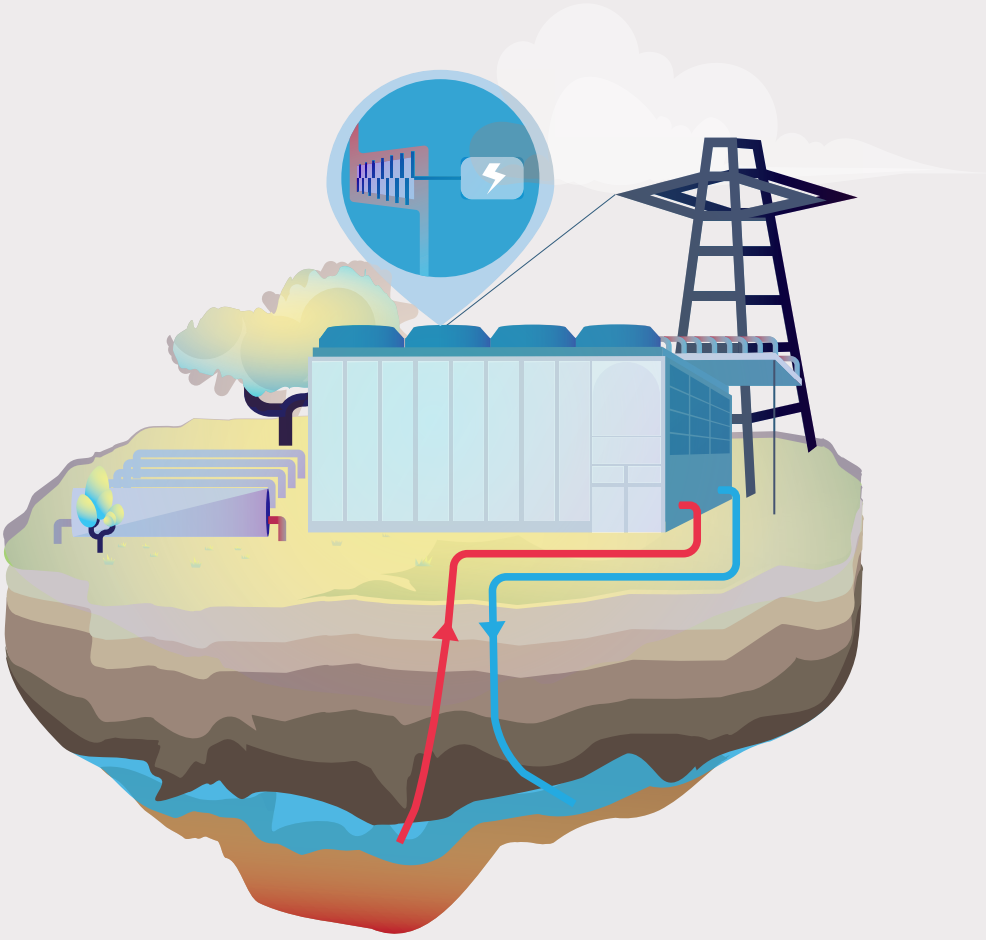
DEEP GEOTHERMAL



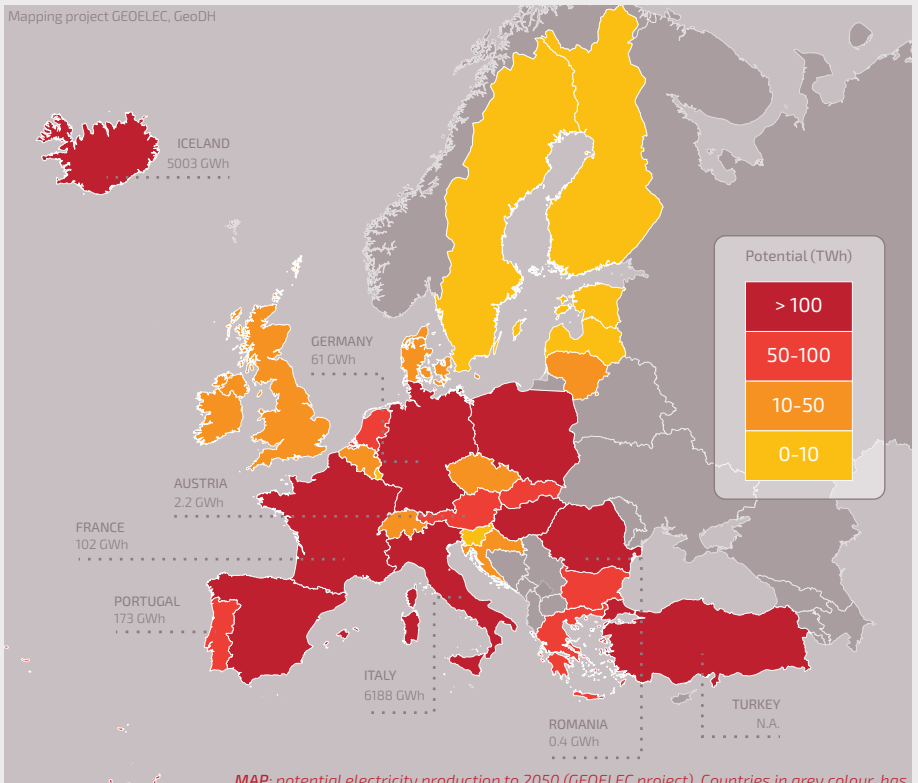
The growth potential for deep geothermal has been recognized just recently, but geothermal has been a source of energy to humankind since the dawn of civilization. For centuries, hot springs have been used for bathing, healing and heating.

