 2025; Deadline: 31 Mar 2026

Relevance for geothermal: geothermal as made-in-EU technology and local value chain

Expected Outcome:

- Strengthen European autonomy, research capacity and industrial leadership
- Develop technical and value chain solutions, improving the competitiveness

Scope:

- Addresses specifically critical aspects affecting the competitiveness of specific renewable energy technologies and their value chains

HORIZON-CL5-2026-04-Two-Stage-D3-02: **Next generation of renewable energy technologies**

Budget: €23.50 M, €4.00 M per project

TRL 4-5

Opening: 18 Dec 2025 Deadline(s): 31 Mar 2026 (First Stage), 20 Oct 2026 (Second Stage)

Relevance for geothermal: EGS, ultra deep geothermal, storage technologies

Expected Outcome:

- Breakthrough and game-changing renewable energy technologies enabling a faster transition
- Establishing a solid long-term dependable European innovation base.

Scope:

- High-risk and high-return technology developments

HORIZON-CL5-2026-03-D3-22: **Novel solutions for off-grid storage of renewable energy for critical infrastructures**

Budget: €12.00 M, €4.00 M per project

TRL 4-5

Opening: 18 Dec 2025; Deadline: 31 Mar 2026

Relevance for geothermal: thermal storage (UTES, ATES, BTES, etc.)

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Expected Outcome:

- Improved energy security and cost-effectiveness of Europe's energy systems
- Elimination of fossil-based backup solutions for critical infrastructures

Scope:

- Develop novel, cost-efficient off-grid energy storage solutions for renewable energy, tailored for critical infrastructures

HORIZON-CL5-2027-05-D4-06: **Thermal energy optimisation and waste heat recovery of high energy demand IT rooms in buildings or small edge data centres**

Budget: €15.75 M, €5.25 M per project

TRL 6-7

Opening: 05 May 2027 Deadline(s): 15 Sep 2027

Relevance for geothermal: geothermal cooling for data centres

Expected Outcome:

- Improved open access to performance data, sharing of best practices and useful knowledge and information for owners and operators of IT infrastructure, as well as the IT and building sectors

Scope:

- Address the energy and resource consumption over the full ICT value chain

HORIZON-CL5-2026-09-D4-08: **Full-scale demonstration of heat upgrade solutions in industrial processes**

Budget: €18.00 M, 9.00 M per project

TRL 7-8

Opening: 05 May 2026; Deadline: 15 Sep 2026

Relevance for geothermal: geothermal energy for industry

Expected Outcome:

- Industrial sector with a significant heating demand in the EU and Associated Countries develops pathways and business models; possible combination with thermal energy storage

Scope:

- Satisfy the need for process heat in the more industrial sectors

HORIZON-CL5-2026-09-D4-04: **Validating policies and business models for affordable and sustainable housing (Built4People Partnership)**

Budget: €15 M, €5.00 M per project

Funded by the European Union

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TRL 4-5

Opening: 05 May 2026; Deadline: 15 September 2026

Relevance for geothermal: geothermal heat pumps are clean and affordable

Expected Outcome:

- Better understanding of the factors and interdependencies influencing levels of renovation of rental properties in the affordable housing sector
- An increased number of policymakers revise policies, regulations, instruments and business models to increase the rate of renovation of rental properties in the affordable housing sector.

Scope:

- Research the effectiveness and implications of existing policies at different levels of governance
- Validate a methodology for comparing the affordability of different types of rented properties
- Design and validate new or improved solutions for affordability while meeting decarbonization targets

4.2. Innovation Fund

The Innovation Fund is one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies. It will provide around €40 billion of support over 2020-2030, thanks to the carbon price, for the commercial demonstration of innovative low-carbon technologies. Annual calls will be announced for large-scale, medium-scale, and small-scale projects.

