35 years Dutch experience on ATES

Speicher City

February 19 2025

Bas Godschalk

- Study: chemistry, geochemistry, microbiology
- Worked 7 years at a soil remediation company with electro(bio)reclamation
- 17 years in shallow and deep geothermal energy projects, with a focus on:
  - *ATES, BTES, Surface Water Energy*
  - *HT-ATES & MT-ATES*
  - *International Projects*
- Since 2024: DTESS

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Who is dtess?

- **D**utch
  - Consultant company based in the Netherlands
  - Active in: BE, DE, KR, JP, US, EU, CA
  - Owner Bas Godschalk
- **T**hermal **E**nergy **S**torage
  - Shallow and deep geothermal energy projects
  - Focus on ATES, HT-ATES, BTES, Surface Water
  - Innovations in thermal energy storage
- **S**olutions
  - Project Management
  - Business Development
  - Knowledge Exchange

dtess

accelerating thermal energy knowledge

What we do?

Think in solutions

- From idea to realisation
- Feasibility study
- Design & permits
- Supervision during realisation
- Support exploitation

Driven by business

- Develop your geothermal business
- Value chain mapping
- Stakeholder analysis
- Critical success factors

Sharing is caring

- Facilitating and accelerating exchange of knowledge and experience
- Training & courses
- Organize trade trips and fact-finding missions

Our partners

Focus DTESS

- Project Management
- Business Development
- Knowledge Exchange

Partners

- Collaboration in projects
- Decades of experience
- Bringing the best knowledge
- Accelerate the energy transition

