# Competitiveness of the EU geothermal industry

***Clean Energy Technology Observatory (CETO)***

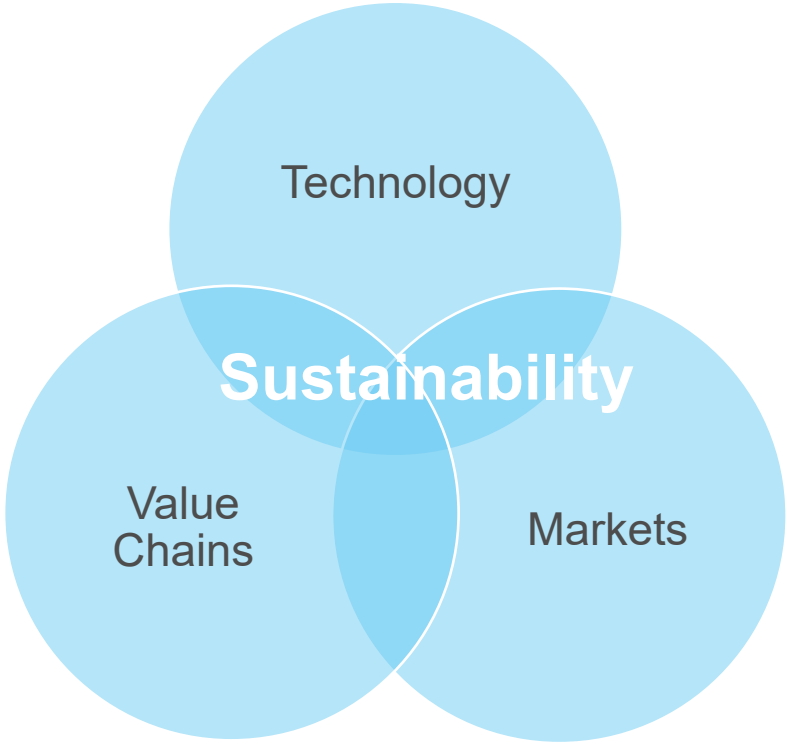
**Preliminary results**

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# Clean Energy Technology Observatory (CETO)

- Commission **in-house project** to
  - monitor EU research and innovation activities on clean energy technologies needed for the delivery of the European Green Deal
  - assess the competitiveness of the EU clean energy sector and its positioning in the global energy market
- JRC runs CETO under an administrative agreement with DG Research & Innovation and DG Energy



