

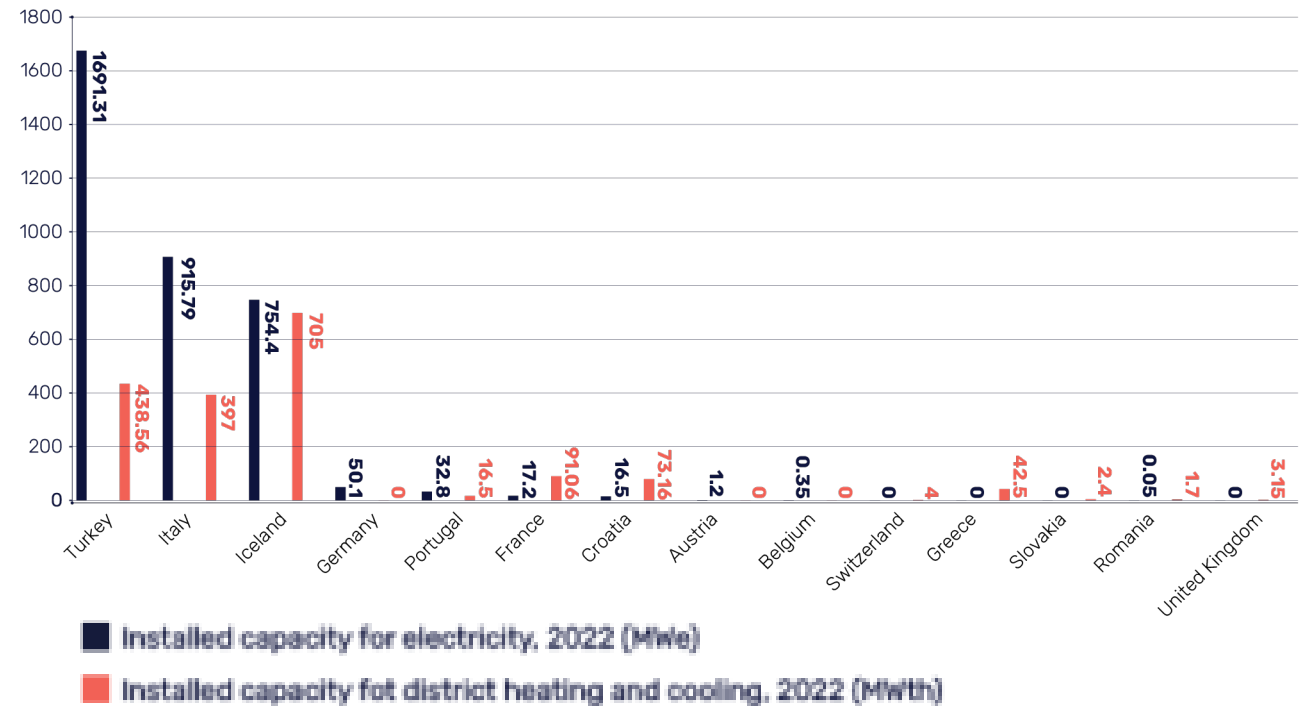
Geothermal opportunities in Europe: Ways forward

Overview

Some key figures

- 142 Geothermal electricity plants: 3,5 Gwe installed and more than 22 TWh produced
- 395 geothermal DH systems in operation, with 14 new in 2022: 5,6 GWth capacity
- More than 2,19 million geothermal heat pumps in Europe at the end of 2022

Installed capacity for electricity and district heating and cooling in 2022 (MW)



First glance of the Market report 2024

more than 30 wells will be drilled in the next 3-5 years **for Geothermal electricity** power plants

25 plants are under development (construction or extension) and 100+ projects are investigated