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TNO

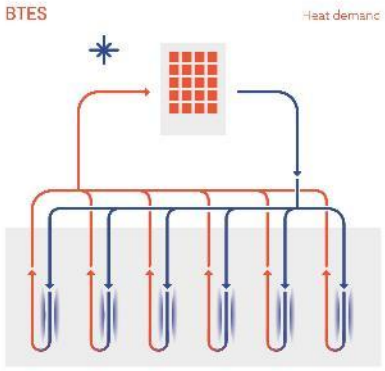
Renewable Heat

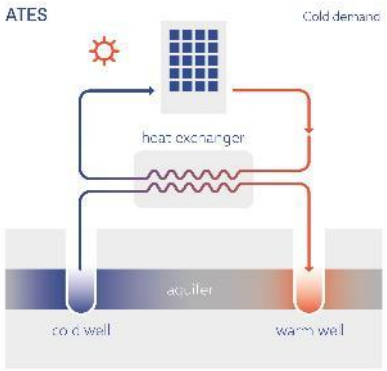
Witteveen + Bos

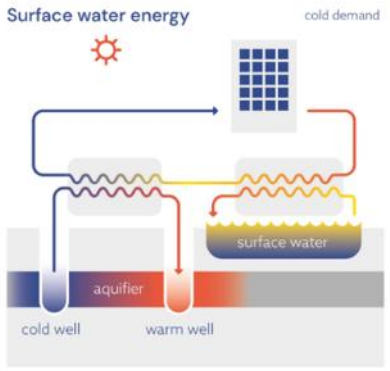
KIT
Karlsruhe Institute of Technology

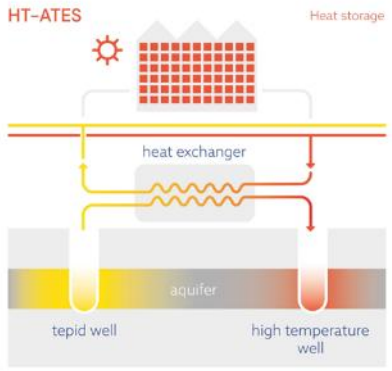
Gemelio

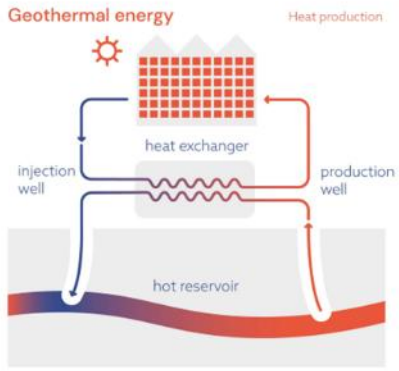
Shallow and deep geothermal solutions









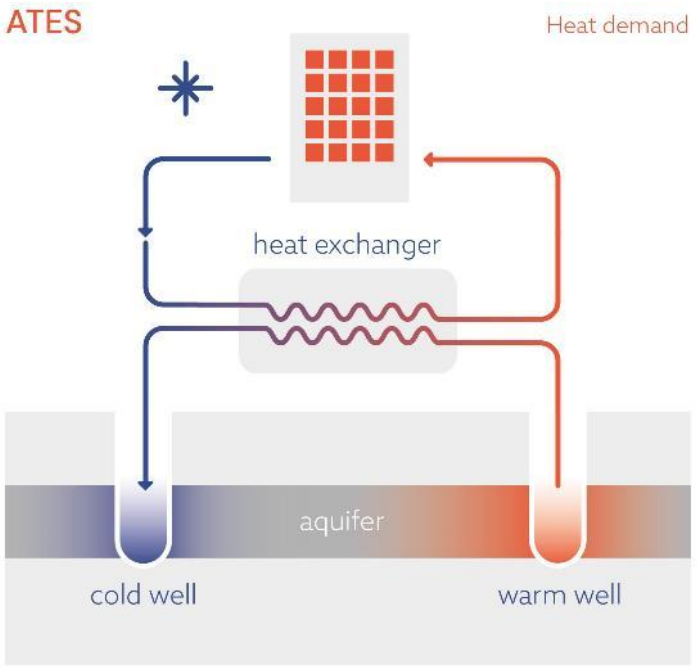


	BTES	ATES	SWE	HT-ATES	Deep Geothermal
Name	Borehole Thermal Energy Storage	Aquifer Thermal Energy Storage	Surface Water Energy	High Temperature ATES	Deep Geothermal
Type	Closed loops	Open groundwater wells	Surface water inlet	Open groundwater wells	Open wells
Depth range	50 – 150 m-bsl	40 – 250 m-bsl	Inlet + outlet	100 – 1000 m-bsl	2,000 – 5,000 m-bsl
Application	Single home, small office	Offices, hospitals, greenhouse	Heat or cold, balancing ATES	District heating, heat buffer	Direct heating, electricity production

ATES

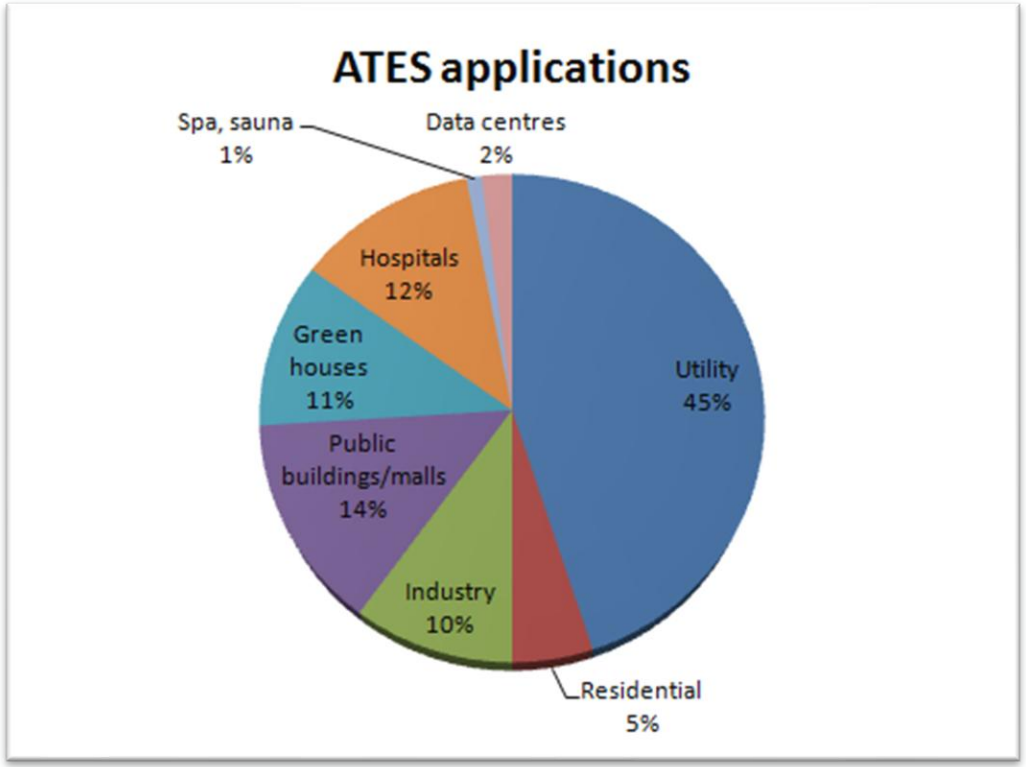
Aquifer Thermal Energy Storage

ATES - characteristics



- Seasonal storage of heat & cold
- Battery of heat & cold
- High performance in cooling mode
  - COP: 30-40
- Good performance in heating mode
  - COP: 4-5
- Temp. range cold well: 5 – 10 ^{o}C
- Temp. range warm well: 13 – 17 ^{o}C
- Depth well: 40 – 250 m bsl
- Flow rates: 25 – 250 m^3/h per doublet

