

Towards a Vision document

Geothermal Heat Pumps & Underground Thermal energy Storage

- Firmly established on the market in all EU countries. Integrated in energy systems for building, combined with other RES, in particular in H&C networks.
- Geothermal energy storage developed for seasonal storage, with specific applications for waste heat from industry (high temperature storage).
- Key provider for heating and cooling for individual houses, commerce and services.

Direct uses – District heating

- Develop commercial deep geothermal projects for industrial use and agriculture applications, desalination and innovative applications
- Development of large integrated district heating and cooling systems in which geothermal energy is flexibly used in different forms, alone or in combination with other RES.

Heat from geothermal CHP systems (Binary and EGS)

- Cogeneration with Enhanced Geothermal Systems and Low temperature power plants, micro cogeneration
- Develop new district heating systems for dense urban area



UPDATES

- Direct heat – general development
 - Awareness fossil fuel heating needs to be replaced rapidly and massively
 - Therefore rapid Growth anticipated of DH networks
 - Marked by RE system integration (see Lund et al., 2014)
 - Geothermal role considered more important than in the past
 - Extended range of temperature and application
 - Through technological innovation
 - Through policy awareness and economics (e.g. focus process heat for industry up to 200C)

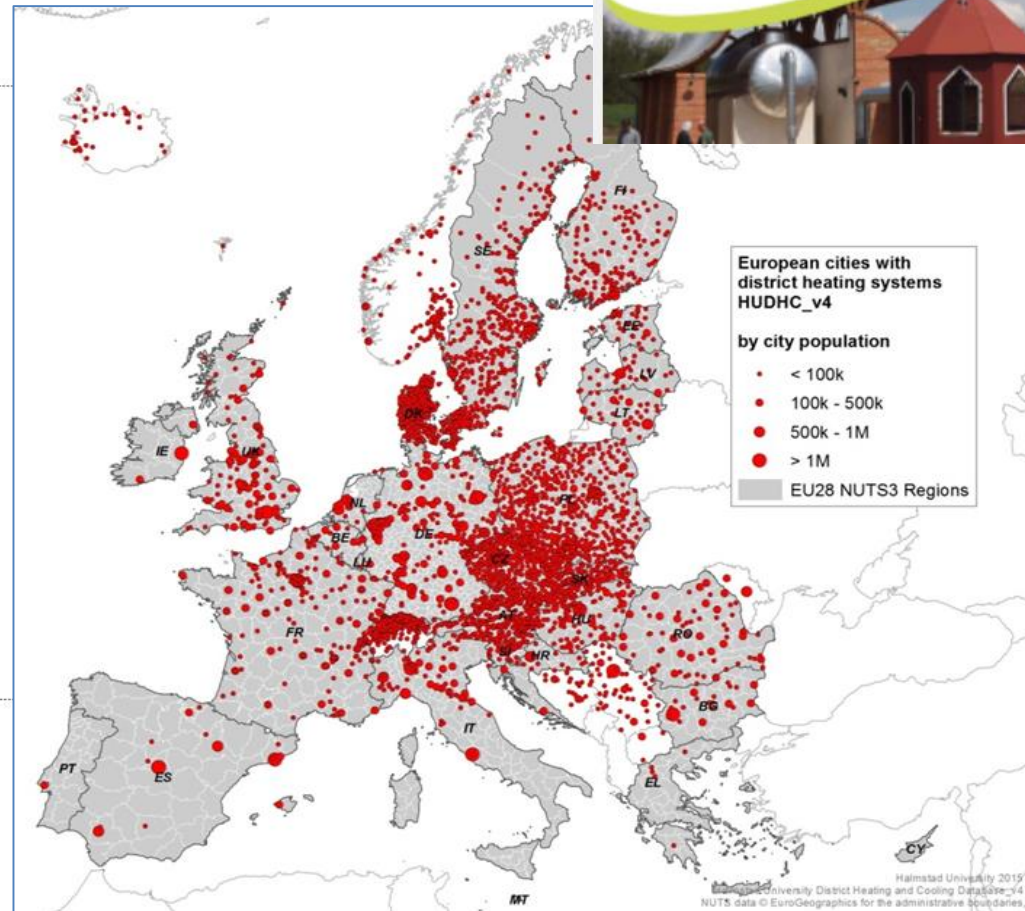
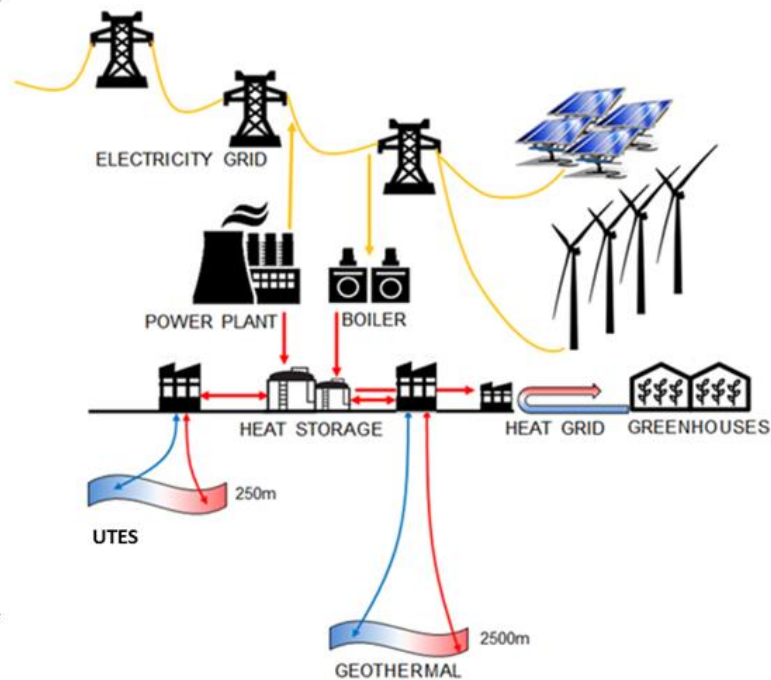
Renewable direct heat – energy mix developments