# CETO Impact

**Technology Development**

**Value chains**

**Markets & Deployment**




**Horizon Europe R&I programme priorities**

**EU Climate Law implementation**

**Clean Industry Deal Net Zero Industry Act**

Progress on competitiveness of clean energy technologies

***Reports link: https://setis.ec.europa.eu/publications-and-documents/clean-energy-technology-observatory_en***

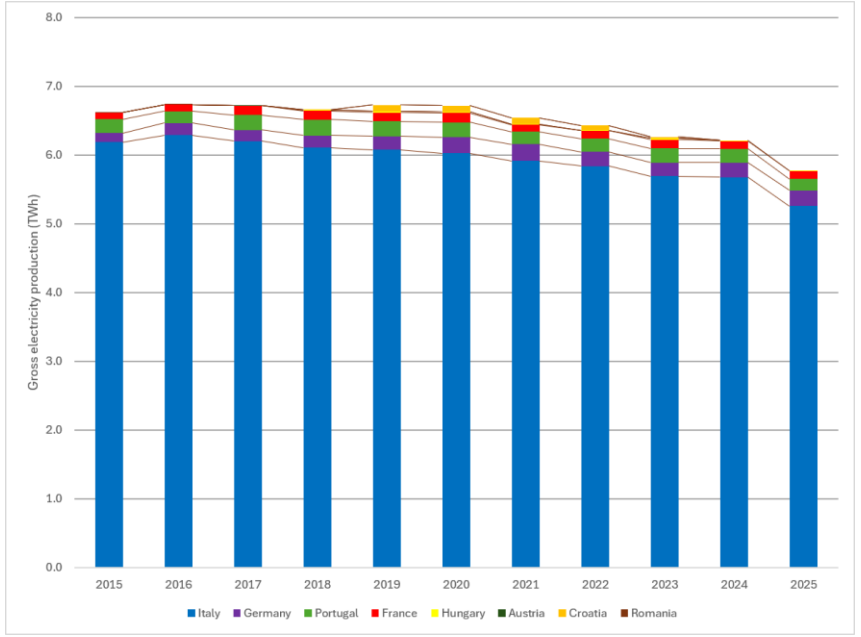
# Geothermal Energy in the EU

STATUS REPORT ON TECHNOLOGY DEVELOPMENT, TRENDS, VALUE CHAINS & MARKETS

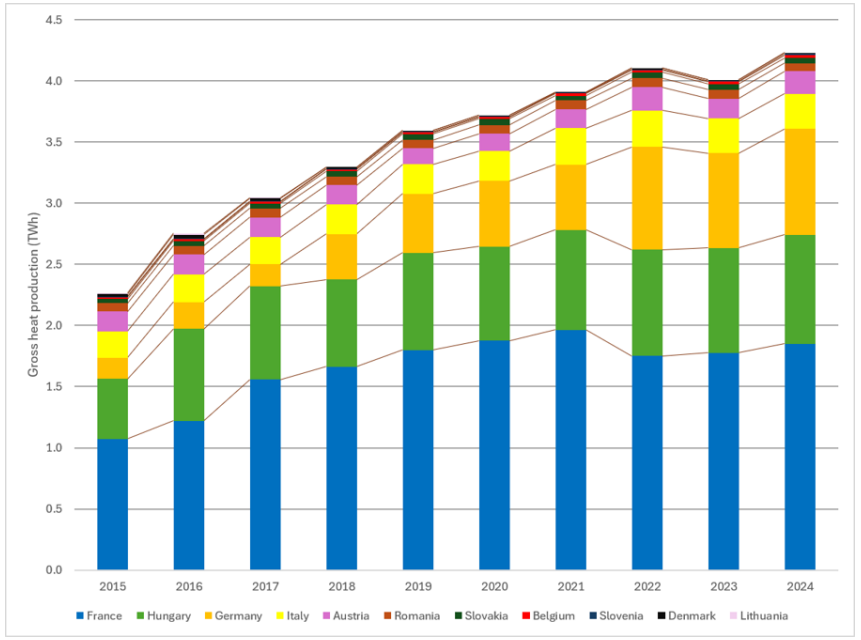
# Current developments

## Status and trends (2025)

- Well-established technology, remains one of the smallest of the commercial renewables
- Around 5.8 TWh (0.2 % of electricity production) and 0.7 % of heat energy consumption (Eurostat) / 7 TWh electricity production based on EGEC
- First AGS plant -Eavor-Loop™ (1 Mwe), began delivering electricity to the commercial grid
- 9 new DHC systems in 2025, more than in 2024
  - growing integration of large-scale industrial heat pumps into geothermal district heating systems




Gross electricity production from geothermal energy

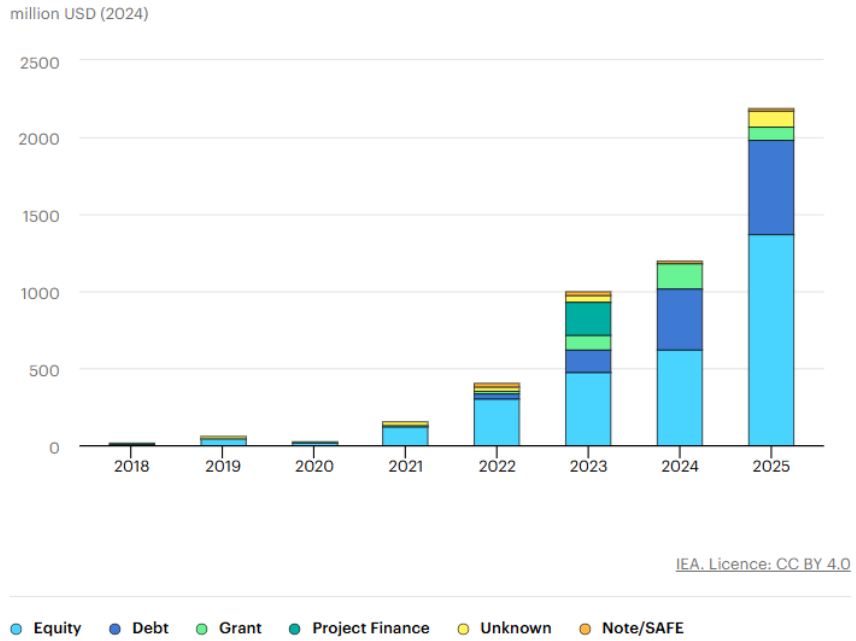



Total heat production from geothermal energy
Source: JRC elaboration of Eurostat data