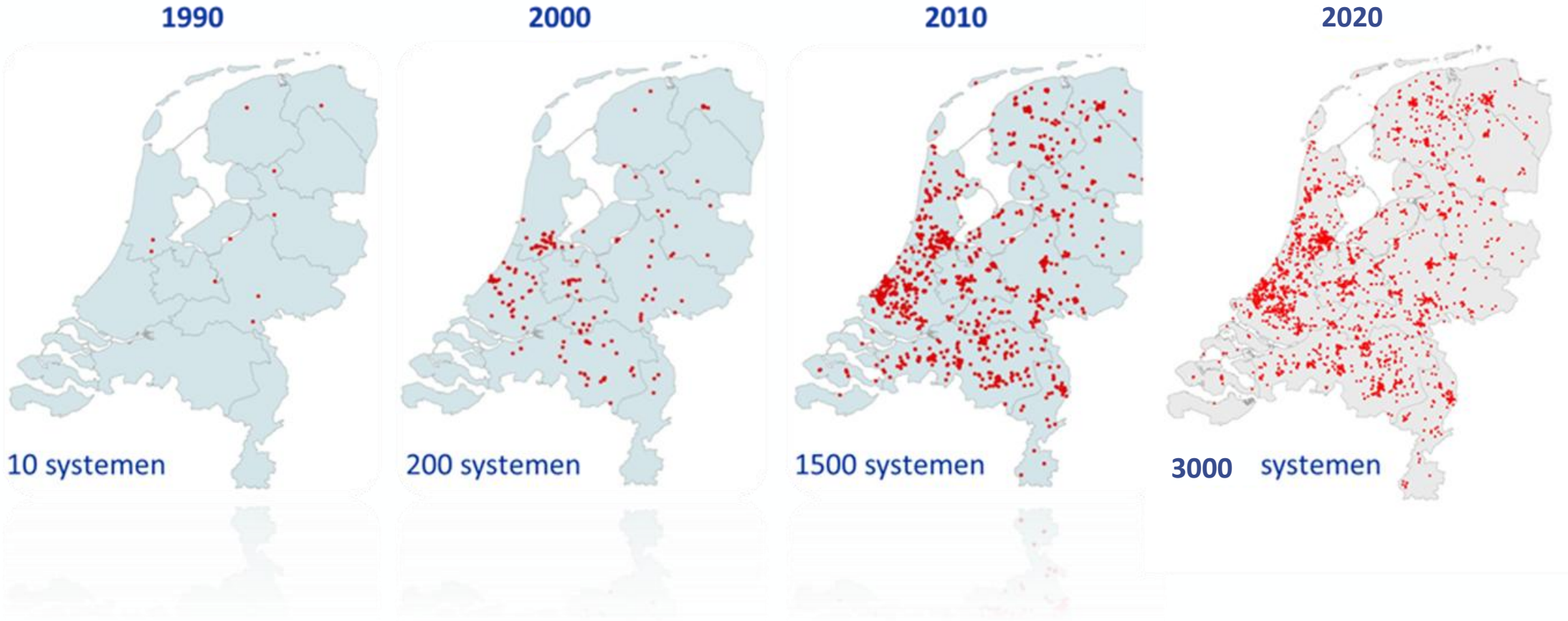
ATES – applications Dutch market



- Utility (office buildings)
- Hospitals
- University campuses
- Greenhouses
- Airports
- Shopping centres
- Residential areas
- Data centres

Development of ATES in the Netherlands?

ATES development over 3 decades



Source: IF Technology

Geothermal Heat pumps in Europe

EGEC Geothermal **Market Report 2022**

Fig. 14 Number of geothermal heat pumps installed (stock) in 2022 in Europe, per country