The Innovation Fund awards grants through calls for proposals and competitive bidding procedures (auctions). The Fund aims to finance a varied project pipeline, achieving an optimal balance of a wide range of innovative technologies in all eligible sectors (energy-intensive industries, renewable energy, energy storage, carbon capture, use and storage, and net-zero mobility and buildings) in EU Member States, Iceland, Norway, and Liechtenstein.

At the same time, the projects need to be sufficiently mature in terms of planning, business model, and financial and legal structure.

Projects will be selected based on:

- effectiveness of greenhouse gas emissions avoidance
- degree of innovation
- project maturity
- scalability
- cost efficiency

Funding will be available for:

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1. General decarbonisation (large-scale) - for projects with CAPEX (capital expenditure) above EUR 100 million
2. General decarbonisation (medium-scale) - projects with CAPEX between EUR 20 million and EUR 100 million
3. General decarbonisation (small-scale) - projects with CAPEX between EUR 2.5 million and EUR 20 million
4. Cleantech manufacturing - projects with CAPEX above EUR 2.5 million focusing on component manufacturing for renewable energy, energy storage, heat pumps and hydrogen production
5. Pilot - EUR 200 million available for projects with CAPEX above EUR 2.5 million focusing on deep decarbonisation (i.e., technologies that can reduce relative GHG emissions by at least 75% compared to the reference scenario).

The Innovation Fund supports up to 60% of the relevant costs calculated according to the methodology indicated in each call for proposals.

The grants are being disbursed in a flexible way based on project financing needs, considering the milestones achieved during the project lifetime.

For regular grants, up to 40% of the grant can be given based on pre-defined milestones before the whole project is fully up and running.

IF25 Net-Zero Technologies Call (IF25 NZT Call)

A general grant call launched in late 2025. It supports large, medium, and small-scale projects focused on net-zero manufacturing and deployment, including geothermal components.

Budget: €2.9 billion

Deadline: Applications are open until April 23, 2026

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Topic	Capital Expenditure	Topic budget	Activities that can be funded
Large-scale projects	above €100 million	€1 200 million	In sectors listed in Annex I and Annex III to the EU ETS Directive 2003/87[11], including CCU and the development of substitute products
Medium-scale projects	between €20 million and €100 million	€300 million	Carbon Capture and Storage (CCS)
Small-scale projects	between €2.5 million and €20 million	€100 million	Innovative renewable energy and energy storage technologies
Clean-tech manufacturing for components*	above €2.5 million	€1 000 million	Construction and operation of manufacturing facilities to produce components for: Renewable energy, Electrolysers and fuel cells, Energy storage solutions, Heat pumps
Pilot projects	above €2.5 million	€300 million	Validating, testing and optimising highly innovative, deep decarbonisation solutions in all sectors eligible for Innovation Fund support

* Components also include final equipment such as wind turbines, solar panels, batteries, heat pumps and electrolysers

Table 1 Topics, budget and funded activities of the IF25 NZT Call

Carbon capture and utilisation (CCU) can be funded if the captured CO2 is from activities in Annex I of the EU ETS Directive, or if the utilisation of CO2 results in products substituting carbon-intensive ones from the sectors listed in Annex I of the EU ETS Directive

4.3. LIFE

The new LIFE programme 2021-2027 is divided into four sub-programmes:

- Nature and biodiversity
- Circular economy and quality of life
- Climate change mitigation and adaptation
- Clean energy transition

Climate change mitigation and adaptation and Clean energy transition programmes' deadlines were 23 September 2025.

[11] *Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC (Text with EEA relevance)* https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32003L0087

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New calls are expected to open in spring 2026.

More information can be found at: https://cinea.ec.europa.eu/programmes/life_en.

4.4. Financing and Structural Funds

4.4.1. European Investment Bank (EIB)

The European Investment Bank (EIB) serves as the "EU Climate Bank," providing substantial long-term financing for geothermal infrastructure through several specialised mechanisms. For 2026, the EIB has an estimated funding program of €60 billion, with a strong focus on energy security and the green transition. The European Commission is expected to publish a European Geothermal Action Plan in Q1 2026. This plan is anticipated to further align EIB lending with geothermal-specific needs, such as dedicated risk-sharing instruments for drilling. Additionally, the EIB is doubling its climate adaptation financing to €30 billion for the 2026–2030 period, which may benefit geothermal storage and resilient energy infrastructure.