# Current developments

## Status and trends (2025)

- Increased interest in next-generation geothermal




Next-generation geothermal financing
Source: IEA

## Legislative framework

- High potential to support the EU's energy transition and decarbonisation

- Net Zero Industry Act, EU Green Deal
- Supported through Horizon Europe and Innovation Fund

- Strategic planning
  - SET Plan Implementation Group
  - European Technology Innovation Platform for Geothermal Energy

- **Electrification Action Plan, Action 5**
  - **Geothermal Stakeholder Partnership**

# Technology status and costs

## Status

- Mature technology
  - Low-cost energy supply
  - Highest capacity factor
  - Lowest land area power density
- Hydrothermal systems
- EG and HDR systems
  - Less mature
  - Higher costs
  - Synergies with O&G industry

## TRL

- The highest level – 9
- Numerous developments to improve all aspects of technology:
  - Resource assessment
  - Resource development: drilling and subsurface engineering
  - Resource utilization and management
  - Resource sustainable management
  - Data and knowledge sharing

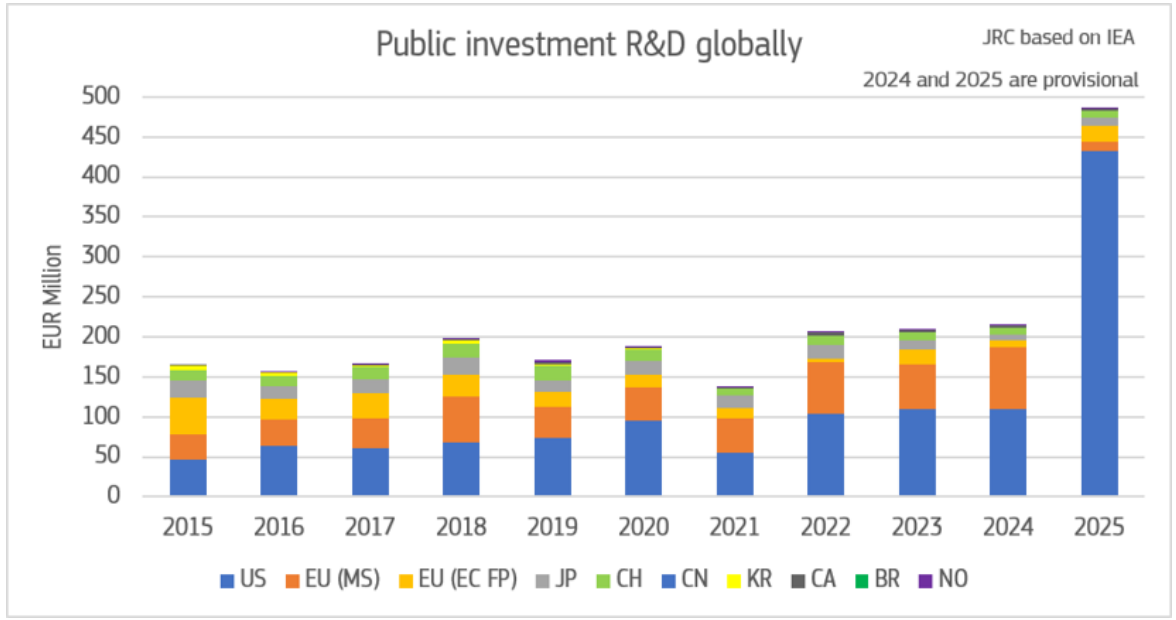
## Costs

- Global weighted total installed cost (TIC) in 2025 - USD 5 997/kW ranging from USD 2 741 /kW to USD 8 141/kW
- Increase of almost 90 % since 2010
- Cost trends largely influenced by the specific locations where projects were commissioned