more than 100 wells will be drilled **for heating projects**

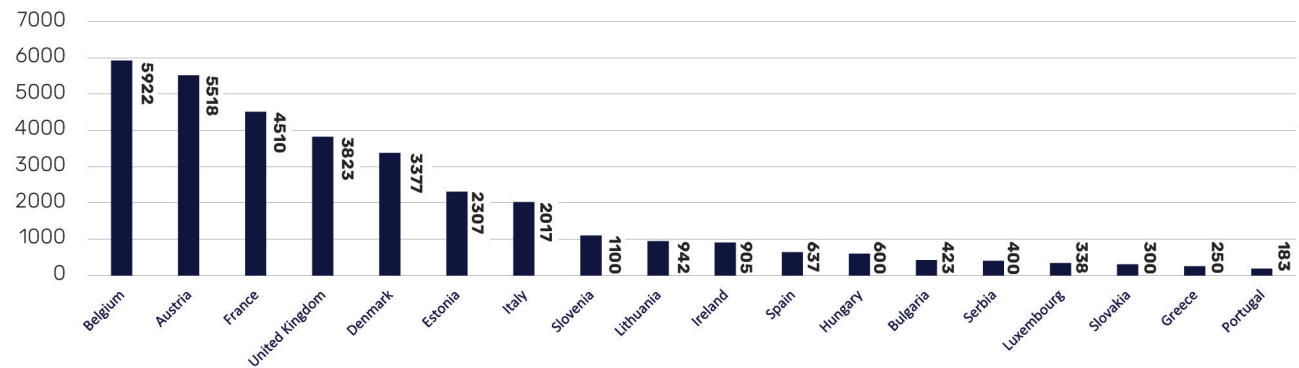
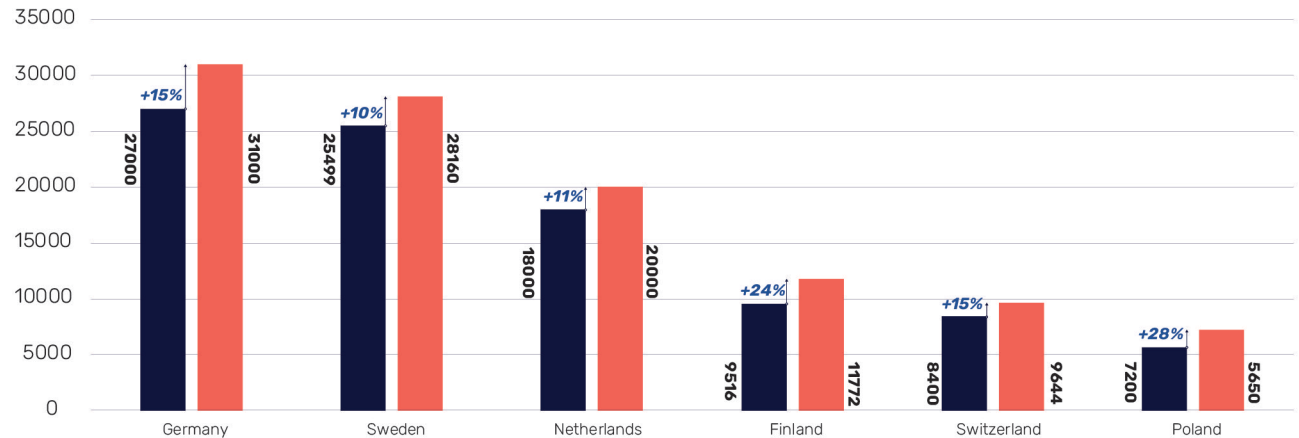
16 projects are currently (or about to) drilling, 300+ are developed or investigated – typically doublet, but some projects portfolio (e.g. Innargi drills 19 wells in Denmark), and some extension with triplets

Geothermal heat pumps market in Europe



Growing sales in old and new markets

- 2022 witnessed the **largest ever volume of GHP sales**, with more than 141,300 geothermal heat pump systems installed.
- This surpassed 2021, which was the last record year with 120,900 sales...**still concentrated in 6 markets** with >ca. 10 K units/years (accounting for 80%)
- 2022 figures were **17% higher than those in 2021**.