- **Replacement** needed for **fossil fuel** for **space/agriculture/industry heat**
- Takes up to **40% of energy demand** (<200C), in (northern) Europe, 20% < 100C
- **heat networks (DH)** rapidly evolve to harness waste heat, and will in long run be fed by RE sources
- **Seasonal storage** is a major challenge to boost performance and overcome mismatches demand/supply (e.g. solar)

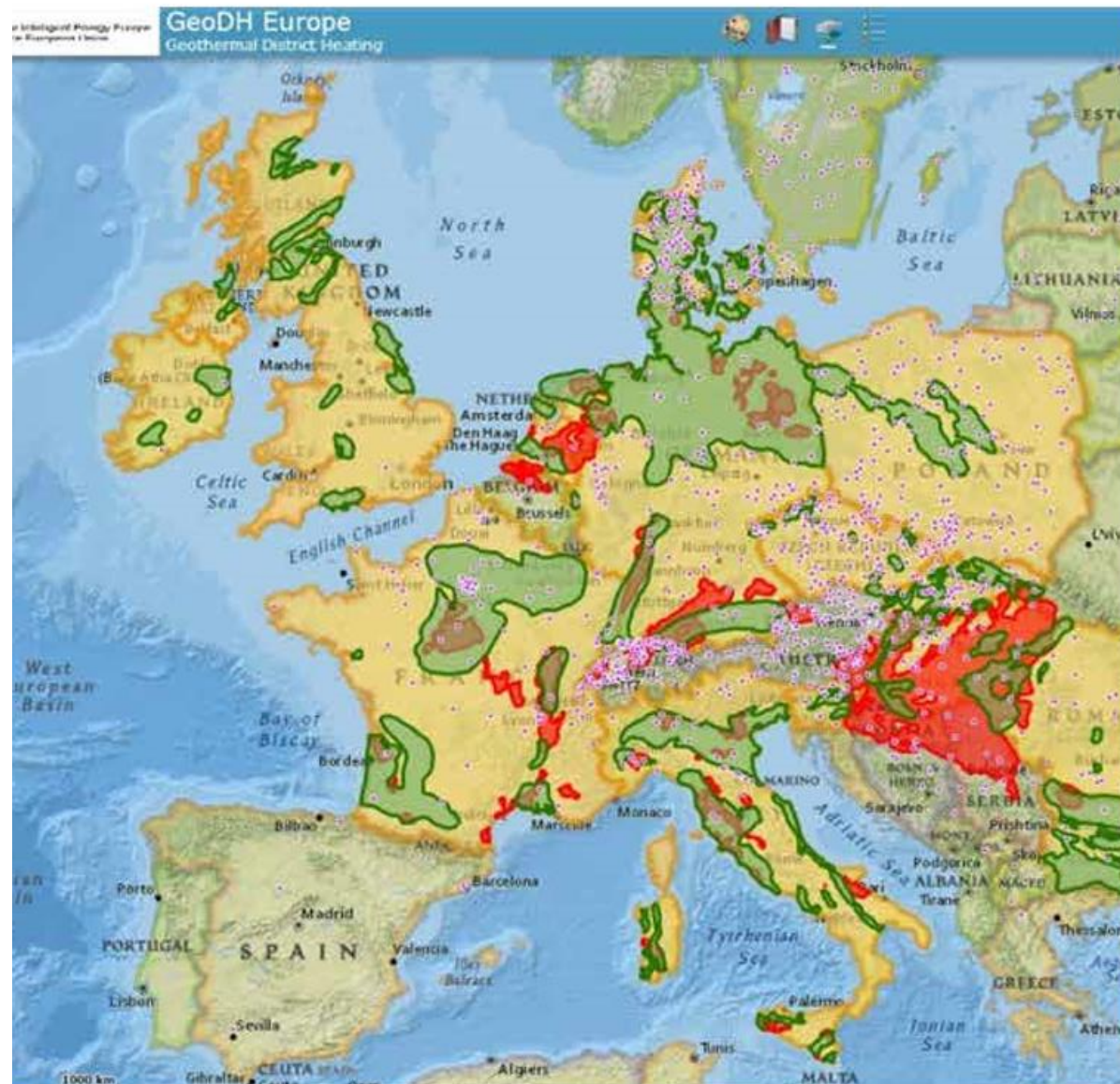
Renewable direct heat – deep geothermal role in energy mix

