Geothermal Potential of Germany
Perspective of Industry

Geothermal Potential of Germany
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EnBW Research & Innovation
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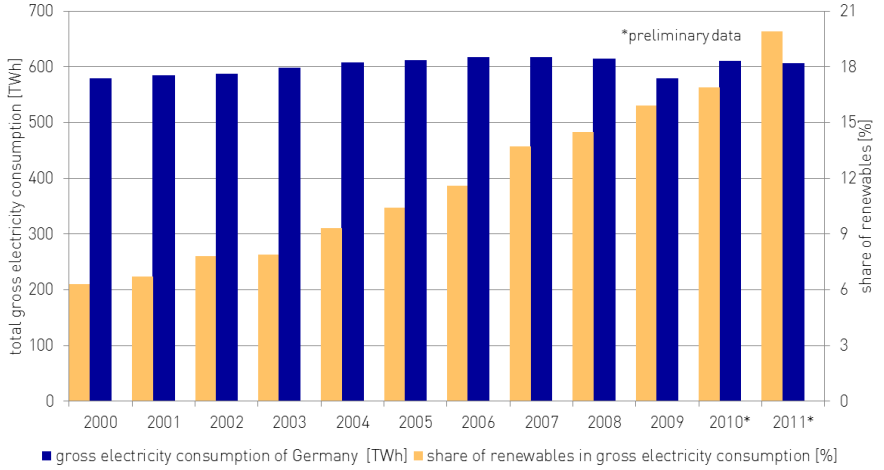
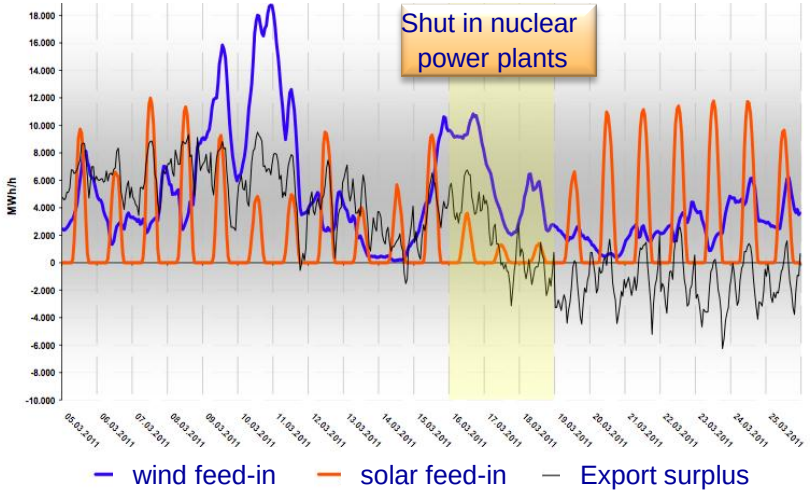
Electricity Demand in Germany

- Status quo
  - Annual gross power consumption about 600 TWh
  - 2011: Share of renewables about 20 %
- Moratorium of nuclear power plants
  - Shutdown March 2011: 5000 MW
  - Gradual exit of nuclear energy till 2022
- Consequences
  - Decreasing export activity
  - Need of electricity imports despite feed-in of volatile renewables sources
  - Increasing north-south load flows