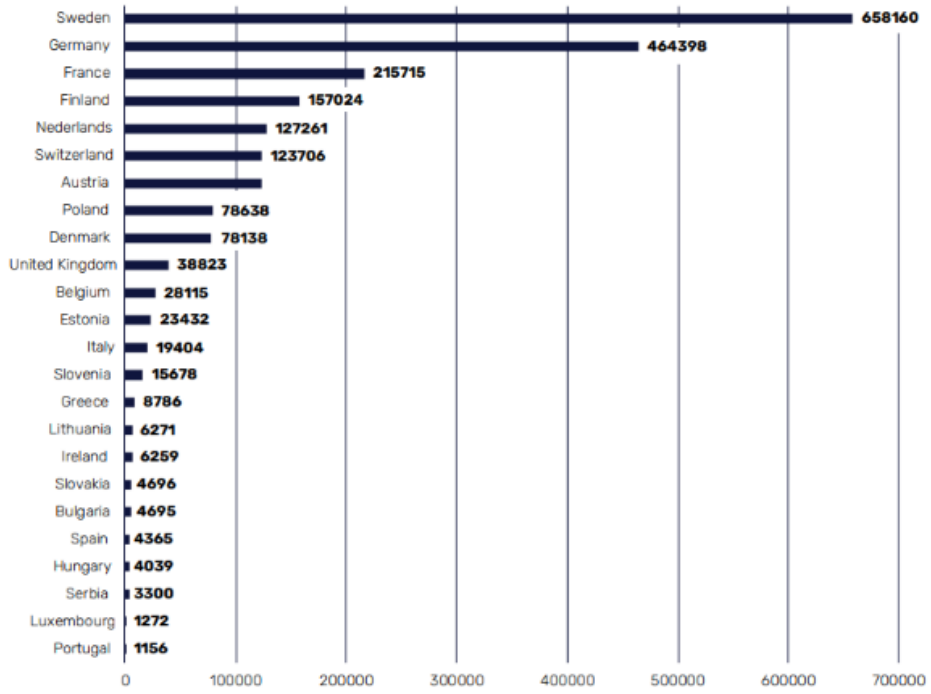
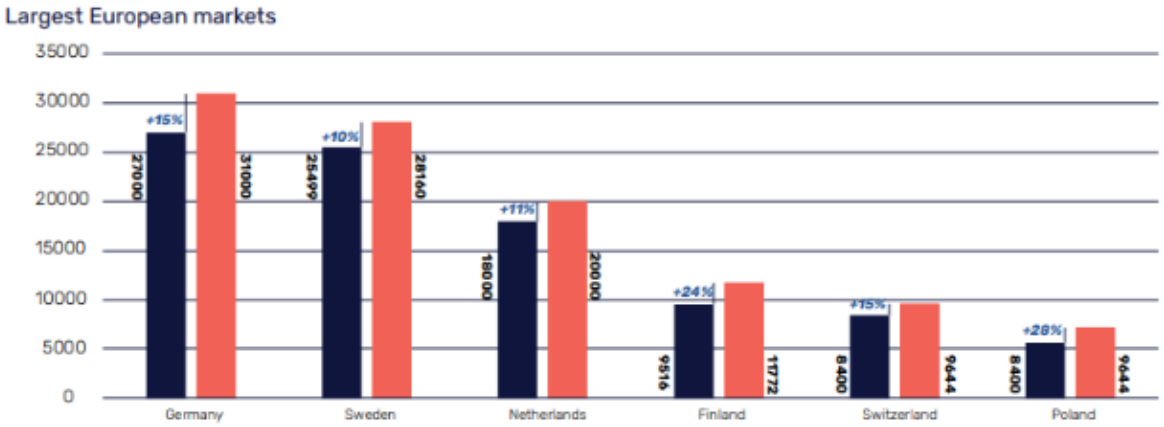
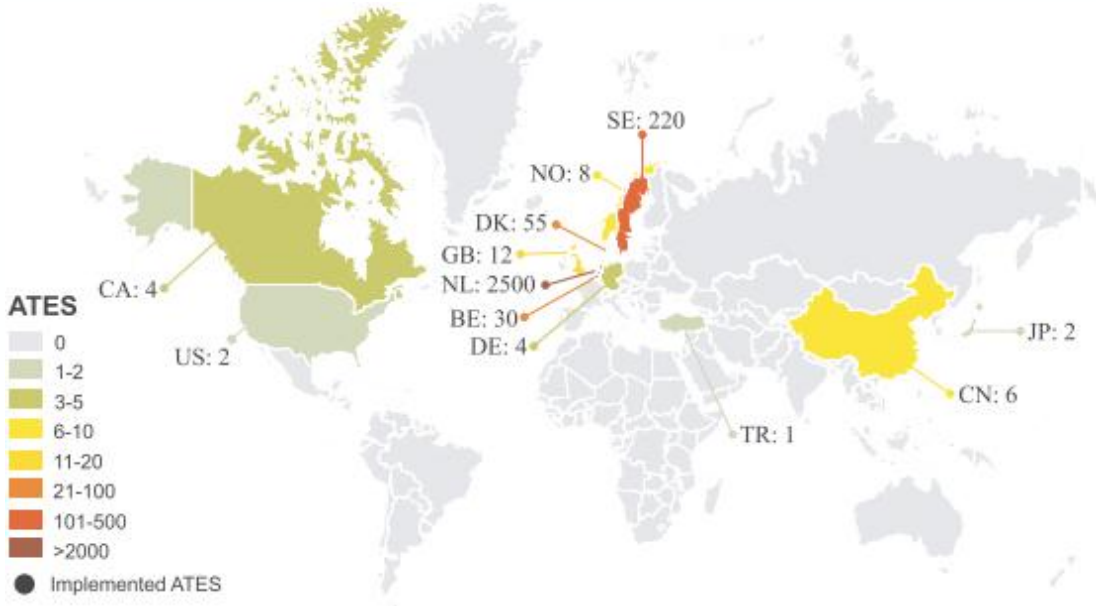


Fig. 13 Sales of geothermal heat pumps in Europe (2021-2022) in selected countries highlighting growth rate