Key Financing Mechanisms include:

- Direct Loans: Targeted at large-scale projects, typically starting at €25 million. The EIB usually covers up to 50% of total project costs.
- REPowerEU+ Initiative: Part of a €45 billion dedicated package (running until 2027) specifically aimed at ending reliance on fossil fuels. Geothermal projects that provide "firm" (24/7) clean energy are a priority under this framework.
- InvestEU Guarantee: Provides a budget guarantee to lower financial risk for "first-of-a-kind" or innovative geothermal projects, such as the Eavor-Loop technology in Germany, which received a €45 million EIB loan backed by InvestEU.
- Intermediated Loans: For smaller projects (under €25 million), the EIB provides funds to local commercial banks, which then lend to project developers.

Eligibility and Priorities focus on:

- Net Emission Reductions: Projects must demonstrate significant greenhouse gas savings compared to the local grid factor over a 30-year lifetime.
- Sector Focus: The EIB prioritises district heating networks, power generation, and innovative "next-generation" geothermal technologies (e.g., closed-loop or enhanced geothermal systems).
- Cohesion Regions: About 50% of EIB lending is directed toward "cohesion regions" (areas with lower per capita income), making geothermal projects in Eastern and Southern Europe particularly competitive for funding.

4.4.2. Cohesion Policy Funds -Programs

EU Cohesion Policy Funds, with a total budget of over €392 billion for 2021-2027, are a key source of funding for geothermal projects across Europe, particularly in less-developed regions. These

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funds are managed jointly by the European Commission and national/regional authorities, who select projects based on their own operational programs.

Key Funds and Programs are:

- European Regional Development Fund (ERDF): Supports investments across all five policy objectives, with a strong focus on a "Greener, carbon-free Europe". A significant portion of the total budget for 2021-2027 is dedicated to climate action and renewable energy, including geothermal energy.
- Cohesion Fund**:** Targets Member States with a gross national income per capita below 90% of the EU average (including Croatia, Greece, Poland, Hungary, etc.). It specifically supports investments in the environment and energy efficiency, including renewable energy sources and related storage.
- Just Transition Fund (JTF): A component of the Cohesion Policy, the JTF helps regions most affected by the transition to climate neutrality (e.g., former coal regions). Geothermal projects can be funded to help diversify local economies and retrain workers in these areas.

Unlike central EU programs, these funds are managed locally. Member State administrations define their specific "Operational Programmes" and select which projects to finance.

Within the 2021-2027 period, a substantial amount (around €14.4 billion) is allocated specifically for renewable energy (especially solar and geothermal) and storage within the non-transport infrastructure category.

Countries with high geothermal potential and lower gross national income often integrate geothermal development into their national strategies. To access these opportunities, developers must apply to the relevant national or regional managing authorities within each Member State, which publish specific calls for proposals. Information on particular programs and application processes can be found on the European Commission Cohesion Portal.

4.4.3. Modernisation Fund

The Modernisation Fund is available to 13 lower-income EU Member States (Bulgaria, Croatia, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, and Slovenia) to support the modernisation of energy systems, including geothermal investments. The fund has disbursed over €20.7 billion since 2021, with projected revenues reaching €57 billion by 2030.

For 2026, it remains a critical source of capital for geothermal energy, particularly for district heating and industrial modernisation.

Member States must submit investment proposals by January 15, 2026 (non-priority) and February 12, 2026 (priority).

Geothermal projects are typically considered "Priority Investments" and can receive up to 100% funding of eligible costs. This includes support for geothermal power and heat generation, modernising energy networks like district heating utilising geothermal heat, and industrial decarbonization projects replacing fossil fuels with geothermal.