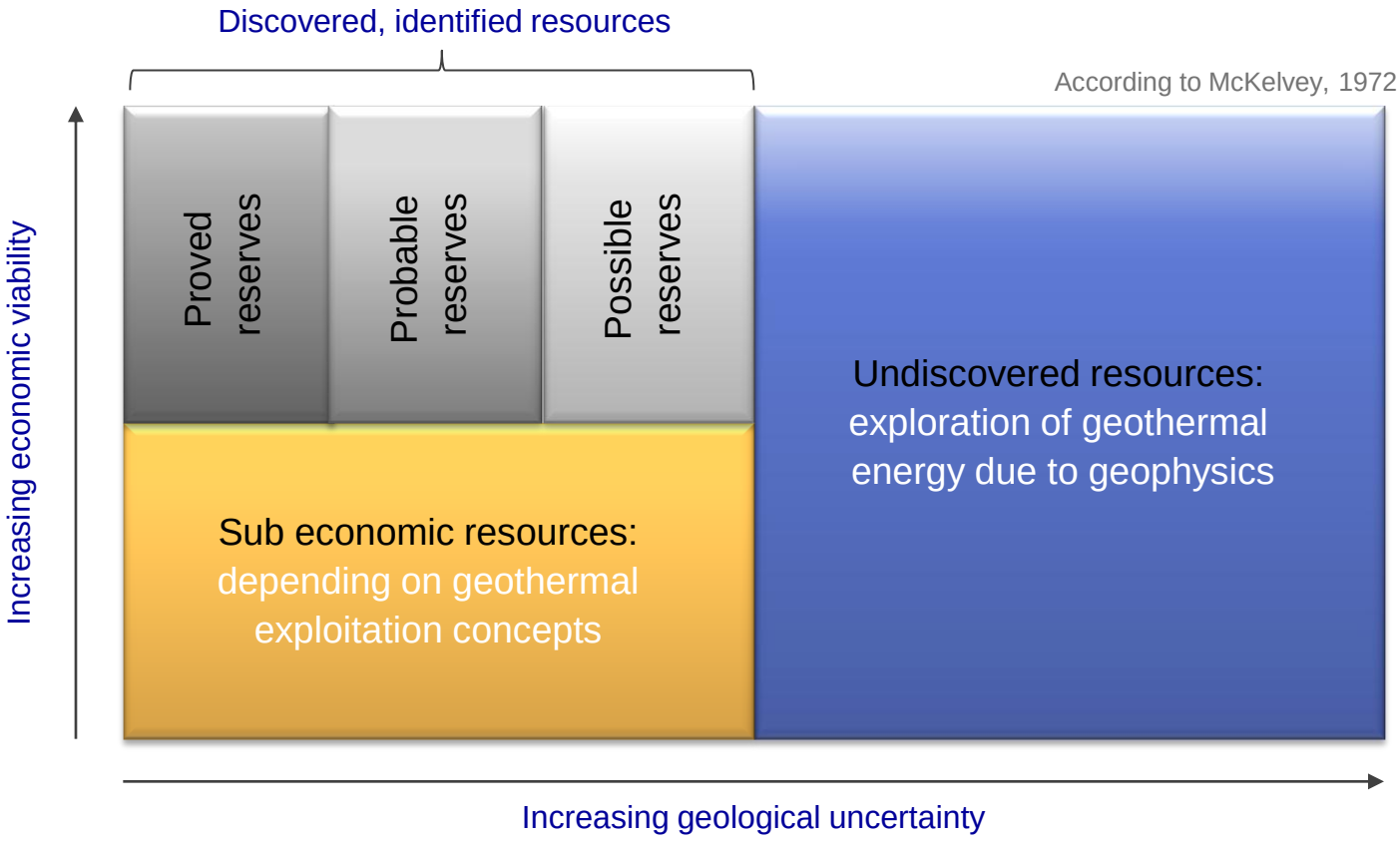
Source: Statistisches Bundesamt, 2011

Source: BNetzA, 2011

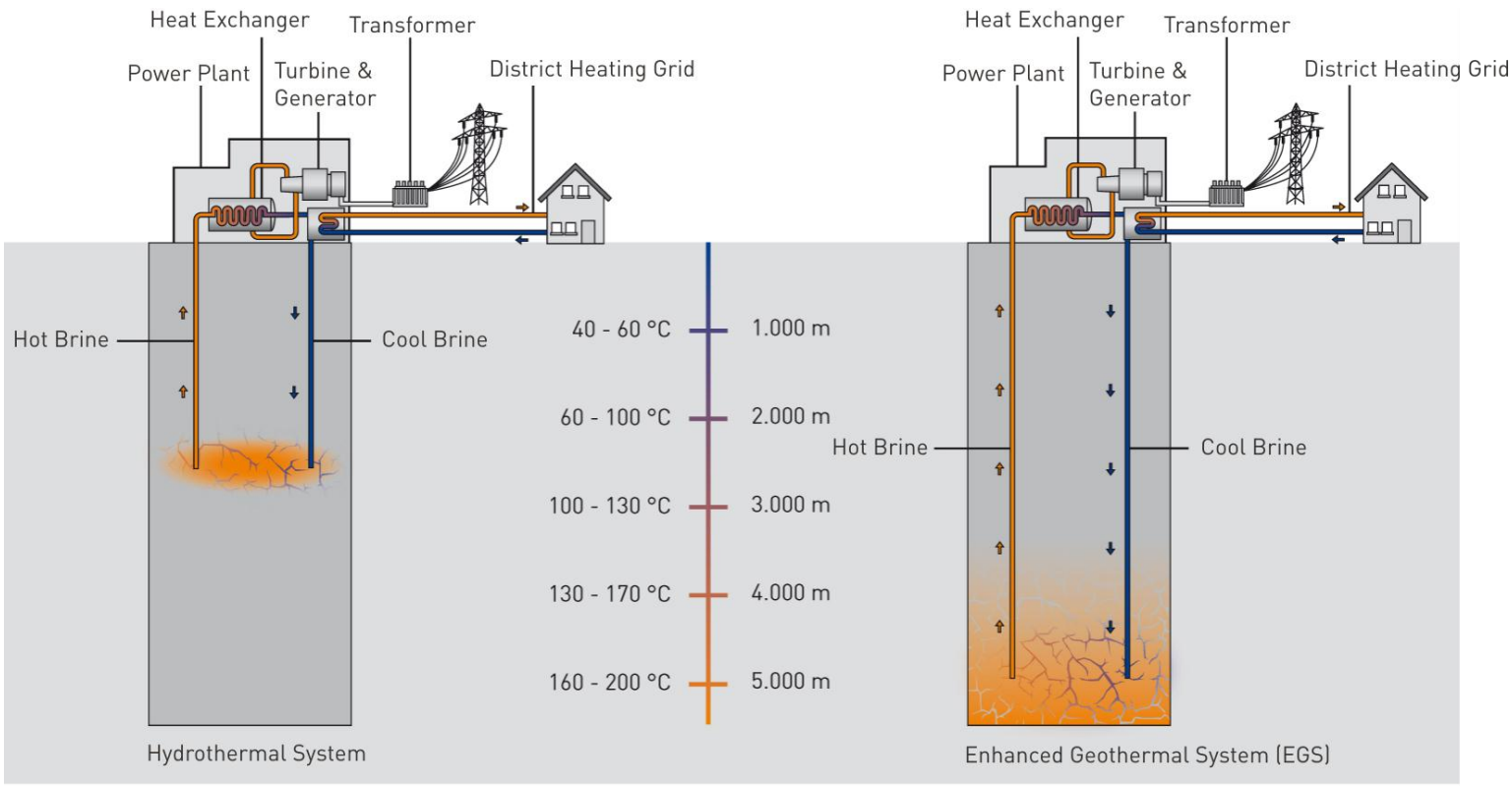


Classification of Geothermal Potential