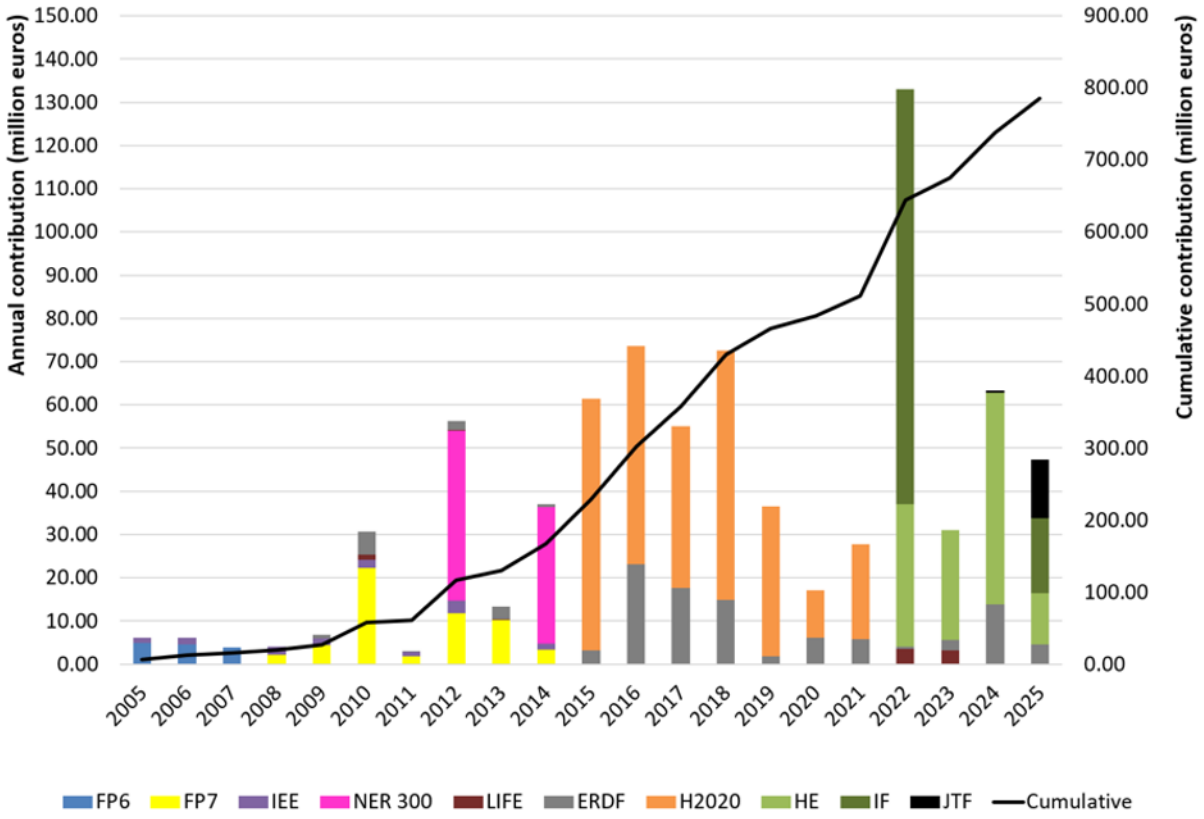
# Research and innovation investments

## Public RD&I

- In 2025 record level of public RD&I funding
  - More than double compared to 2024
- Large increase in support in the US