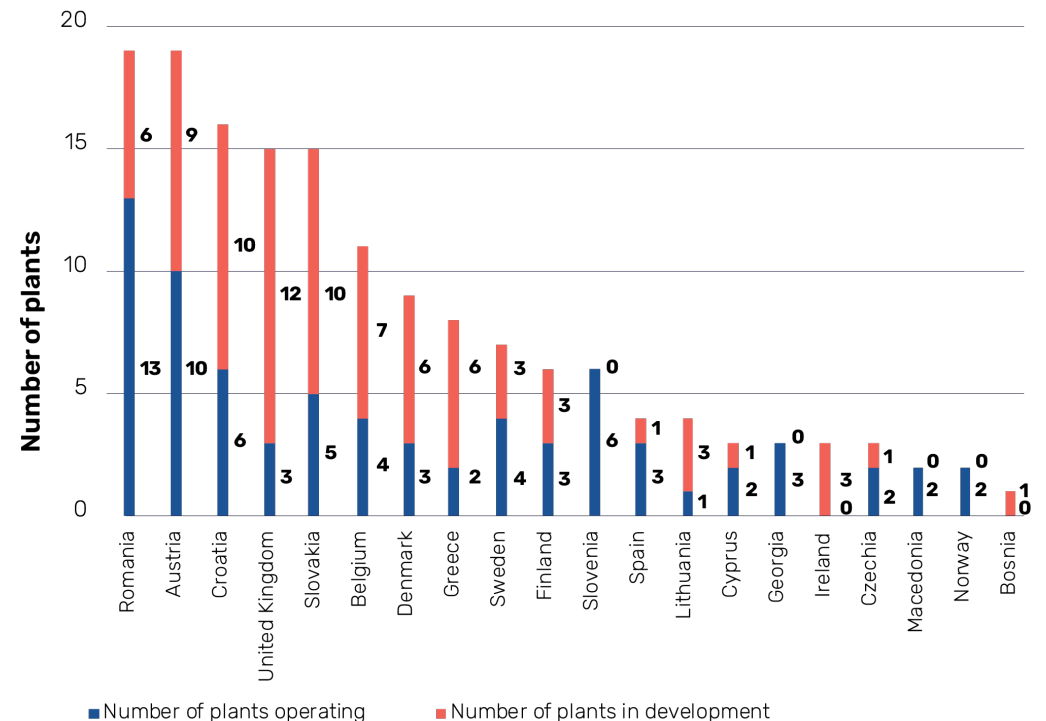
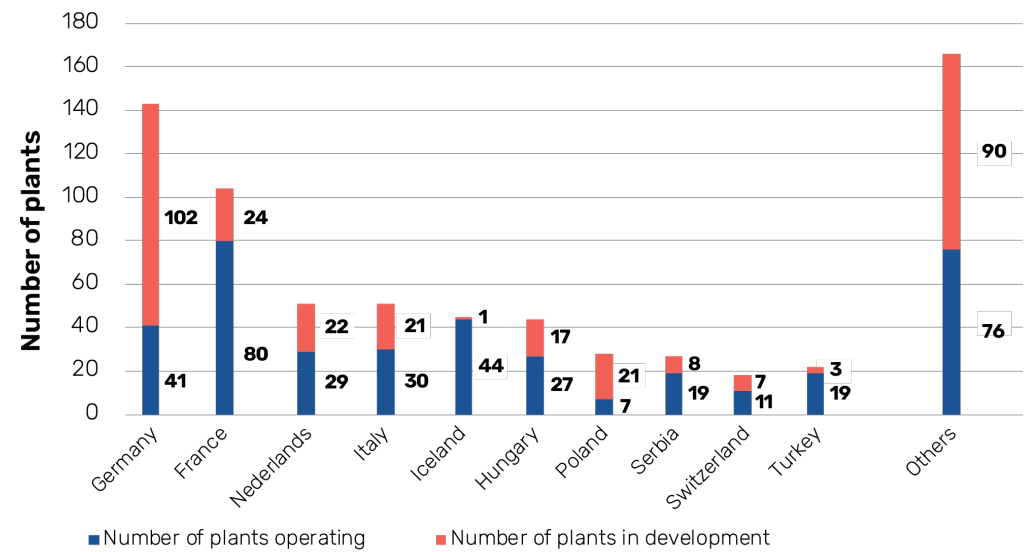