› Use of geothermal energy in comparison to McKelvey's resource economics

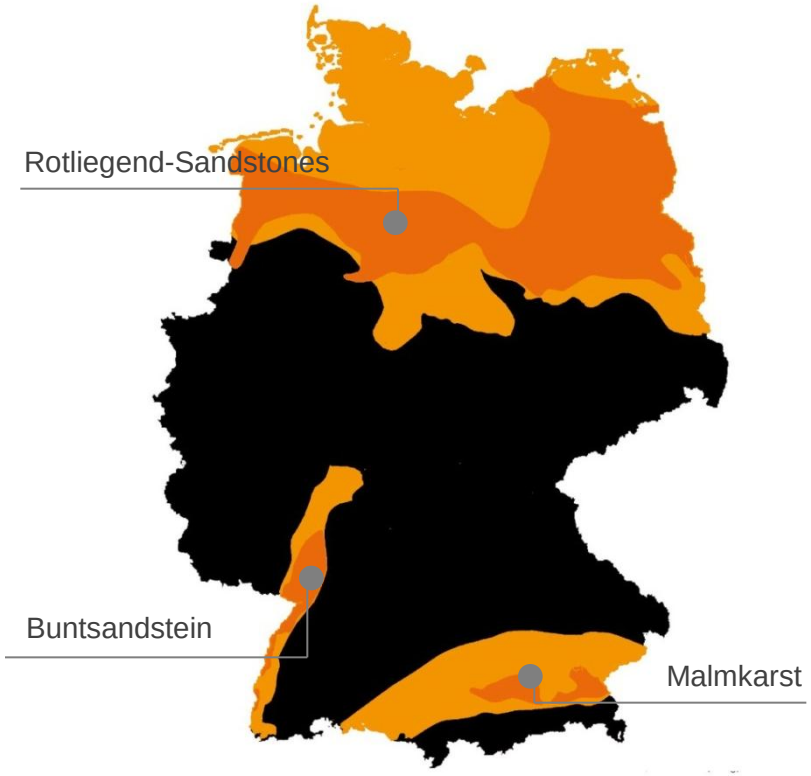


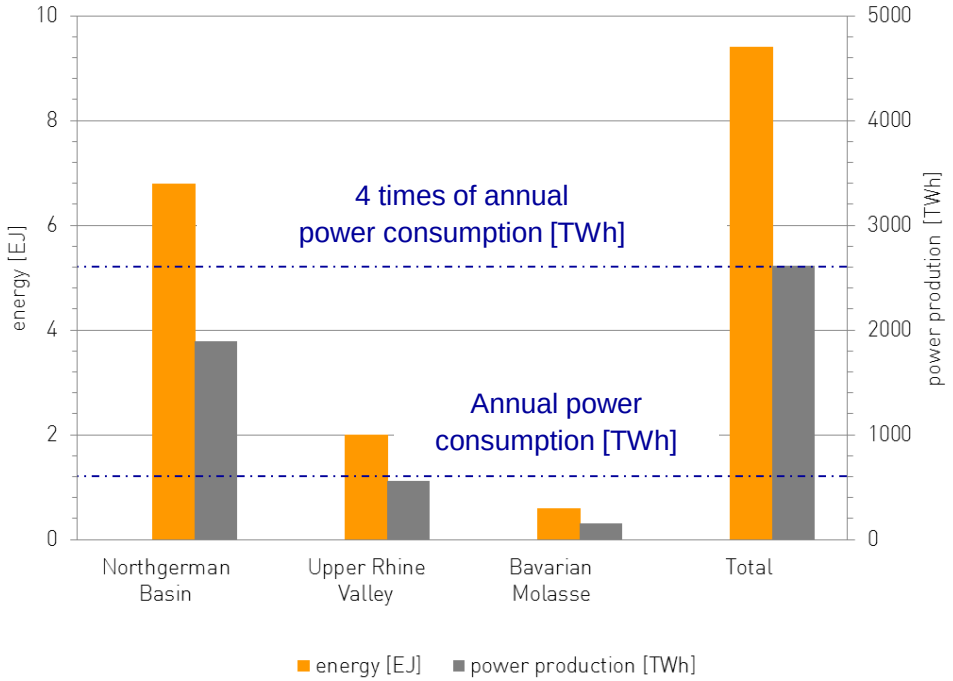
Deep geothermal systems for power production