ATES systems worldwide

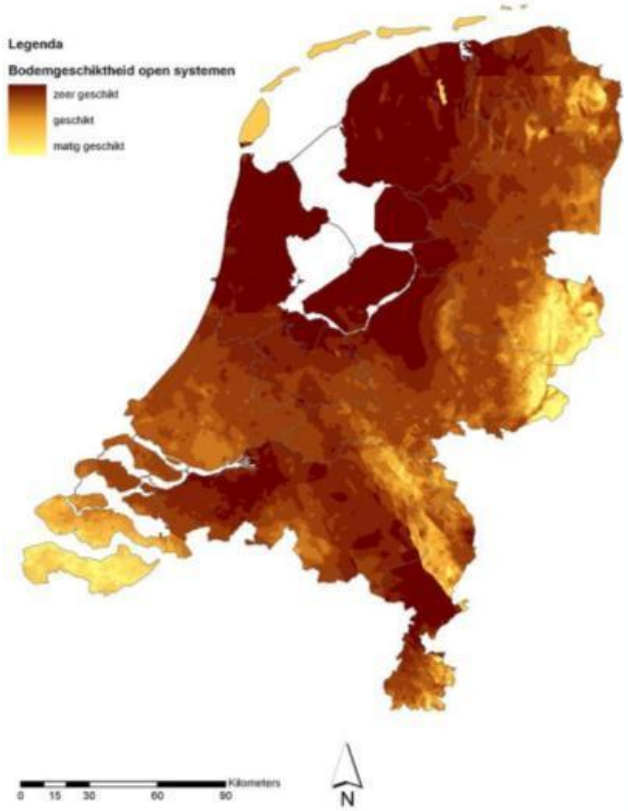
Country	Estimated amount of larger ATES systems
The Netherlands	> 3,000
Sweden	> 220
Belgium	> 30
UK	> 30
Germany	> 10
Denmark	5-10
Norway	> 5
China	50
USA	10



Fleuchhaus et al., Worldwide application of aquifer thermal energy storage – a review. Renewable and Sutainable Energy Reviews 94 (2018) 861-876.

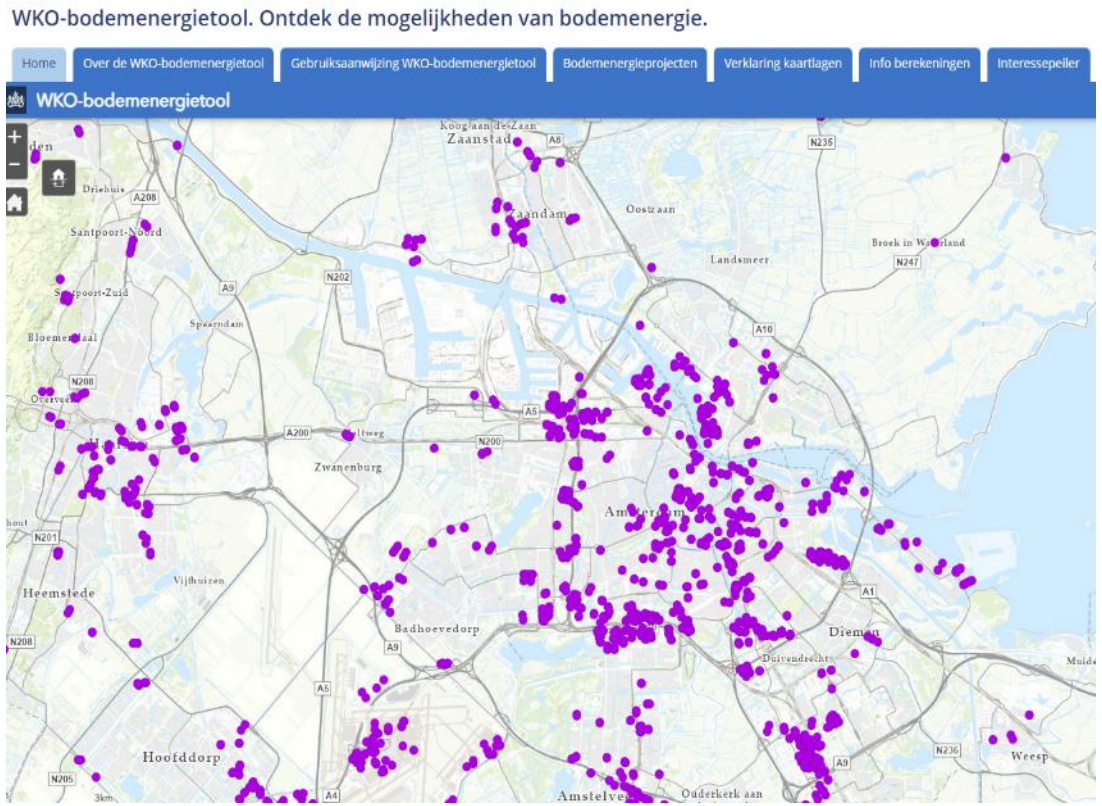
So, why is it a success in the Netherlands?

We have aquifers



- ATES needs proper aquifers.
- The Netherlands does have many good aquifers.
- Most requests for ATES can be accepted and realised.
- This resulted in a broad acceptance of the technology.
- Also due to good aquifers, the upfront research costs where limited.
- Due to the scale, a lot of research has been done to clogging problems and solutions has been found.

We have a database and ATES-tool



- Central database of all hydrogeological information
- Managed and maintained by TNO
- Free access to the database
- Contains drilling logs, groundwater analysis, location of systems, abstraction, protection zones, etc.
- Cross sections can be obtained

- Permit ATES demands that you submit new drilling data to the database

Good climate for ATES

- Cooling is the business case driver
- ATES and BTES is a storage technology. Heat of the summer and cold of the winter will be stored and re-used in the next season.
- A warm and a cold period are required to store energy, but also to have a demand of energy.
- The Netherlands does have a C climate (Köppen system), so moderate winters and summers.
- ATES is not subsidized.