Geothermal District Heating in Europe



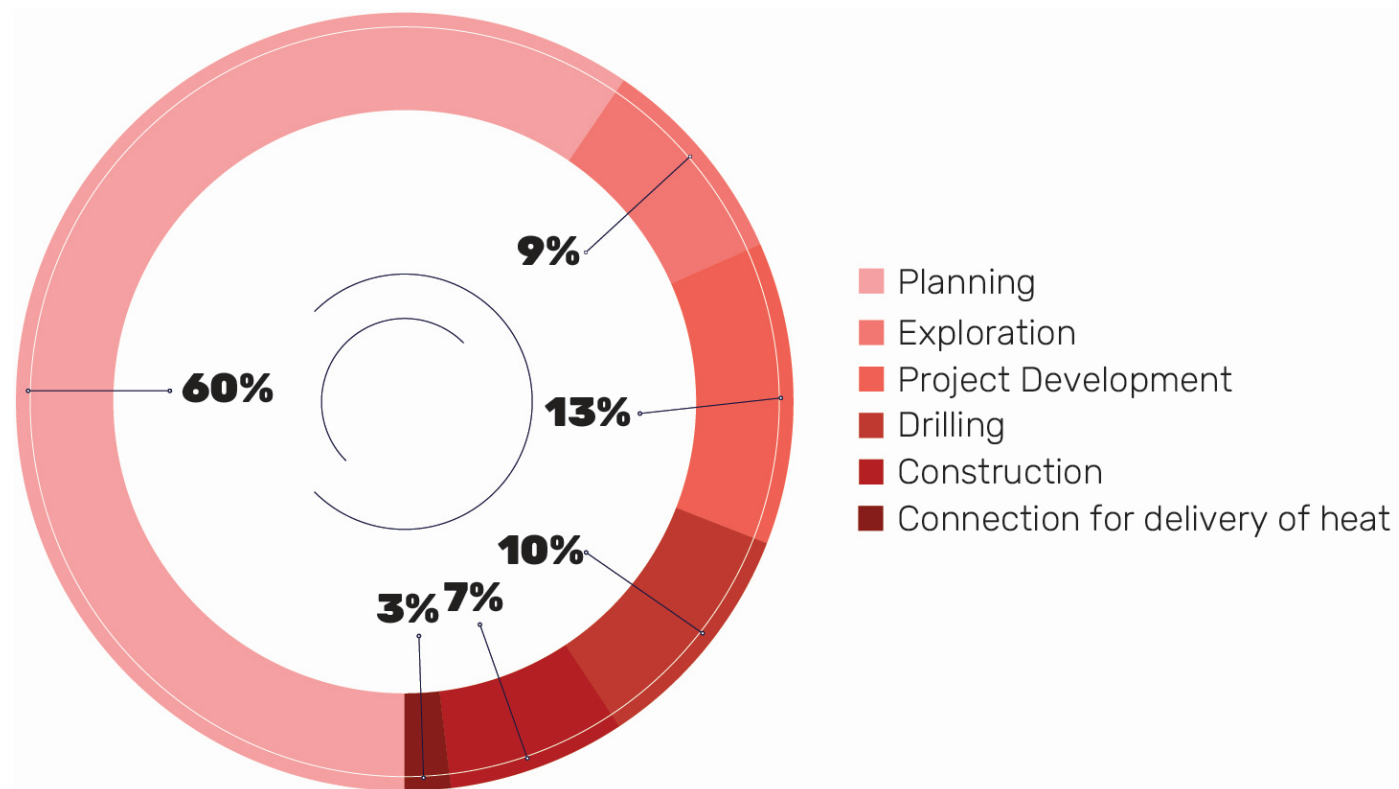
Market development

- 17 geothermal heating systems were commissioned in 2023. Four are in Serbia; three in Finland; two in the Netherlands and one in Austria, Cyprus, Estonia, Hungary, Italy, Portugal, Slovakia and Spain.
- More than **300** are being developed or are under investigation.
- These are **typically doublets**, but some projects will drill **multiple wells**. Others will seek **extension** of existing capacity with triplets.