The early 20th century saw major advances in geothermal technology, with electricity generation in Larderello, Italy, and district heating in Reykjavik, Iceland. Since then, there has been no stop in technological innovations.

ETIP-DG
European Technology & Innovation Platform on **Deep Geothermal**

www.etip-dg.eu

DEEP GEOTHERMAL ELECTRICITY AND HEATING & COOLING IN EUROPE

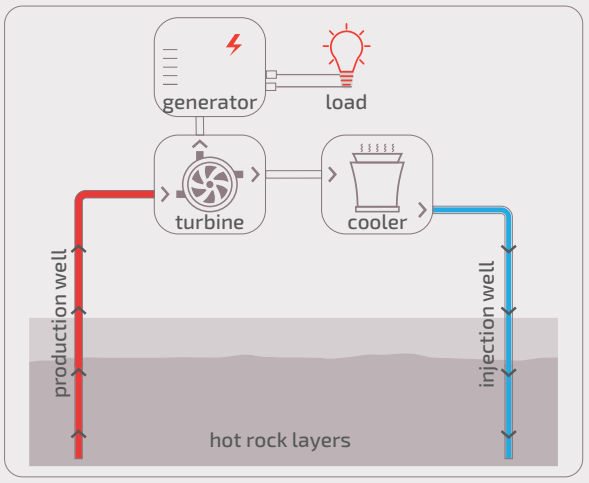


MAP: potential electricity production to 2050 (GEOELEC project). Countries in grey colour, has also geothermal potential, but were not part of the mapping project.

Electricity

Electricity is produced from geothermal fluids through a turbine, where heat is transformed into electricity via a generator. The fluid sent to the turbine can be the geothermal fluid extracted from the ground (direct or flash steam systems) or a secondary fluid heated by a heat exchanger (binary system).

By the 1970s, only a few plants had been installed in Europe, mainly in Italy and Iceland, followed by France (Guadeloupe) and Turkey. All of them used high temperature (>250°C) resources with direct or flash steam turbine technology.



With the development of binary cycle technologies that can produce electricity from lower temperatures (as low as 110°C), geothermal plants were then set up in other countries (Austria, Germany, Portugal). Today, 102 geothermal power plants are set up in seven European countries with a total installed capacity of 2,5 GWe.

Electricity generation from geothermal resources has a huge potential in Europe, especially when the new generation technologies for enhancing heat extraction become competitive, then electricity could be generated in most European countries (see map).

The total geothermal electricity potential in the EU is 34 TWh, about 1 % of the projected total electricity supply in the EU in 2030.

Heating and cooling

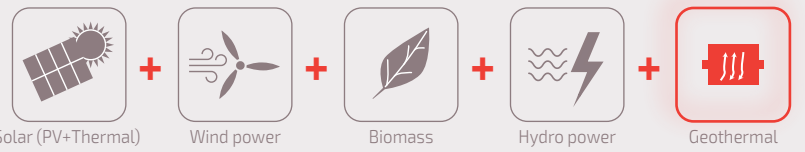
The heating and cooling sector represents nearly 50% of Europe's energy demand, and geothermal is becoming more and more attractive as a competitive renewable heating source, as the energy sector as a whole is facing dual challenges: decarbonization and securing heating at an affordable price for costumers.

To cover demand for heating and cooling geothermal energy offers vast resources to be utilized for numerous technical options, ranging from the supply of heat and cold (H&C) to single houses also in combination with geothermal heat pumps, up to providing heat to whole cities or city quarters through large district heating (DH) networks. Geothermal resources are also used for industrial purposes.

Deep geothermal installations require the extraction of fluids from the underground and their reinjection after use, in a typical doublet or triples system. The heat from the fluid can be used directly, or adjusted by ground source heat pumps.

Today, Europe has 280 plants for Geothermal District Heating (GeoDH, EGEC Geothermal market report). The plants are spread over 24 countries and represent a total heating capacity of 4,8 GWth. In 2015 they supplied 12,9 TWh of heat. With 163 plants under construction the heating capacity from deep geothermal sources in Europe is expected to grow significantly.

SUSTAINABLE ENERGY MIX for the future =



UNLOCKING GEOTHERMAL ENERGY

Heat generation development

Thanks to continuous technological developments, geothermal resources that previously were out of reach will be explored and developed. The new technologies will make it technically and economically feasible to deliver hot fluids even in areas with an average or low geothermal gradient, by enhancing heat extraction or going deeper.