We adapt the legal framework together

Involve various stakeholders

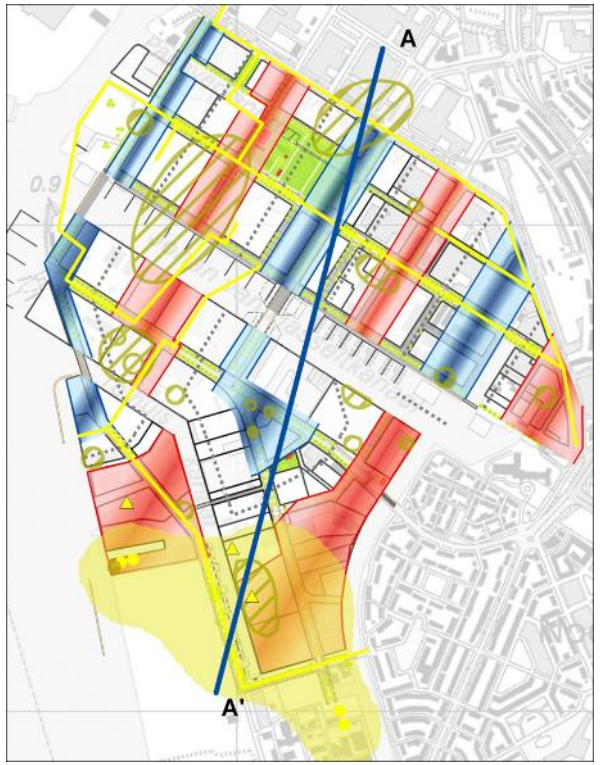
- Sustainable energy, CO_2 reduction
- Soil and groundwater protection
- Drinking water companies
- Commercial companies – authorities
- Other groundwater users

Together: development and improvement of the legal framework and this will be updated each 10 year.

We did a lot of applied research

- Solving clogging problem
- Preventing subsidence of the soil
- Improving drilling method: reversed rotary drilling with air lifting
- Combined research MMB to:
  - Impact on soil & water chemistry
  - Biological processes
  - Interference
  - High temperature storage
  - Combination ATES + remediation
- Also: setup of a hydrogeological database

We have a supportive authority



No subsidies on ATES or BTES, only at small scale on HP's, but...

- Funding of scientific research
- Apply ATES at their own buildings
- Develop and tune the legal framework with market parties
- Access to very useful database of boreholes and groundwater analysis of the Netherlands
- Make masterplans or special planning with ATES
- Driven by energy savings and CO_2-reduction

Value chain of ATES

Clients	Consultants	Data and quality	Authorities	Suppliers	Constructors	Exploitation
Project developers	Architects	Branche association	Water permits	Wells and piping	Drilling company	ESCO
End users	ATES consultant	Geo-database	Building permits	Controlling systems	Installation company	Maintenance companies
Energy companies	HVAC engineers	Quality institute	Environmental permits	Heat ex. + HP	Building construction	Special services