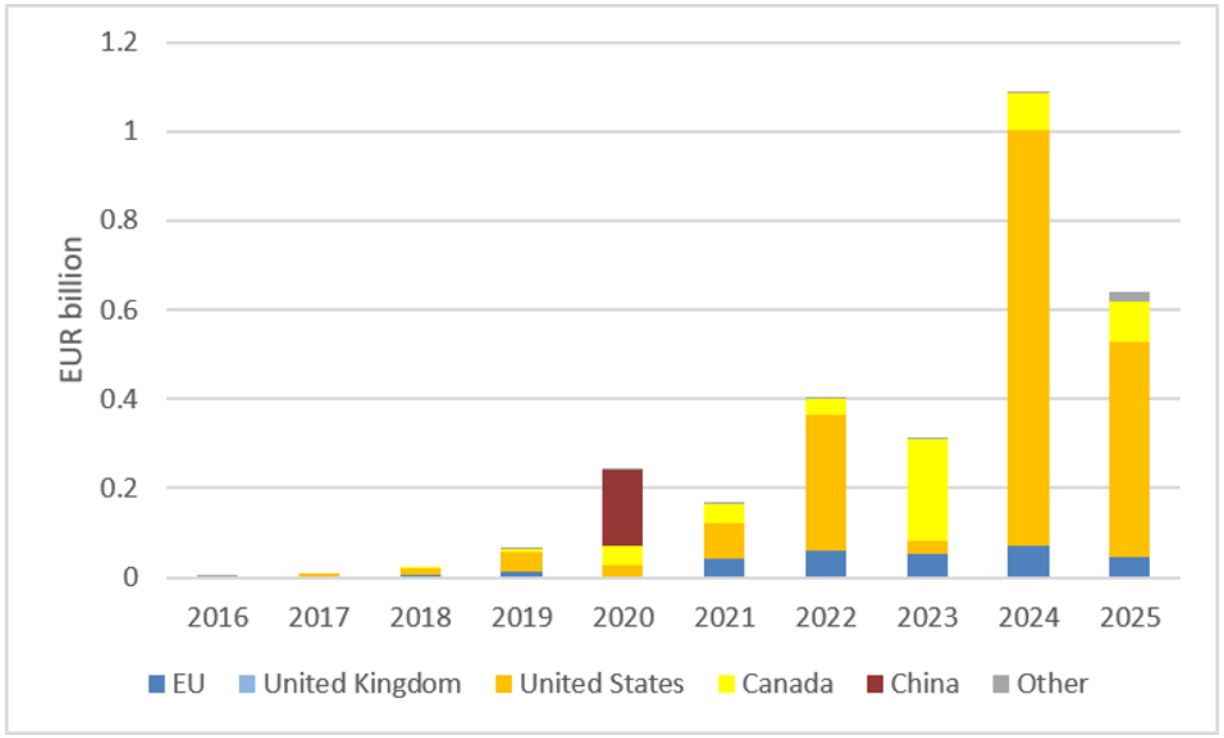

Global geothermal: public RD&I funding.
Source: JRC based on IEA




EU contribution to co-funded projects.
Source: JRC elaboration based on relevant project databases

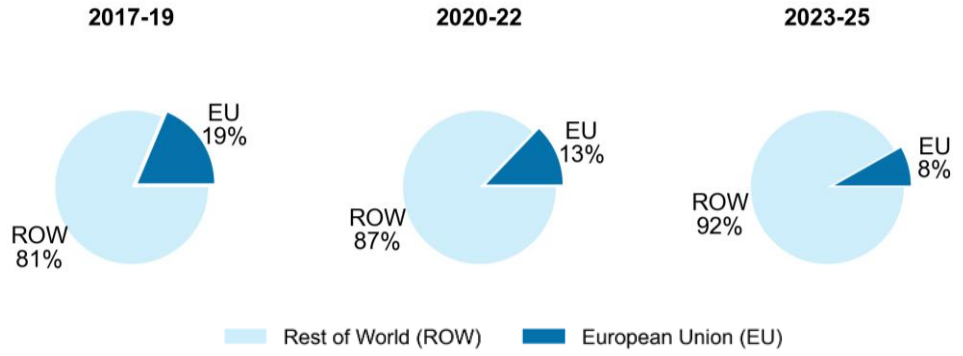
# Research and innovation investments

## Venture capital investments



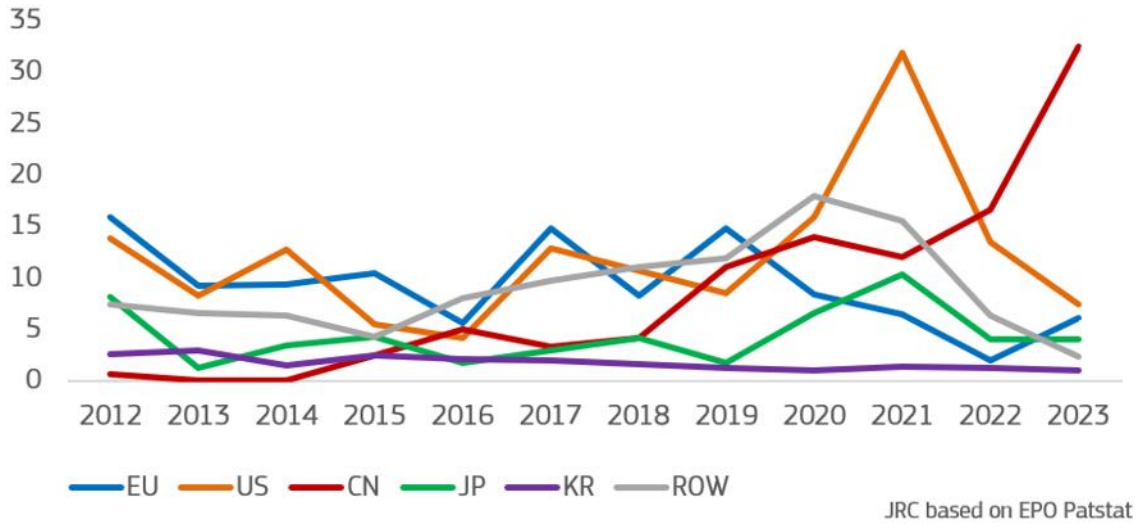

Global VC/PE investment in the geothermal sector.
Source: JRC analysis based on Pitchbook data, 2025