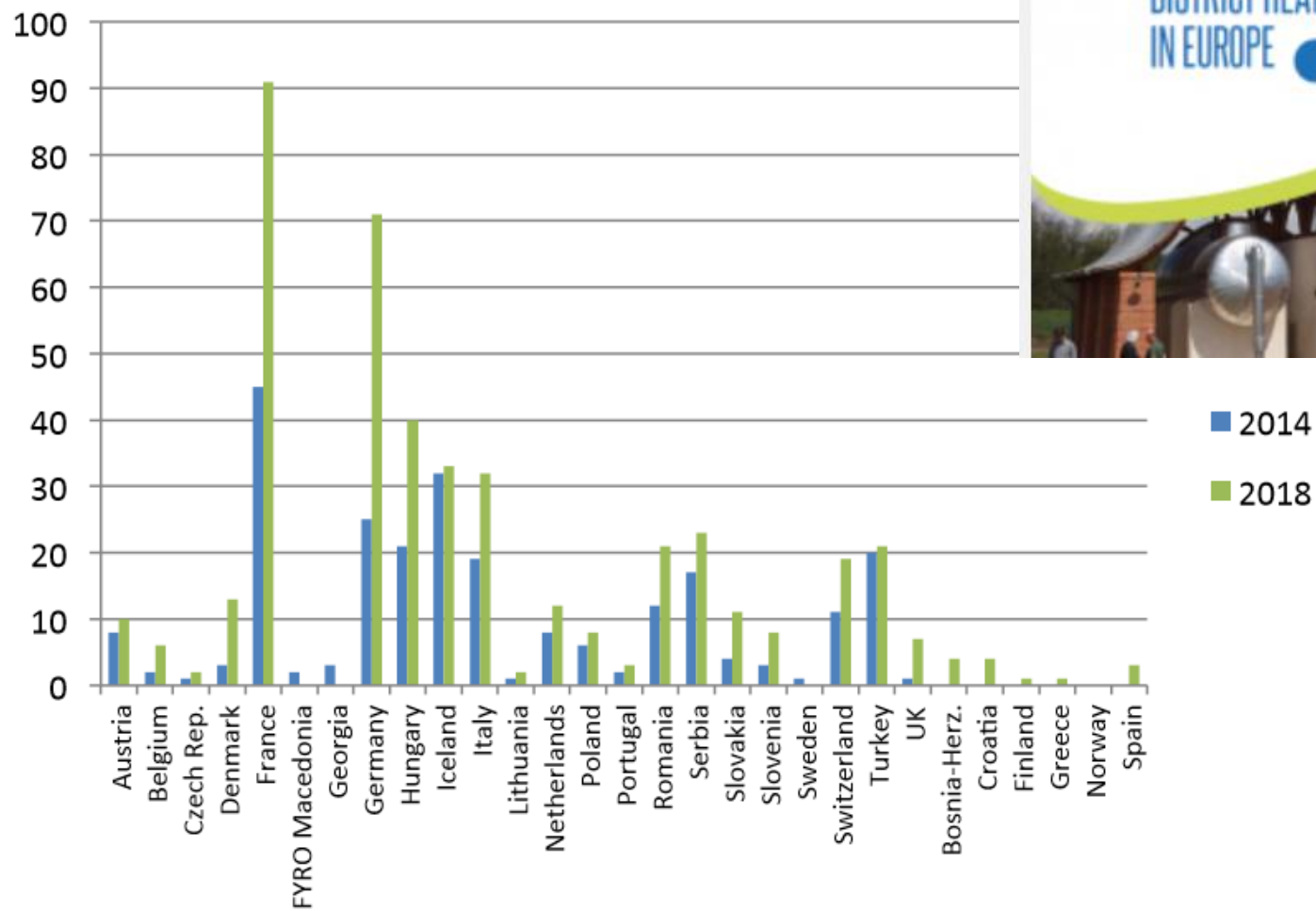
- **Excellent subsurface potential** to feed networks
 - Excellent low hanging fruit in sedimentary basins (>500 Billion invested by oil&gas), in theory easy to find sweet spots (mostly < 100C)
 - In long term EGS (cf. geoeELEC) and shallow resources (e.g. GSHP)
 - Proven track record in small areas, cheap option compared to other RE alternatives.
 - Well suited for densely populated areas (no surface use)
 - 3G and 4G DH are suited to continuously lower temperatures and larger sourcing areas
- **High temperature storage** for enhancing production (all year round GT sourcing) and seasonal balancing
- **RE system integration/ HP** allows to **enhance production Temperature** and to deploy for **cooling** purposes