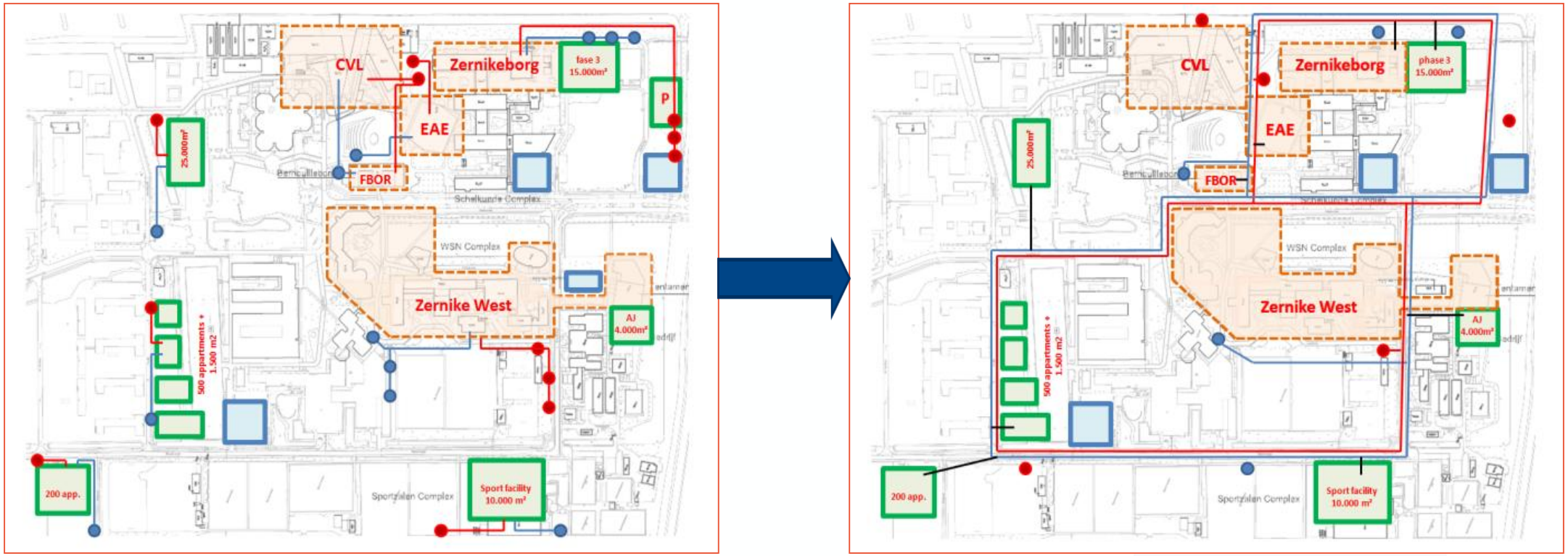
Trends in ATES

Actual trends in shallow geothermal energy

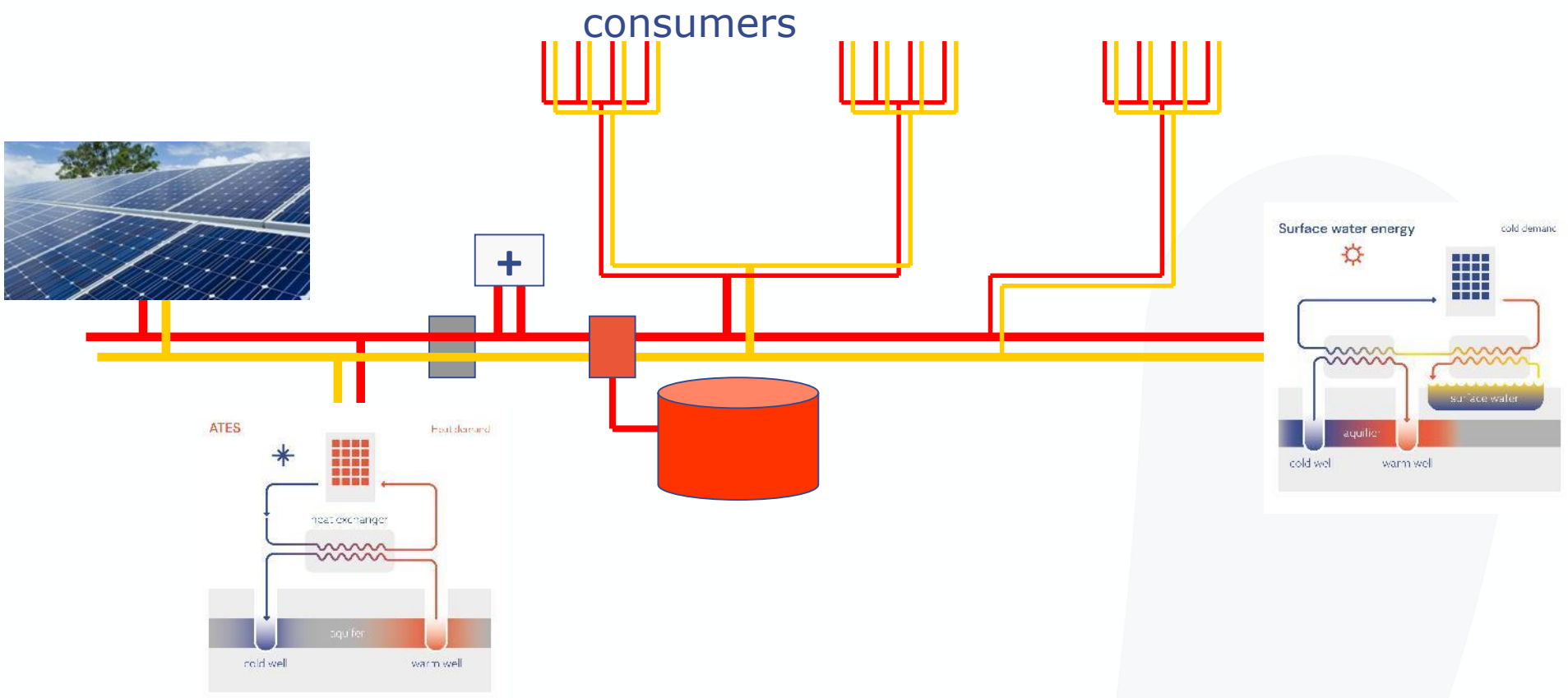
- We want to get rid of the gas → stimulates the use of (shallow) geothermal energy
- Residential areas are upcoming market
- It is a mature business – becoming a turnkey market – many companies developing ATES projects
- Growing interest in district heating networks
- Growing business to optimize the use of heat by large scale heat storage