- In 2025, global VC investment decreased to EUR 643 million – 42 % decrease compared to 2024
- 2025 is the second-highest investment year, well above pre-2022 levels
- EU VC/PE investments decreased from EUR 70 million to EUR 44 million (EU behind US and Canada)
- Levels of investment in EU ventures remain much lower than in the US

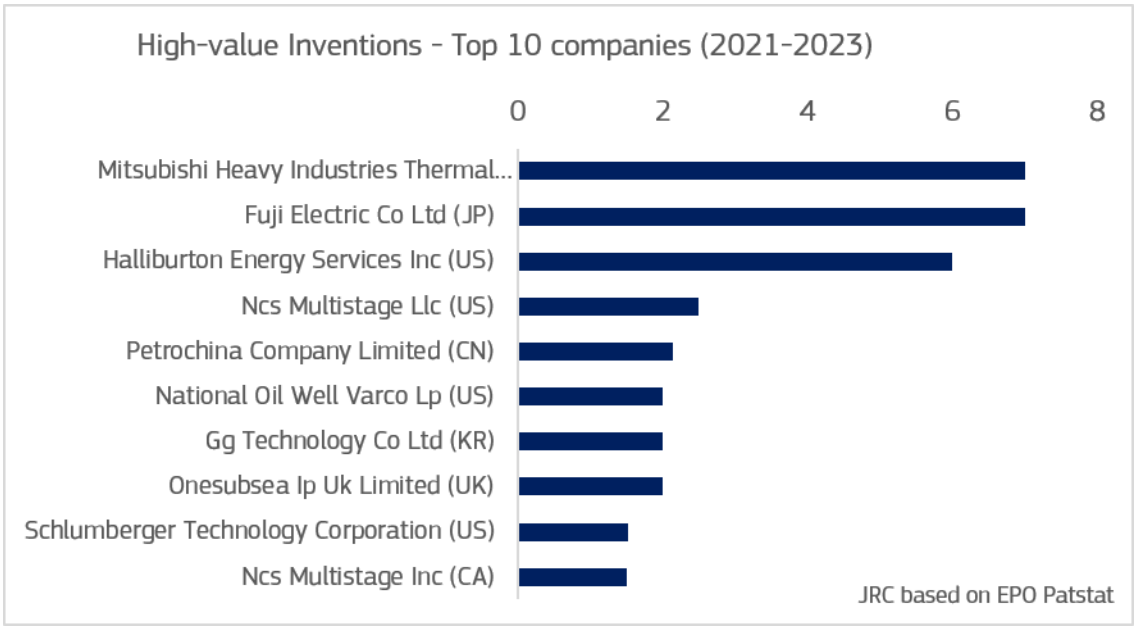



Geothermal VC/PE investment share in the EU and the Rest of the World (ROW) by period
Source: JRC based on Pitchbook, 2025

# Patenting trends




Patents filed in more than one patent office – high value inventions
Source: JRC based on PATSTAT data




Top 10 companies globally – high value inventions
Source: JRC based on PATSTAT data

# EU Market Position and Global Competitiveness

## EU position

- Global market shows modest growth
- Decarbonisation plans promise better future for geothermal sector in general
- Industrial position of the EU is positive with plenty of opportunities for further growth and improvement
- Key factors for the competitiveness (EGEC):