Heat networks

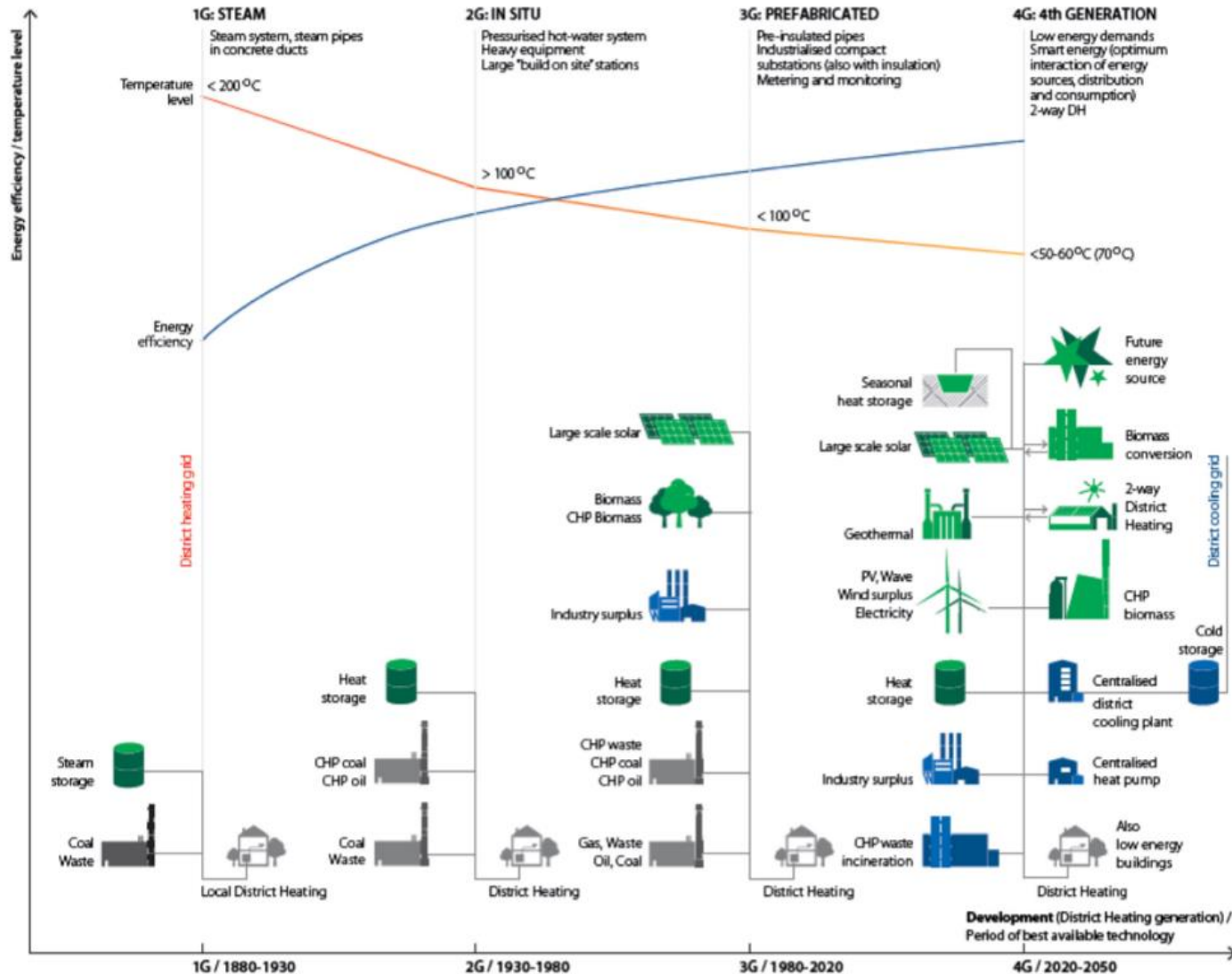


DEVELOPING GEOTHERMAL DISTRICT HEATING IN EUROPE