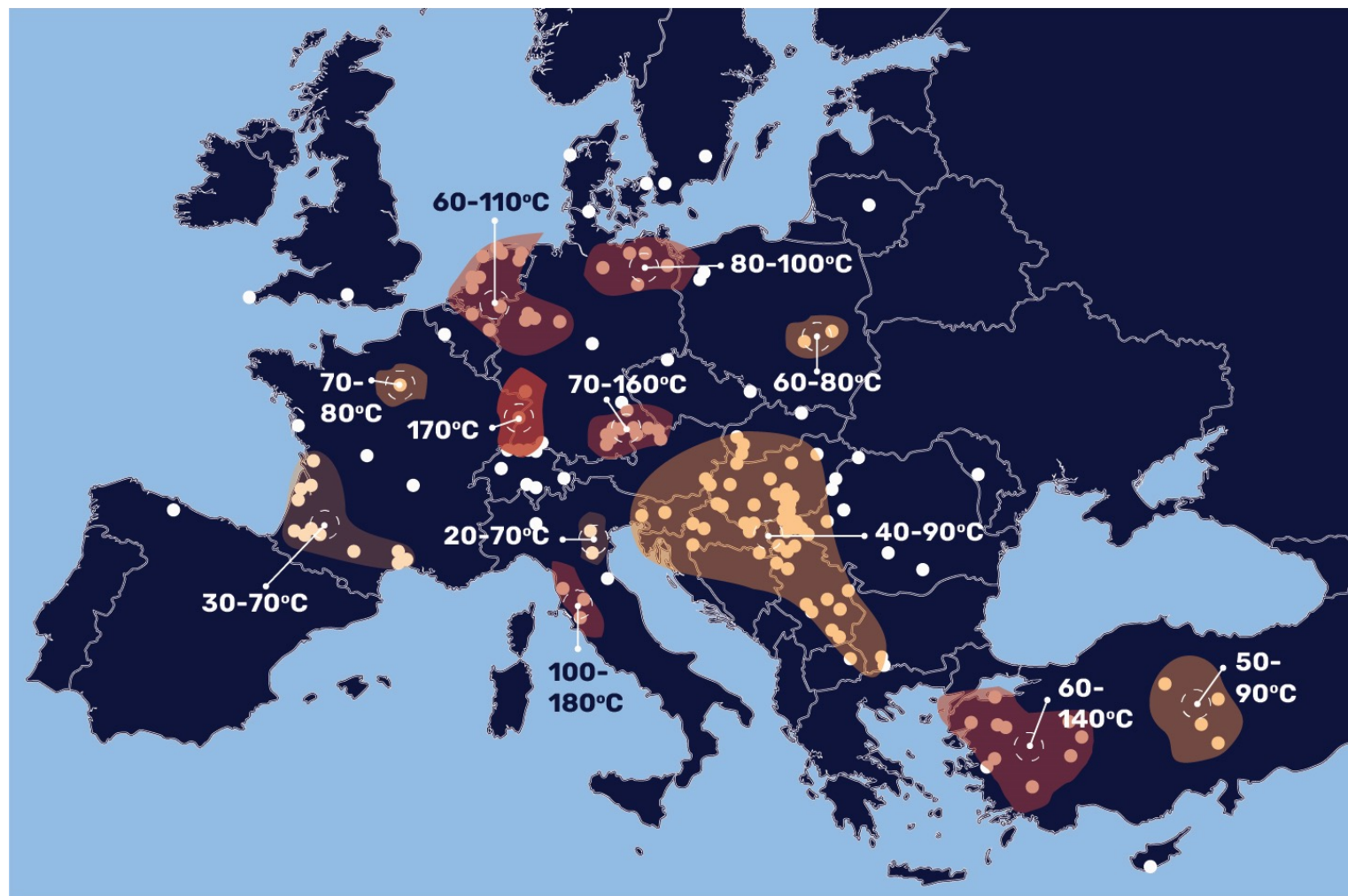
Geothermal DHC project pipeline

- **316 new projects** under active investigation, which add over 744 MW to the operational 5,608 MW capacity.
- **Germany has the largest pipeline** with 102 projects and is followed by France with 24, the Netherlands with 22, Italy and Poland with 21 respectively.
- **Geothermal and agrifood:** new project in Industry, greenhouses and agrifood production sites.



Resource and flow rates

- Most projects centre on reservoirs with temperatures in the 60-80°C range in the EU.
- One of the key trend is the use of large Heat Pumps.
- Greater effort needed for resource mapping to develop green fields.