Since modern, energy efficient buildings and new heating systems allow rooms to be comfortably heated at supply temperatures of 40°C and less, the operative temperatures of the DHC network can be further reduced.

Through thermal energy storage it will be possible to balance heat demand and supply in a DH network. While demand in a DH network fluctuates on a daily, weekly and seasonal basis, the supply from a geothermal source is constant all year round. Increasing the number of full load hours of the geothermal installations has a direct impact on profitability.

Electricity generation development

The use of geothermal heat for producing electricity is the most flexible way to produce a clean renewable and sustainable energy, easily transportable even over long distances and ready for use for the end-users. Only two conditions are necessary: the hot fluid produced via a geothermal well must have a sufficient flow rate and must have a temperature above a given threshold (depends on used technology).

With new technologies geothermal electricity generation will be possible everywhere, going deep enough to reach the required temperature and improving heat extraction wherever the natural flow rate proves to be too low.

Geothermal energy will also play a unique role on islands and in remote areas, where its flexibility and stability can be a major asset for small local grids, solving critical problems for isolated communities.

Combined renewable

Deep geothermal adds flexibility to the energy landscape of the future with its interconnected local energy grids that are fed by a variety of local (renewable) energy sources and that connect the various energy sectors (i.e., electricity, heating & cooling and transport).

The local grids will be driven by new market models in which the separation between energy producers and consumers becomes less sharp than it is today.

The integration of local renewable resources such as photovoltaics, solar thermal, (small) wind turbines or digesters will allow users to become both producers and consumers of energy, i.e. “prosumers”.

KEY MESSAGES

SUSTAINABILITY
The geothermal environmental footprint is much lower than those of other energy sources

RESOURCE POTENTIAL
Geothermal is a widely available energy source, since underground heat is available everywhere

OPTIMISATION
Geothermal is a versatile energy, whose multiple-applications are optimised by cascading uses of heat at progressively lower temperatures

FLEXIBILITY
Geothermal operates continuously to meet the minimum level of power demand and may adapt to meet variable levels of energy demand

GROWTH
Production from untapped geothermal resources has the potential to become a local economic development booster

COGENERATION & HYDRIBISATION
Geothermal can be combined with other energy sources and technologies to optimise efficiency

MARKET PENETRATION & SOCIAL DIMENSION
Geothermal is a domestic and green resource, secure, stable, clean, and contributes to energy efficiency

COOL & APPEALING
Besides cooling the air of our houses, working spaces, malls, and airport geothermal is simply beautiful because it is essentially invisible

FIT FOR PURPOSE
Geothermal has a large potential of expansion in numerous applications and places

STABILITY & AVAILABILITY
Geothermal energy is available around the clock and has a predictable output

The **ETIP-DG** (European Technology & Innovation Platform on Deep Geothermal) is an open stakeholder group, including representatives from industry, academia, research centers, and sectorial associations supporting the deployment of the next generations of geothermal electricity and heat plants.

The ETIP-DG actively collaborates with the ETIP on Renewable Heating and Cooling (RCH-Platform) which gathers stakeholders from biomass, geothermal and solar thermal sector to define a common strategy for increasing the use of renewable energy technologies for heating and cooling.

ACTIVITIES

› The development of a long term common Vision for deep geothermal for power and/or heat.

› The development of a European Strategic Research Agenda for deep geothermal for the next decade(s).

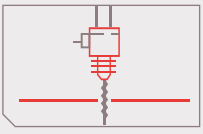
› Recommendations for the implementation of the Strategic Research Agenda through a customized Technology Roadmap.

› Contribution to the European industry and research to maintain and consolidate its leading position in energy technologies for geothermal.

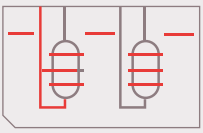
WORKING GROUPS

The ETIP-DG members participate in the implementation of activities, organized in the following groups:

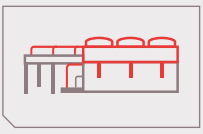
› **Exploration**
Reducing exploration costs, developing new techniques, improving exploration of geothermal resources to decrease the geological risk.



› **Deep drilling**
Reducing costs with novel drilling concepts and improvements to current drilling technology, optimising the economics of drilling operations.



› **Production technologies**
Increasing reservoir performance, developing new materials and equipments to optimize the efficiency and decrease costs.



› **Surface systems / Generation**
Improving the overall conversion efficiency, addressing the needs for flexibility in the integrated energy system.

› **Non-technical**
Improving the RD&I framework, supporting market deployment, promoting social and environmental sustainability.

Participation in the activities of the ETIP-DG is free and on a voluntary basis. Members are informed about the activities of the ETIP-DG and are invited to contribute to the drafting of the Strategic Research Agenda and the Technology Roadmap.

To become member of the ETIP-DG, visit www.etip-dg.eu

EGEC GEOTHERMAL

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National Research Council of Italy

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