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Applications are made through National Contact Points in beneficiary countries, not directly to the European Commission. The European Investment Bank (EIB) assesses proposals before the Commission makes disbursement decisions.

More information is available at https://www.modernisationfund.eu/.

4.5. EEA/Norway grants 2021–2028

The EEA and Norway grants provide funding to 15 EU member states (Bulgaria, Poland, Croatia, Estonia, Greece, Hungary, Lithuania, Latvia, Malta, Portugal, Romania, Cyprus, Czechia, Slovakia, Slovenia) to reduce social and economic disparities across Europe and to strengthen bilateral relations.

The EEA and Norway Grants 2021–2028 build on the successes of the 2014–2021 period and will promote the following three thematic priorities:

- European green transition
- Democracy, rule of law and human rights
- Social inclusion and resilience

The Green Transition programme area supports the transition towards climate neutrality in 2050 through the implementation of the EU's Green Deal and its legal obligations. Further efforts are needed to ensure access to affordable, reliable and clean energy. Energy use must become more efficient, and it is crucial to secure a more sustainable supply of raw materials to scale up clean technologies.

Areas of support include:

- Clean energy transition
- Air, water, and soil pollution
- Energy security
- Energy poverty
- Sustainable and smart mobility
- Circular economy
- Industrial carbon management
- Natural sinks for absorbing carbon
- Climate change adaptation
- Biodiversity and ecosystems
- Green governance

The new calls for project proposals are expected to be published in the second half of 2026. More information is available at https://eeagrants.org/en/fmo.

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5. Business tools in geothermal project developments

Geothermal project development is supported by a robust ecosystem of digital and financial tools designed to de-risk high upfront capital expenditures and streamline complex planning phases.

5.1. Financial and Techno-Economic Modelling

These tools are essential for securing EU funding by demonstrating long-term viability and managing cash flow gaps.

- **GEOPHIRES[12]:** An open-source, Python-based simulator that performs techno-economic simulations to estimate capital and O&M costs, as well as the levelized cost of heat or electricity.
- **SAM (System Advisor Model):** Now integrated with the latest **GETEM** (Geothermal Electricity Technology Evaluation Model)[13], this tool enables site-based estimation of performance and potential revenue.
- **Geothermal Financial Model Templates[14]:** Professional Excel/Google Sheets tools designed for 2026, featuring five-year projections, EBITDA forecasting, and stress-testing for variable electricity prices or drilling cost overruns.
- **REopt & URBANopt[15]:** Specialised for district-scale analysis, these modules help design networked geothermal heat pump systems with integrated life-cycle cost analysis.

5.2. Risk Assessment and Decision Support

Given that exploration and first drilling are high-risk, dedicated tools help bridge the "bankability" gap.

- **GEORISK Tool[16]:** An online register and assessment tool that lists plausible risks and corresponding de-risking measures, helping developers establish insurance schemes according to best practices.

[12] https://github.com/NREL/GEOPHIRES-X

[13] https://sam.nrel.gov/geothermal.html

[14] https://www.efinancialmodels.com/downloads/geothermal-energy-feasibility-model-template-253665/

[15] https://docs.urbanopt.net/workflows/reopt/reopt.html

[16] https://www.georisk-project.eu/georisk-tool/

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- **CROWDTHERMAL Toolbox[17]:** A specific set of services for developers that includes a Decision Support Tool and an Interactive Guide to Integrated Finance, focusing on risk mitigation and alternative financing schemes like community-based crowdfunding.

5.3. Resource Exploration and Digital Twins

New digital workflows reduce project development time by quantifying geological uncertainties.