Potential of Hydrothermal Systems

- Geothermal exploitation by the use of aquifers in 2-4 km depth
- Total technical potential of hydrothermal systems ~ 2600 TWh



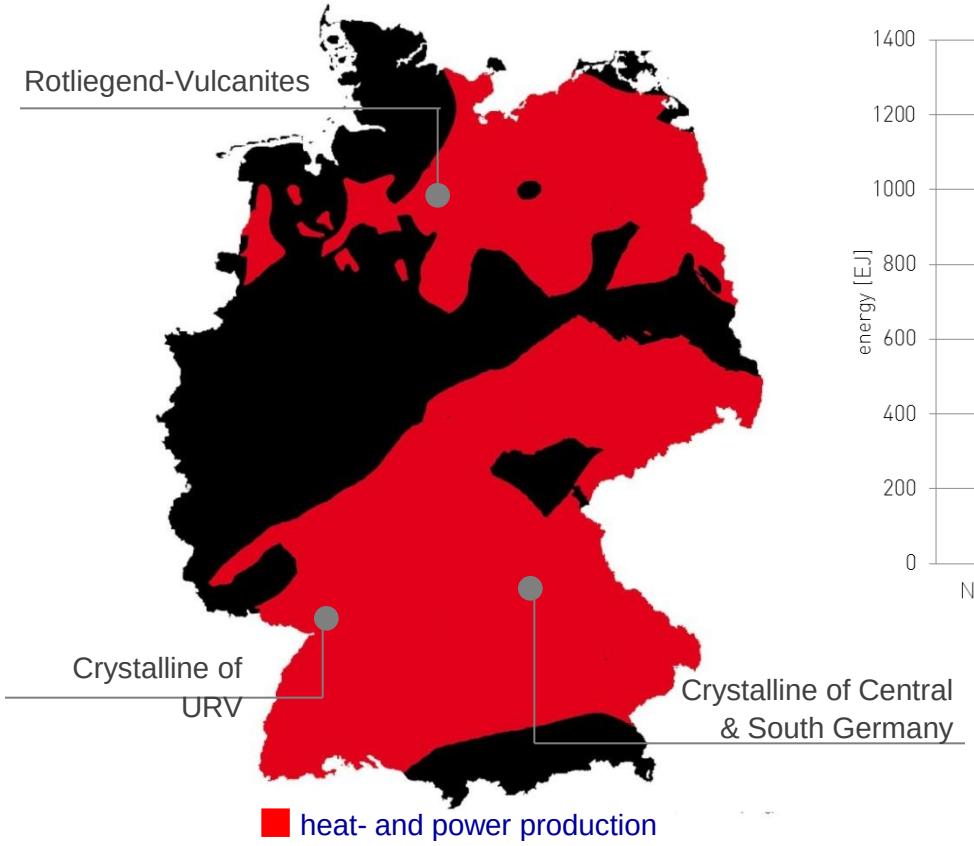


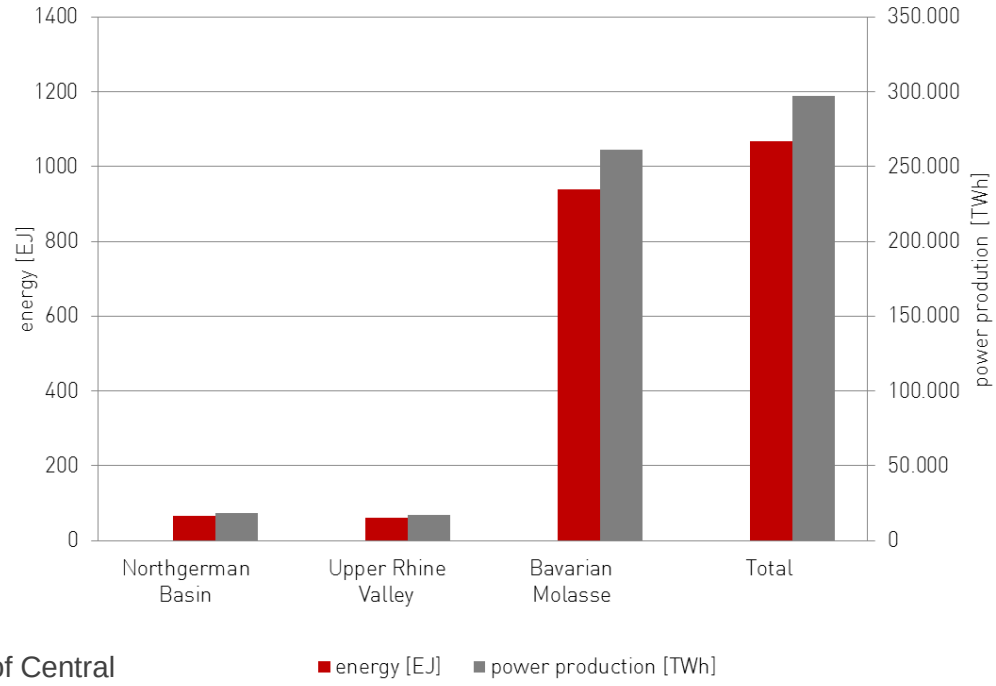
According to TAB, 2003

Source: Agentur für EE, 2011

Potential of Enhanced Geothermal Systems

- Geothermal exploitation by the use of crystalline basement (granite, gneiss)
- Total technical potential of EGS ~ 297000 TWh