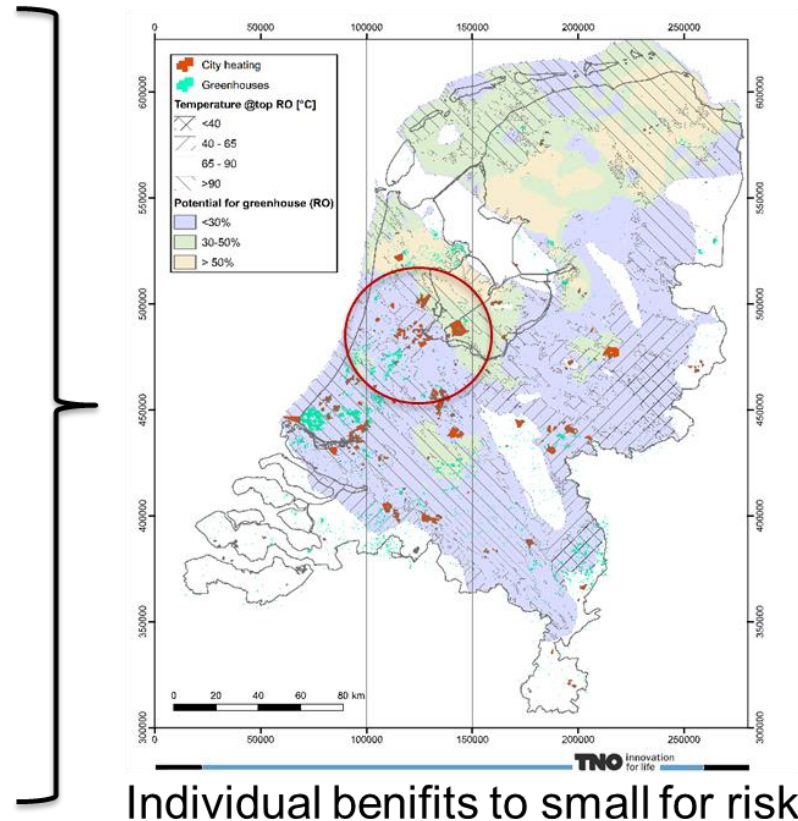
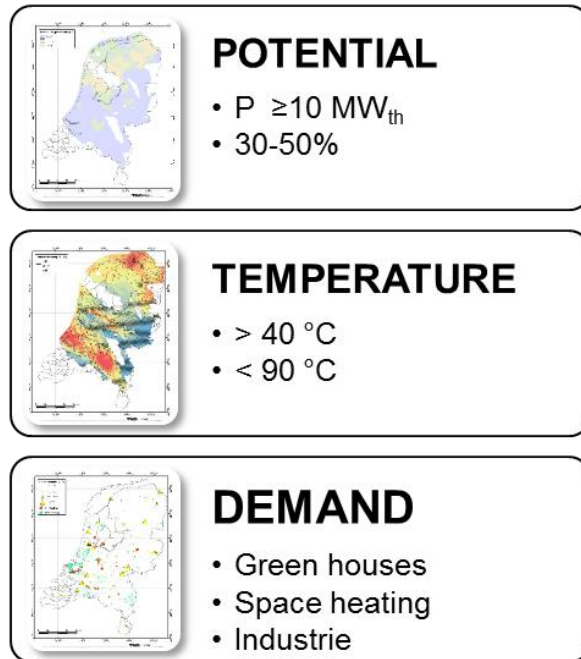