- **Digital Twins:** Projects like **GEOFLEXheat** utilise real-time management and digital twins to optimise plant performance and model stable heat supply. The project will run until September 2027. It is designed to revolutionise the industrial application of geothermal heat by integrating hardware innovations with advanced digital management.
- **Geothermal Radar[18]:** Provides interactive global maps and subsurface datasets paired with techno-economic modelling tools for EGS and closed-loop simulations.
- **AI-Powered Platforms:** Startups like **TerraNexum[19]** use AI optimisation (Quantum Geospatial Organiser) to identify market opportunities, while **Umny[20]** offers data prediction models to reduce the cost of physical drill tests.
- **SEEBASE® (**Structurally Enhanced view of Economic BASEment)**[21]:** A specialized structural framework and depth-to-basement model used to evaluate geothermal potential at regional and basin scales. Originally developed by **Frogtech Geoscience** (now Geognostics), it serves as a foundation for understanding the "bottom-up" heat flow of a region.

5.4. Regulatory and Data Repositories

- **RAPID Toolkit[22]:** A regulatory and permitting information desktop that helps users navigate the complex legal requirements for securing project approvals.
- **EGRISE[23] (European Geothermal Research & Innovation Search Engine):** A central portal providing access to over 10,000 geothermal publications and tools to inform technical documentation.

[17] https://www.crowdthermalproject.eu/toolbox-for-risk-evaluation-and-mitigation/

[18] https://www.geothermalradar.com/

[19] https://www.terranexum.com/

[20] https://umny.ca/

[21] https://www.geognostics.com/about-seebase

[22] https://openei.org/wiki/RAPID

[23] https://www.openaire.eu/egrise-2-0-a-new-gateway-connecting-the-geothermal-community

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6. Market opportunities to promote European green transition

Geothermal energy occupies a distinctive and increasingly strategic position within the European green transition. Unlike variable renewable energy sources, geothermal energy provides a stable, dispatchable supply of energy that can operate continuously and independently of weather conditions. Its most significant contribution in the European context lies not in electricity generation but in the decarbonisation of heating and cooling, which together account for approximately half of total energy demand in the European Union. As such, geothermal energy directly addresses one of the most challenging and least electrified segments of the energy system.

From a technological perspective, geothermal energy encompasses a broad spectrum of applications, ranging from shallow geothermal systems, such as ground-source heat pumps used in residential and commercial buildings, to deep geothermal installations capable of supplying district heating networks, industrial heat, and, in some cases, electricity. Cascade utilization presents more efficient and economically viable use of geothermal energy. It refers to the sequential use of geothermal heat in multiple applications, starting from those that require the highest temperatures and gradually moving toward processes that can operate at lower temperature levels.

Increasingly, geothermal systems are being integrated into hybrid configurations that combine geothermal resources with heat pumps, waste heat recovery, and thermal storage. These integrated solutions enhance system efficiency and flexibility while reinforcing geothermal's role as a foundational element of local and regional energy systems.

Within this domain, a number of niche market opportunities are emerging that offer high potential for innovation, regional value creation, and accelerated deployment. One of the most prominent niches is the decarbonisation of urban and regional heating systems, particularly in medium-density cities where district heating networks already exist or can be feasibly developed. In such contexts, geothermal energy can function as a reliable baseload heat source, replacing fossil fuels while being complemented by peak-load solutions such as large-scale heat pumps or other renewable sources. This model is particularly relevant in countries with established district heating traditions, including France, Germany, the Netherlands, Poland, and the Nordic states.

Another rapidly growing niche lies in the provision of renewable heat for industrial processes. A significant share of European industry relies on low- and medium-temperature heat, for which renewable alternatives remain limited. Geothermal energy offers a viable and cost-stable solution for sectors such as food and beverage production, paper and pulp manufacturing, chemical processing, and textiles. The integration of geothermal heat into industrial clusters and parks represents a particularly promising pathway, as it enables shared infrastructure, economies of scale, and synergies with broader industrial decarbonisation strategies.