According to TAB, 2003

Source: Agentur für EE, 2011

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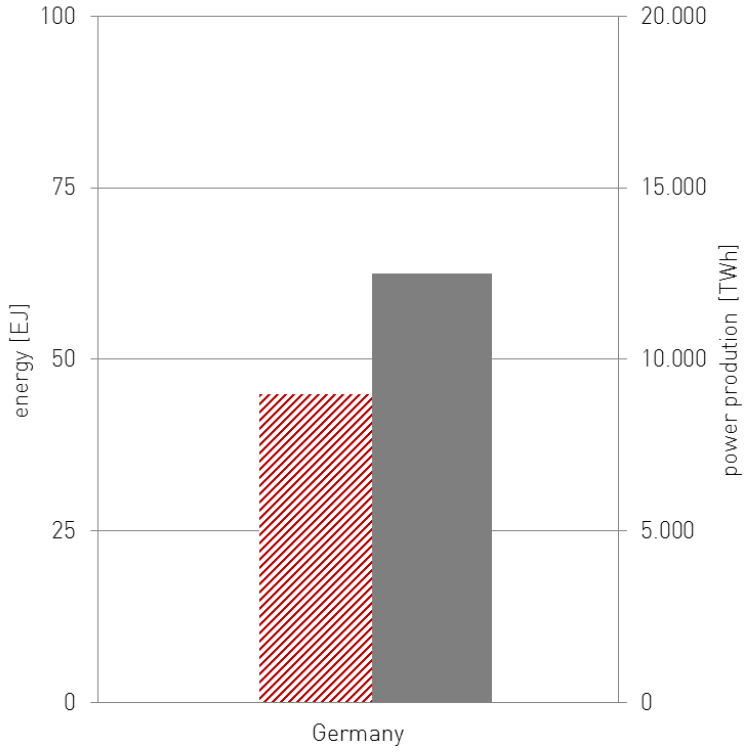
Potential of deep fractures

- Geothermal exploitation by the use of natural occurring fracture (crystalline & sandstone)
- Total potential of deep fractures ~ 12500 TWh