4th generation Heat networks



Excellent potential from hydrothermal reservoirs, but subsurface risks

COMBINATION OF GEOLOGICAL POTENTIAL AND DEMAND



Need for portfolio (collectieve) approach to manage risk

Renewable direct heat –indicate potential and market share

- 2030 : 1-5% of total direct heat demand, rapid growth in places with existing heat demand, and low subsurface risk. Critically dependent on
 - Legislation and pre-competitive efforts harnessing existing subsurface data
 - feed-in incentives
 - collective approaches to manage subsurface risk, exploration technology
 - Market penetration of DH
 - Technical developments for well performance and heat storage
 - Technical developments for GSHP

Renewable direct heat –indicate potential and market share

- 2040 : 5-15% of total direct heat demand, extended growth, deployment if EGS resources. Critically dependent on
 - The above
 - Technical development (GSHP, EGS, etc)

Renewable direct heat –indicate potential and market share

- 2050 : 10-25% of total direct heat demand, extended growth, deployment of EGS resources. Critically dependent on
 - The above
 - Technical development (EGS, GSHP,etc)

Why GeoElec?

- set geothermal on the energy agenda of EU Member States
- convince decision-makers about the potential of geothermal electricity in Europe
- stimulate banks and investors in financing geothermal power installations
- attract potential investors such as oil and gas companies and electrical utilities to invest in the geothermal power

Achievements in brief

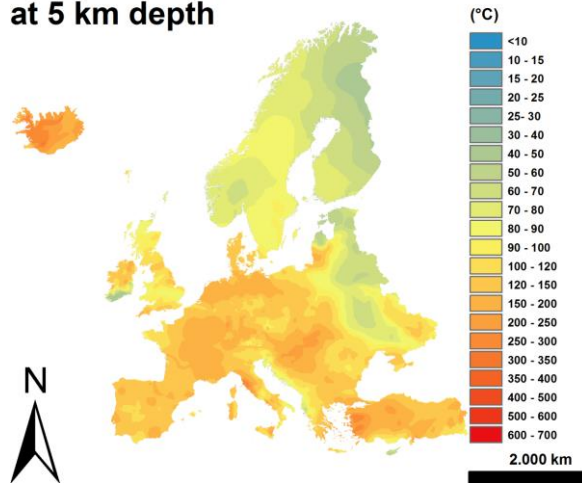
- resource assessment for geothermal electricity in Europe (GeoElec Viewer)
- software to estimate financial viability of geothermal projects
- factsheets with newest numbers on markets, potential, finance, work, regulations, and public acceptance
- training courses for stakeholders from industry and R&D
- promotional workshop in Utrecht with 50 stakeholders