Geothermal electricity production in Europe



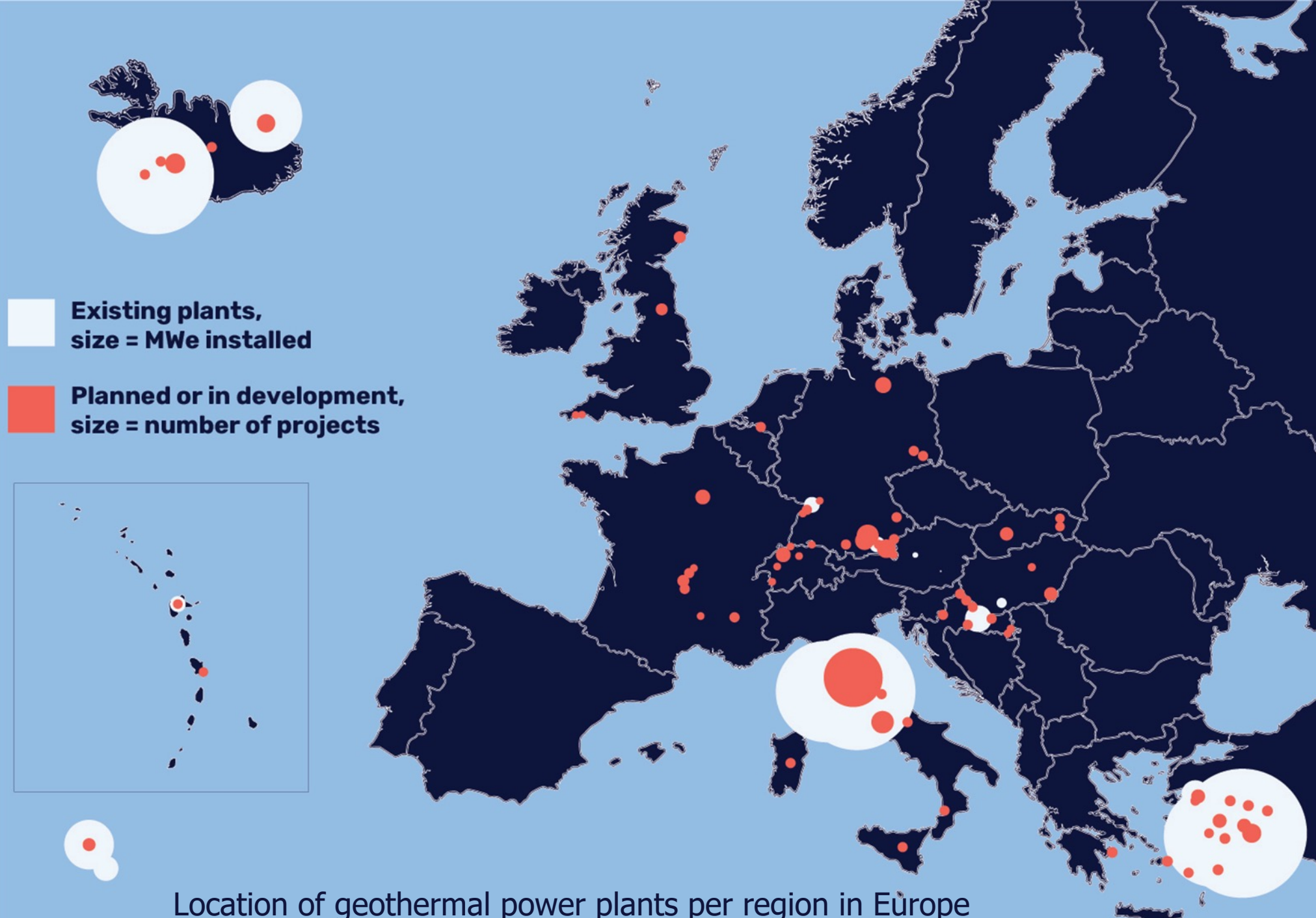
Market analysis

1913 - 2023: Celebrating 110 years of geothermal power

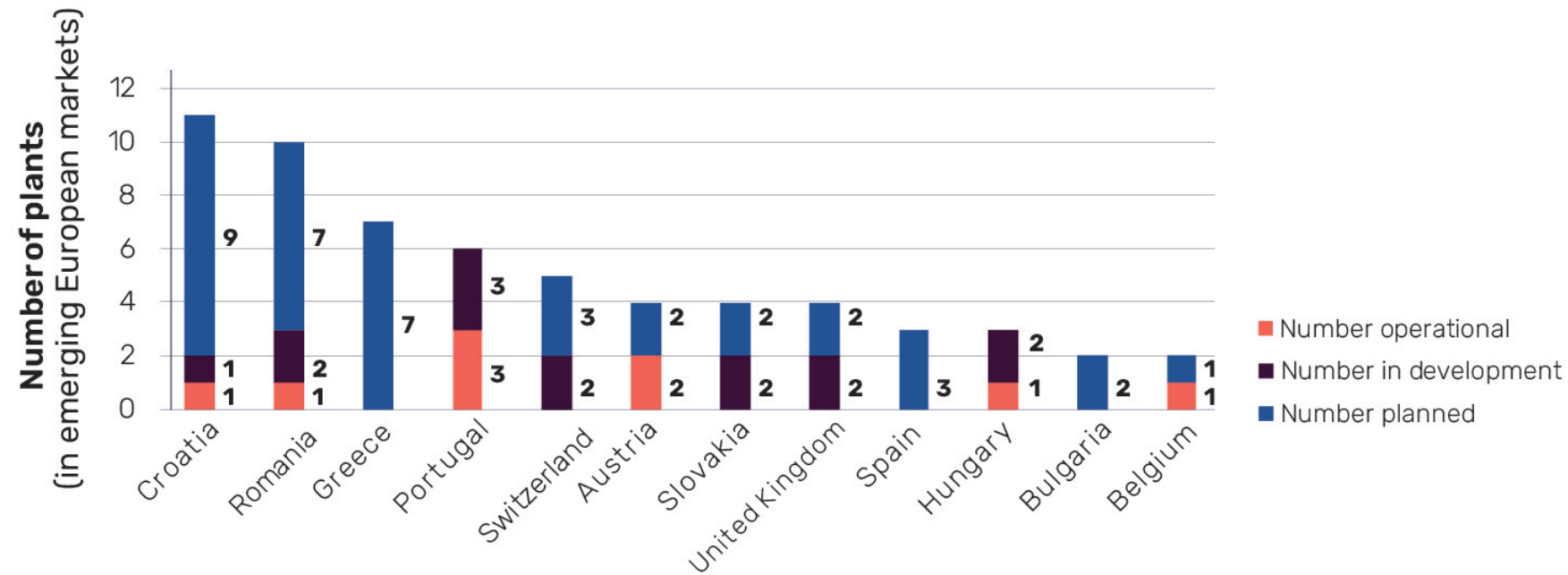
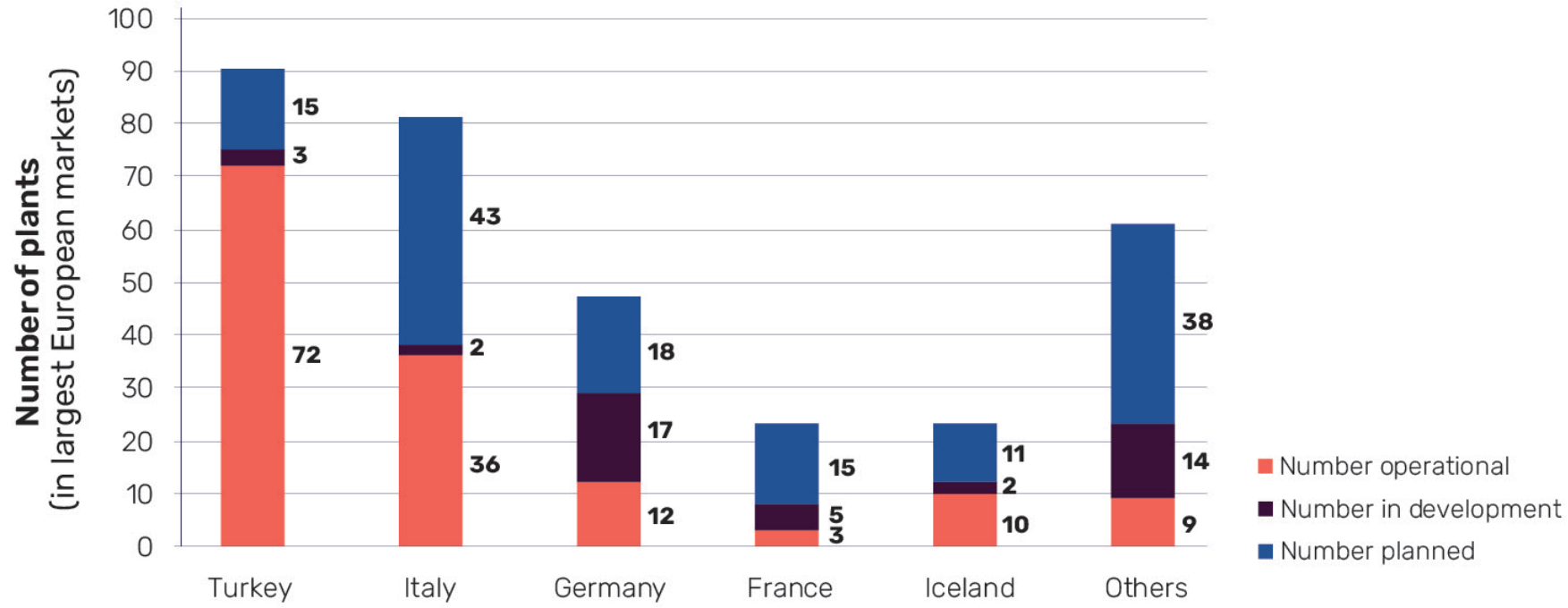
- The oldest geothermal power plant is still in operation is from 1986.
- 4 running plants are from the 80's, 17 from the 90's and 32 plants run from the 2000's.
- 21 power plants are more than 25 years old and 53 are more than 15 years old.