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Beyond urban and industrial applications, geothermal energy also presents important opportunities in agriculture, aquaculture, and food systems. The use of geothermal heat for greenhouses, aquaculture facilities, and food drying or processing has already demonstrated economic and environmental benefits in several European regions, particularly in Southern and Eastern Europe. These applications are especially relevant for rural and peripheral regions seeking to diversify their economies while contributing to climate objectives, thereby reinforcing links between the green transition and territorial cohesion.

Cooling represents another underexplored yet increasingly important niche for geothermal energy. As climate change drives rising cooling demand, particularly in Southern Europe, geothermal-based district cooling and passive cooling solutions offer a low-emission alternative to conventional air conditioning systems. These applications are especially relevant for energy-intensive buildings such as hospitals, data centres, airports, and dense urban developments, where cooling demand is both continuous and critical.

In parallel with these application-driven niches, a growing market is emerging for knowledge-intensive services related to geothermal development. Subsurface data analysis, geological modelling, reservoir simulation, risk assessment, and digital monitoring systems are becoming central components of geothermal projects. European small and medium-sized enterprises and research organisations hold strong competitive advantages in these areas, positioning them to capture value not only within Europe but also in global geothermal markets.

The inherently place-based nature of geothermal energy makes it particularly well-suited to interregional cooperation and smart specialisation approaches. Regions with abundant geothermal resources, such as Tuscany, the Upper Rhine Valley, or the Pannonian Basin, can benefit from collaboration with regions specialising in engineering, manufacturing, digital technologies, or advanced services. Through such cooperation, regions without significant geothermal resources can still participate in geothermal value chains by contributing equipment, expertise, financing models, or digital solutions. European policy instruments, including Interregional Innovation Investments, Horizon Europe partnerships, and Interreg programmes, provide structured frameworks to support these interregional linkages and to scale geothermal innovation across borders.

Geothermal energy also demonstrates strong cross-sectoral linkages that enhance its systemic value. In the built environment, geothermal systems can support the decarbonisation of existing building stock when combined with renovation measures, smart energy management, and local energy planning. In industrial contexts, geothermal heat can serve as an anchor for industrial symbiosis, integrating waste heat recovery and supporting the transition toward climate-neutral production. Emerging connections between geothermal energy, water management, and raw materials extraction, such as the recovery of lithium and other critical materials from geothermal brines, further strengthen geothermal's relevance within circular economy and strategic autonomy debates.

From a social and territorial perspective, geothermal development offers meaningful opportunities for skills development and just transition strategies. The technical similarities between geothermal drilling and oil and gas operations create pathways for re-skilling workers from declining fossil fuel sectors, while the long-term operational nature of geothermal installations supports stable, locally rooted employment. These characteristics contribute to public acceptance and reinforce geothermal energy's role as a socially inclusive component of the energy transition.

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At the European level, geothermal energy aligns closely with major policy frameworks, including the European Green Deal, Fit for 55, REPowerEU, and the EU Industrial Strategy. However, despite this alignment, geothermal energy remains underrepresented in policy prioritisation and investment compared to wind and solar energy. This gap reflects not a lack of potential, but rather the complexity, locality, and cross-sectoral character of geothermal projects, which do not fit neatly into conventional energy policy silos.

Addressing this challenge requires enhanced European cooperation, particularly in the areas of permitting harmonisation, risk mitigation for exploration and drilling, shared geological data platforms, and cross-border resource management in transnational geothermal basins. Strengthening these enabling conditions would significantly reduce project risk and accelerate deployment. At the same time, Europe's strong governance models, technical expertise, and environmental standards position it as a global leader in geothermal solutions, with growing export potential to regions seeking sustainable and resilient energy systems.

In this broader perspective, geothermal energy emerges as a strategically undervalued yet highly effective instrument for Europe's green transition. Its capacity to deliver renewable heat, support regional development, integrate multiple sectors, and anchor local value chains makes it uniquely compatible with Europe's place-based, innovation-driven approach to sustainability. As the focus of climate policy increasingly shifts toward heat, industry, and territorial cohesion, geothermal energy is well placed to move from the margins to the core of Europe's energy transition strategy.

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