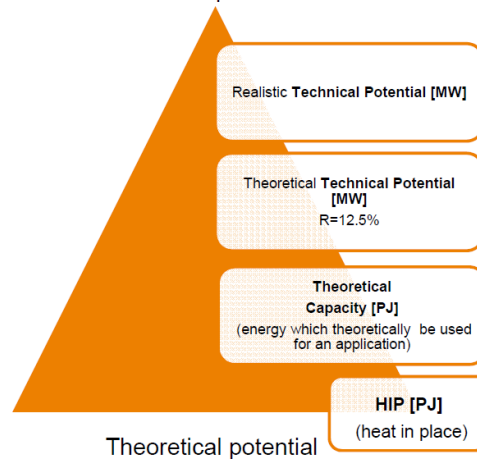
GeoElec Potential

Geothermal Potential for Electricity Generation in the EU

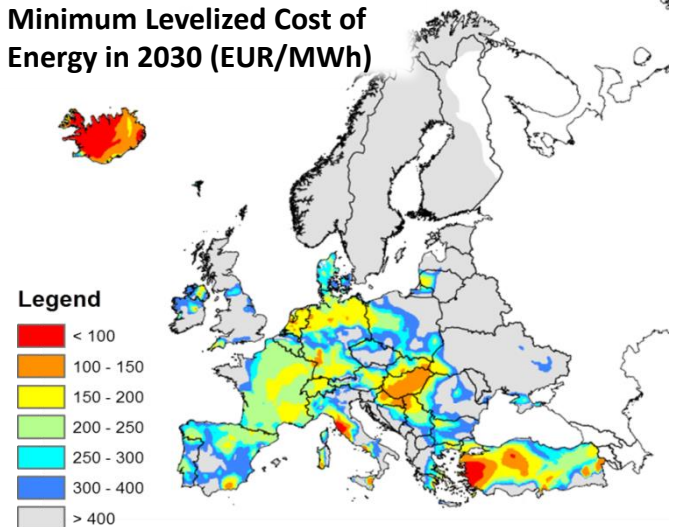
Modeled Temperature
at 5 km depth



Practical potential



Minimum Levelized Cost of
Energy in 2030 (EUR/MWh)

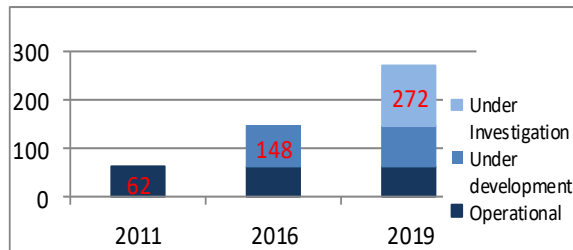


The GeoElec Viewer presents for the first time a geothermal resource assessment from 1 to 5 km depth.

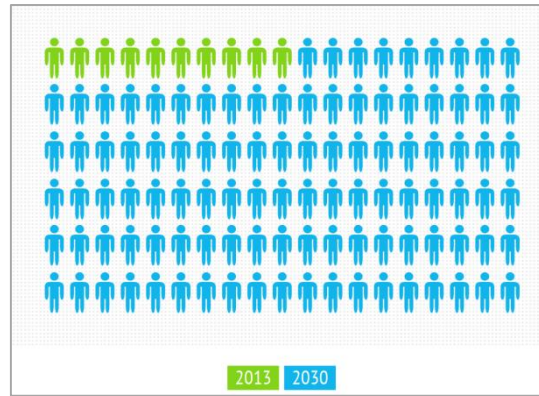
It enables users to assess estimated potential for geothermal electricity production in 2020, 2030, and 2050 in each of the EU-28 Member States plus Norway, Iceland, Switzerland, and Turkey.

Growing business!

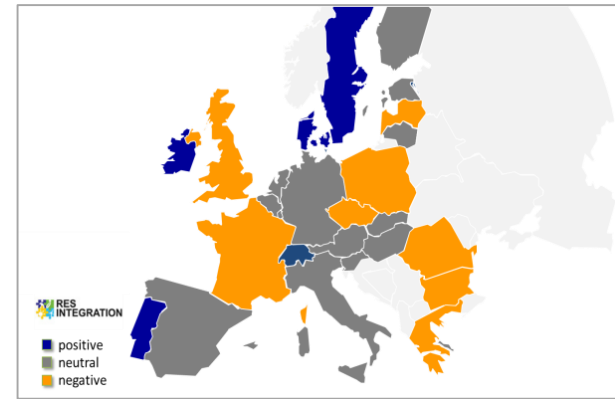
Geothermal will gain more significance in the coming decennia:
markets, jobs, grid infrastructure



No. of geothermal power plants in Europe



Jobs in the geothermal sector in Europe



Grid development process (Binda et al. 2012)

BUT: abolish barriers!