The geothermal electricity market is now entering a new development phase, with many plants to be put into operation throughout the next 5 to 7 years.

- In total, today, 43 projects are developed and 140 are investigated.



Location of geothermal power plants per region in Europe



Research priorities about

Resource Assessment

Resource Development: Drilling and subsurface engineering

Resource utilization and management

Resource sustainable management



ETIP Geothermal

European Technology & Innovation
Platform on Geothermal



ETIP Geothermal

www.etip-geothermal.eu

Strategic Research
and Innovation Agenda



Research priorities about Drilling and subsurface engineering

- Topic 1: Towards robot and AI assisted drilling technologies
- Topic 2: Optimized penetration rate technologies
- Topic 3: Drilling fluids
- Topic 4: Materials for casing, cementing and completion
- Topic 5: Monitoring, logging while drilling and geosteering
- Topic 6: High temperature electronics
- Topic 7: Well architectures and stimulation
- Topic 8: Shallow closed loop technology (<500m)
- Topic 9: Deep closed loop technologies (>500m)
- Topic 10: Enhanced production pumps
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Key trends and features

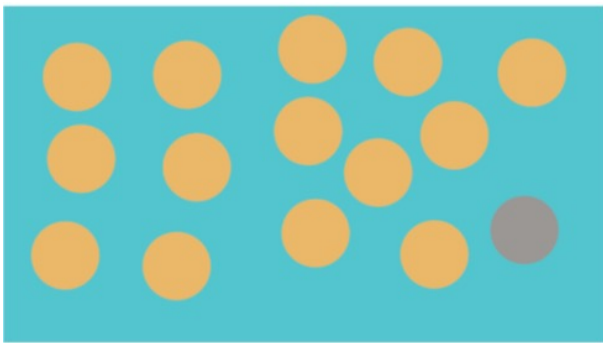
- **Technology transfers from the Oil & Gas industry** with workflows to be developed and adapted to geothermal resources, specific geological settings and environments.
- **Optimization of processes**, spending less time to develop, and a better understanding of geothermal prospects to explore green fields.
- **Definition of business models and standards.** What kind of wells does the industry need? What kind of projects do we want to run? At what cost? Set industrial standards through well established, benchmarked ranges which define what a “common geothermal well” should be (materials, tools and processes, for exploration or production operations).
- **Upscale of projects capacity, making them more robust, reliable and efficient with projects portfolio approach esp. for h&c:** 40% of the energy used in Europe is in the form of heat, most of it coming from fossil sources. Geothermal will therefore be a strong lever to reduce greenhouse gases emissions.

Towards derisking projects by standardisation

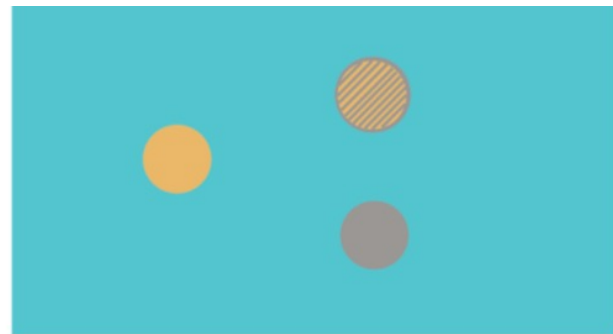
Mutualising the risk:

- more exploration, esp in green fields
- more data and availability of data
- projects portfolio approach

Financial instruments for risk mitigation schemes of geothermal projects



Representation of a mature market with 1 failed project



Representation of an emerging one with 1 failed project and on partial failure.