Fossil fuel energy prices | Growth of cooling capacities

Diversification of geothermal projects | UTES

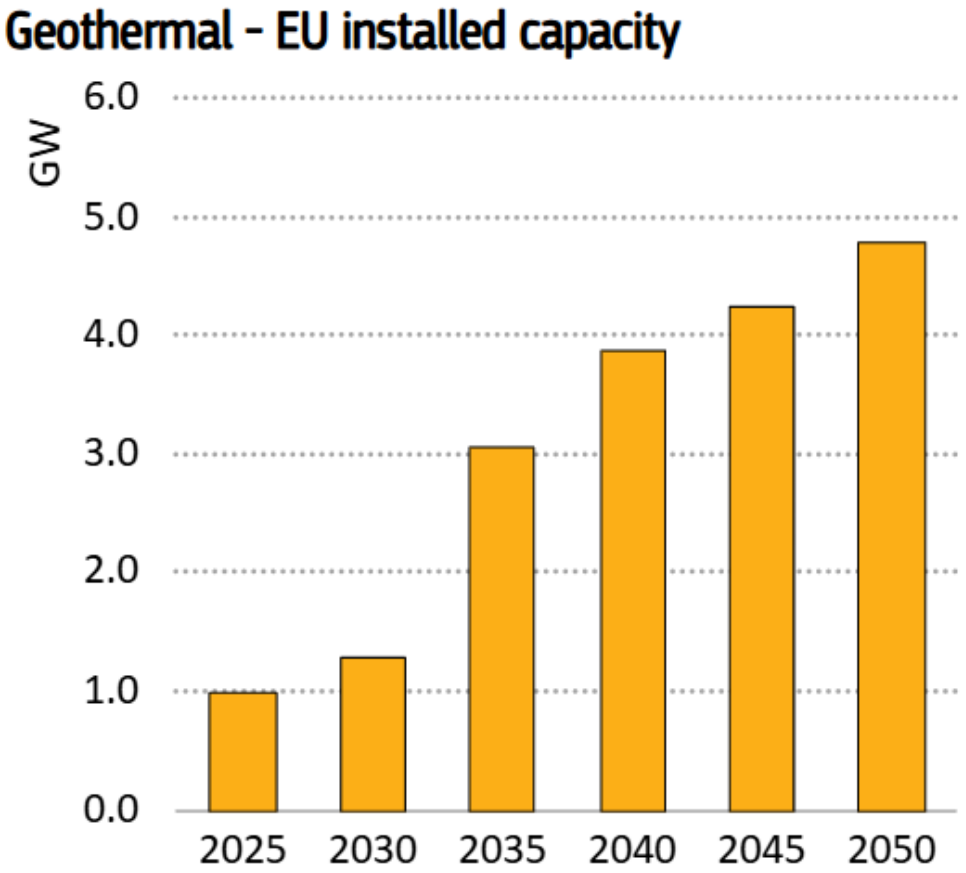
New reservoirs dev. | Material and component prices