heat- and power production

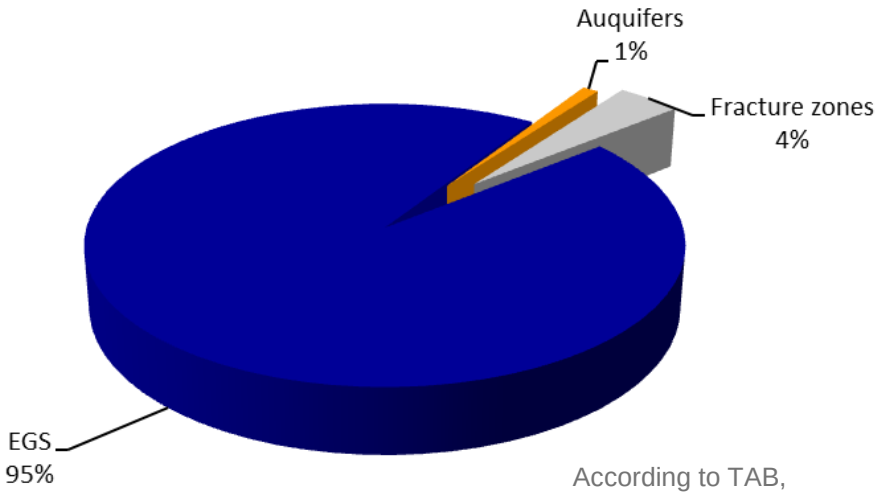
Source: Agentur für EE, 2011



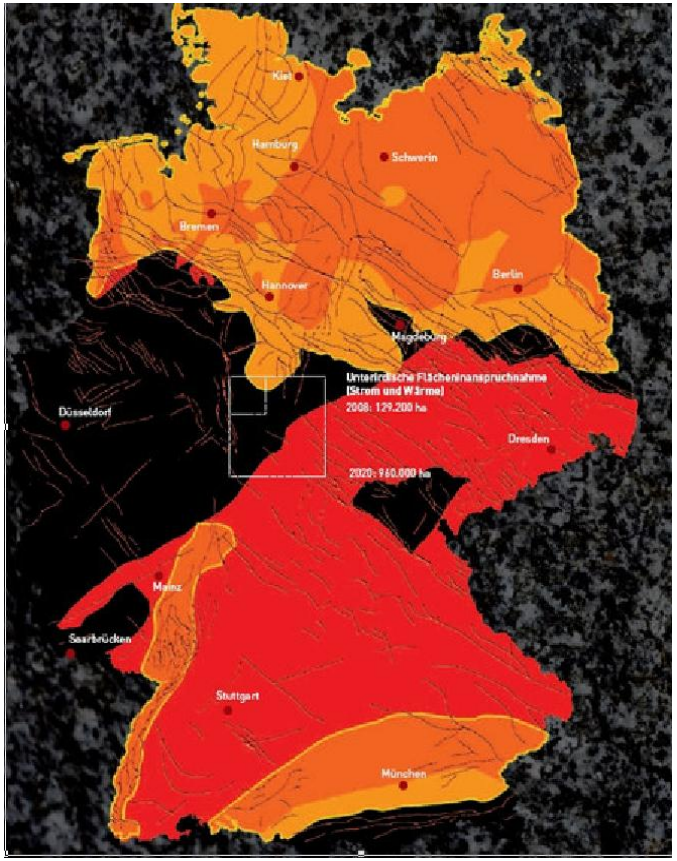
According to TAB, 2003

Total Geothermal Potential

- Total technical potential for power production about 333.300 TWh
- 550 times of the current power consumption
- Future technology: EGS
  - Not only for crystalline rocks, but also for sandstones



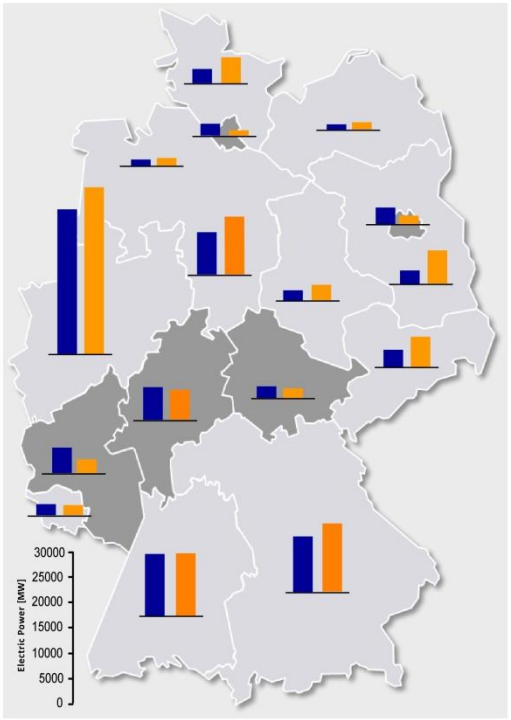
According to TAB, 2003



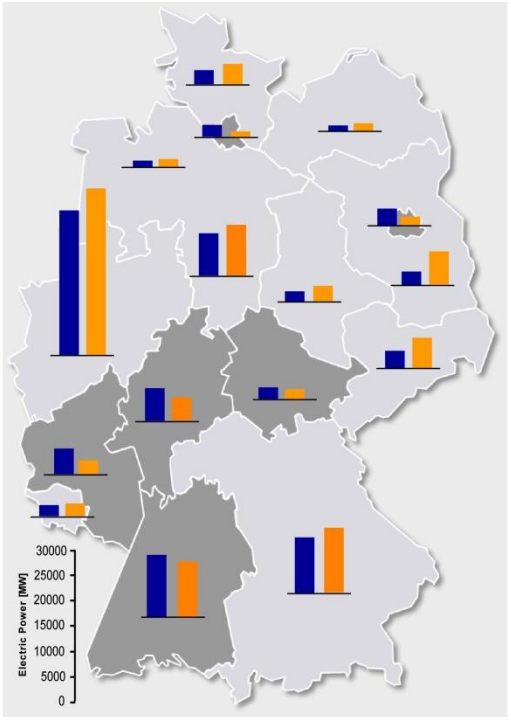
Source: Agentur für EE, 2011

Impact of moratorium of nuclear energy

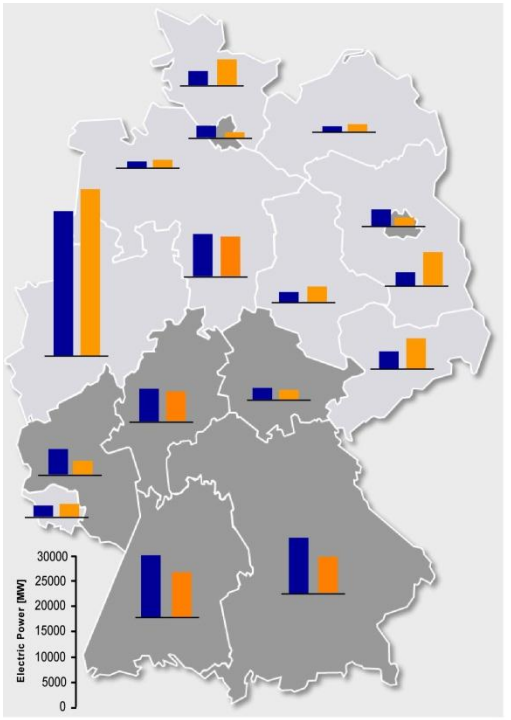
- Assumption: building of new power plants had not been considered



Situation 2008



Moratorium 2011

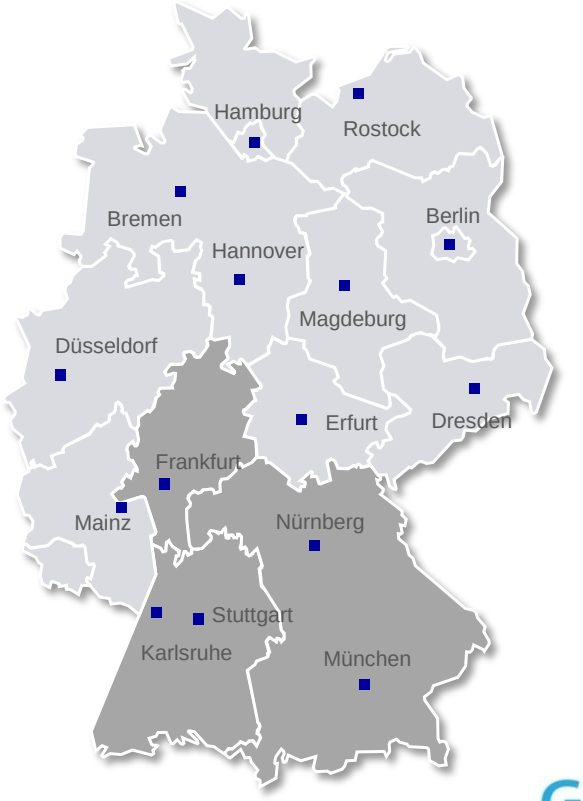


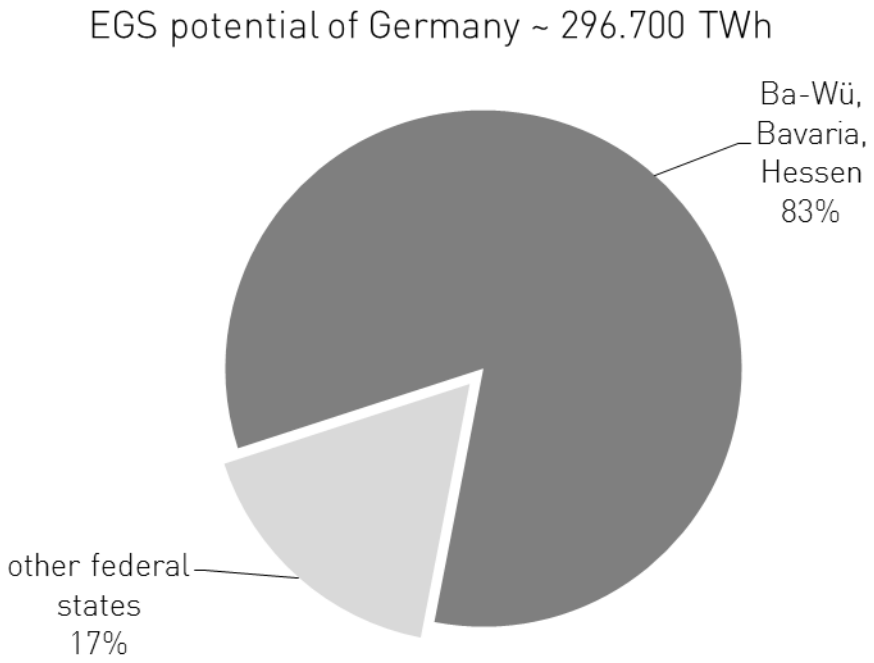
Forecast 2022

Total power consumption [MW] Installed gross capacity [MW]

Contribution of geothermal energy for grid stability

- Technical approach: EGS for crystalline rocks
- Assumption: spatial distribution of the potential of Central & South Germany
- Consideration of geothermal anomalies of the Upper Rhine Valley