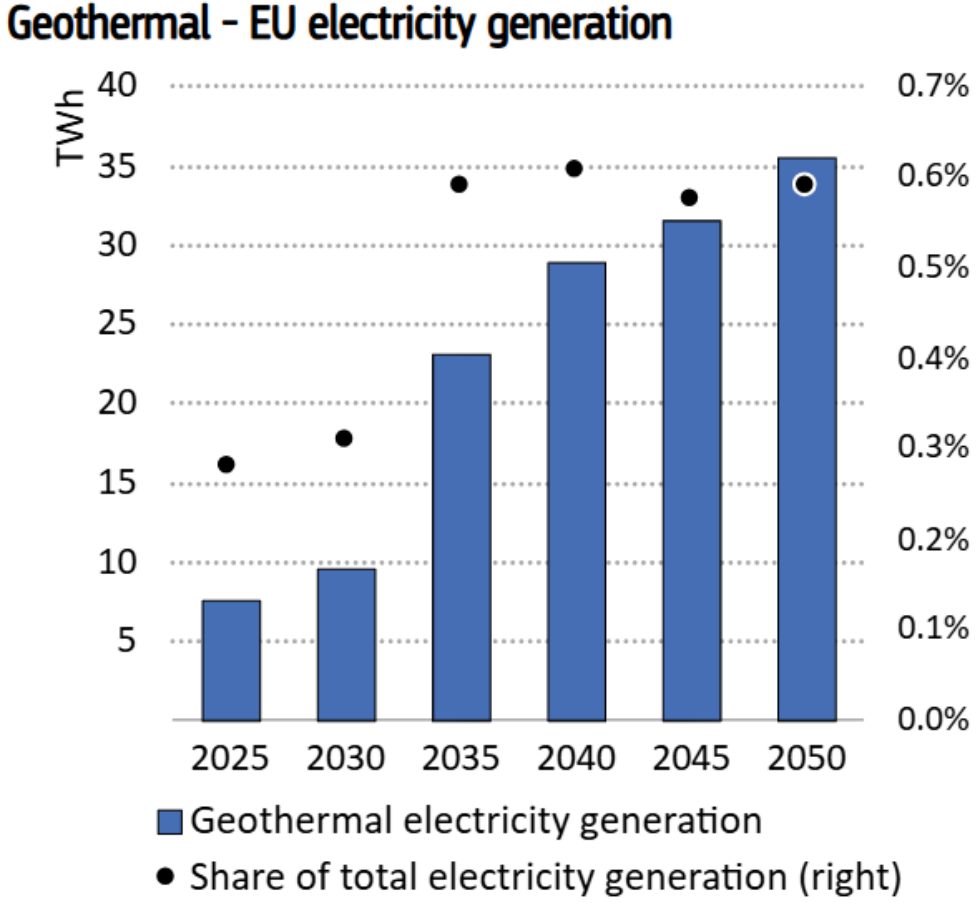
Source: JRC based on EGEC

## Resource efficiency and dependence

- Main sensitivities come from construction materials (alloying elements for steel, aluminium, copper)
- Moderate risk of availability of equipment produced outside of Europe
- Risk related to shortage of well-trained, specialised workforce
  - important: lack of skilled labour within regulatory and permitting agencies
- Unique possibility of extracting materials from the geothermal brine

# EU Market Prospects




EU cumulative installed capacity (a) and annual electricity generation (b) from geothermal under the POTEnCIA & POLES CETO 2026 Scenario in the EU, 2025 to 2050
Source: JRC based on POTEnCIA & POLES CETO 2026 Scenario in the EU

# The role of EU companies in the geothermal sector

| Stage | Typical components & services | Europe/EU position | International role in European market |
|---|---|---|---|
| Site investigation and resource assessment | Mapping software and seismic exploration and measurement tools | Good presence in software services and equipment; significant SME involvement | Major US equipment providers |
| Resource development: drilling and sub-surface engineering | Drilling equipment and services; underground piping and cementing; filters, submersible pumps | Good European market share | Strong North American players; increasing Chinese competition for some aspects |
| Resource utilisation and management | Surface equipment: piping, heat exchangers, turbines, generators | Significant players for all types of equipment | Many strong international players (e.g. for turbines). Increasing competition: int. manufacturers of heat exchangers, valves etc. |
| Operation and sustainable management | | Most EU plants are EU | |

Source: JRC based on EGEC

# Clean Industrial Deal

## Net Zero Industry Act 2024

- Goal: increase the EU's manufacturing capacity of technologies that support the clean energy transition
- Geothermal technology is in scope; primarily used components defined by NZIA delegated regulation
- CETO supports monitoring of industrial capacity benchmarks for primarily used components, e.g. EU manufacturing of 40% of 2030 annual demand

| NZIA Primarily Used Component | European Manufacturers |
|---|---|
| Heat exchangers resistant to geothermal corrosive operating conditions | Danfoss & Sondex Holdings<br>Hamon & Cie International SA<br>Kelvion Holdings GmbH<br>Gunter AG<br>**?** |
| Submersible pumps resistant to geothermal corrosive operating conditions | Grundfos<br>KSB AG<br>Sulzer<br>SLB (ex Schlumberger)<br>Halliburton<br>Weatherford<br>SAIPEM<br>Baker Hughes<br>Exergy LLC<br>**?** |
| Brine re-injection pumps | Oil Dynamics<br>KSB AG<br>Sulzer<br>**?** |

# SWOT analysis for the competitiveness of deep geothermal power and heat

| Strengths | Weaknesses |
|---|---|
| • Large potential resource in the EU<br>• Dispatchability and >80% capacity factor<br>• Supports sector coupling with large-scale UTES<br>• Extensive EU manufacturing base<br>• Many district heating and cooling networks to supply<br>• Established R&D sector<br>• Significant local employment | • High CAPEX<br>• Licensing delays<br>• Seismic concerns for EGS<br>• High-temperature resources at moderate depths only available in some EU locations<br>• Competing demand for drilling expertise and equipment from the oil/gas industry |
| **Opportunities** | **Threats** |
| • EGS with higher efficiencies and more potential locations<br>• Recovery of lithium and other CRMs from geothermal brines<br>• Export of services and equipment<br>• Better resource data, technology and expertise can increase exploitable resources<br>• Expertise synergies with the oil and gas sector<br>• Emergence of the EU heat market, UTES technology<br>• EC policies for accelerated licensing | • Low/subsidised fossil fuel prices<br>• Low social acceptance in some countries<br>• Competition from other clean tech investments in the EU, in particular wind and solar for power generation<br>• Shortage of expertise and skills at all levels<br>• Reduced R&I funding |

Source: JRC CETO

# Thank you

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