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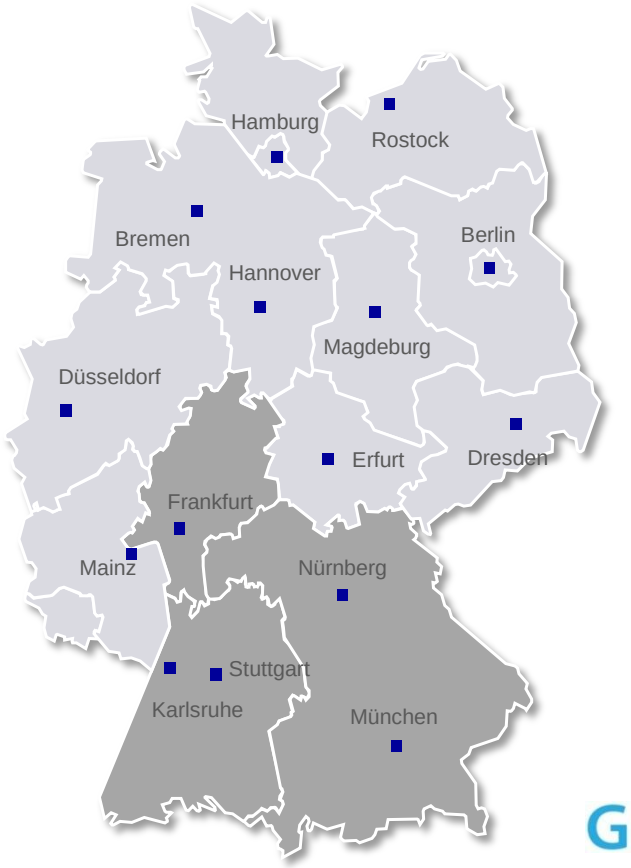
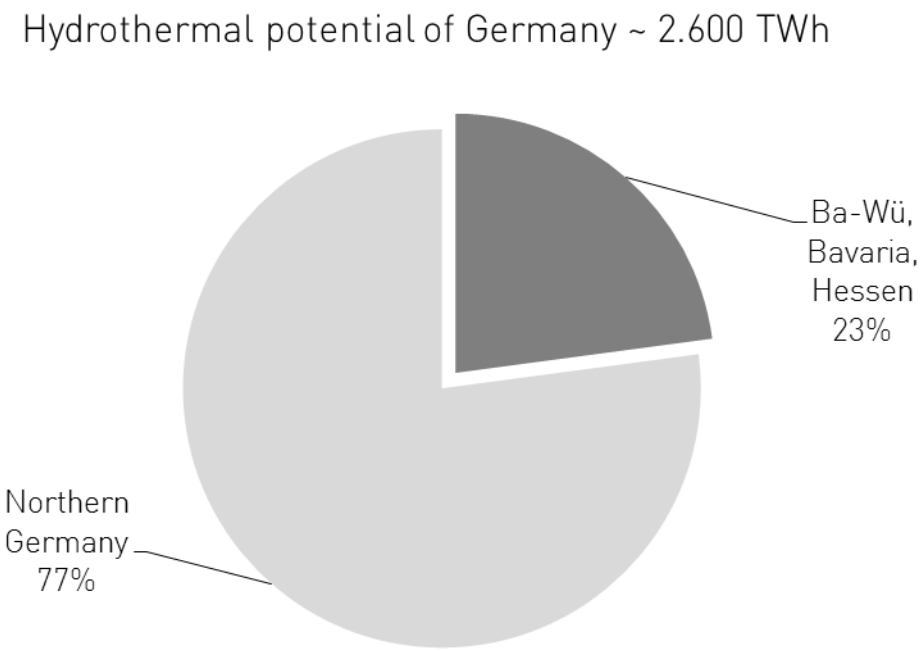
Contribution of geothermal energy for grid stability

- Technical approach: Hydrothermal Systems
- Assumption: one third of the Upper Rhine Valley belongs to Rhineland-Palatinate





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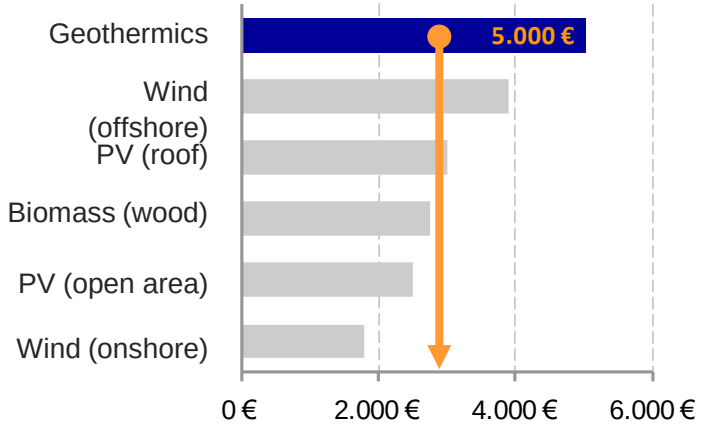
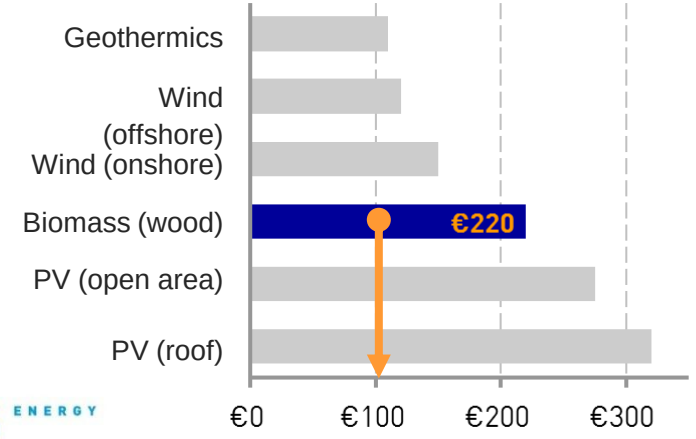
Summary

- Geothermal potential of Germany
  - Technical potential about 1200 EJ
  - 550 times of annual power consumption
- Geothermal contribution to grid stability
  - EGS as future technology
  - Additional power generation in the southern part of Germany
- Economic feasibility
  - Production costs already comparable to other renewable energy sources
  - Cost reduction potential by the use of low hanging fruits

Invest [€/kW]



Power production costs [€/MWh]



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Thanks for your kind attention!