→ three technical developments

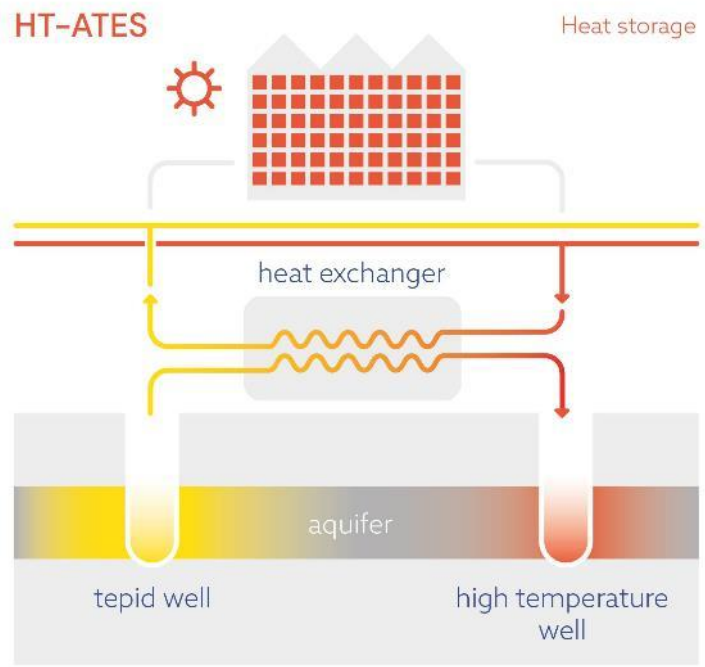
1. From stand alone to district H+C grids



2. Fourth or fifth generation H+C grids



3. Large scale heat storage



Large scale heat storage

- Middle temperature (30 – 50 °C)
- High temperature (50 – 95 °C)
- Heat buffer between heat source and heat users

Is there hope for Germany?

I think so

ATES in Germany

Germany:

- Only one (!) systems operational (Rostock)
- Some abandoned projects and systems
- Main focus is on research projects

Prof. Sebastian Bauer (2024)

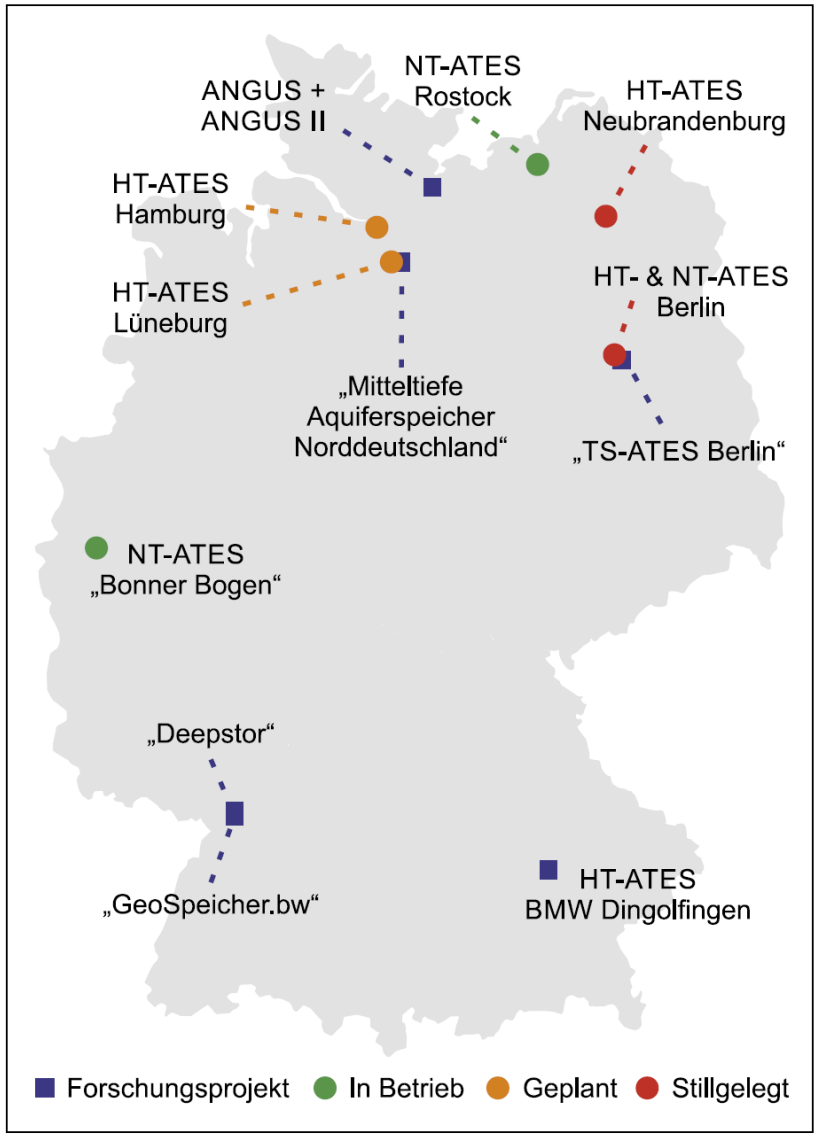


Abb. 2 Übersicht stillgelegter, in Betrieb und in Planung befindlicher Aquiferspeicher in Deutschland
Fig. 2 Spatial distribution of abandoned, operating and planned ATES projects in Germany

Fleuchhaus et al. (2021)

Feasibility of ATES in Germany

- Only parts of Germany show suitable geological potential
- Only some conglomeration areas coincide with areas of ATES potential
- Less hands-on experience
- No established proceedings or regulatory procedures

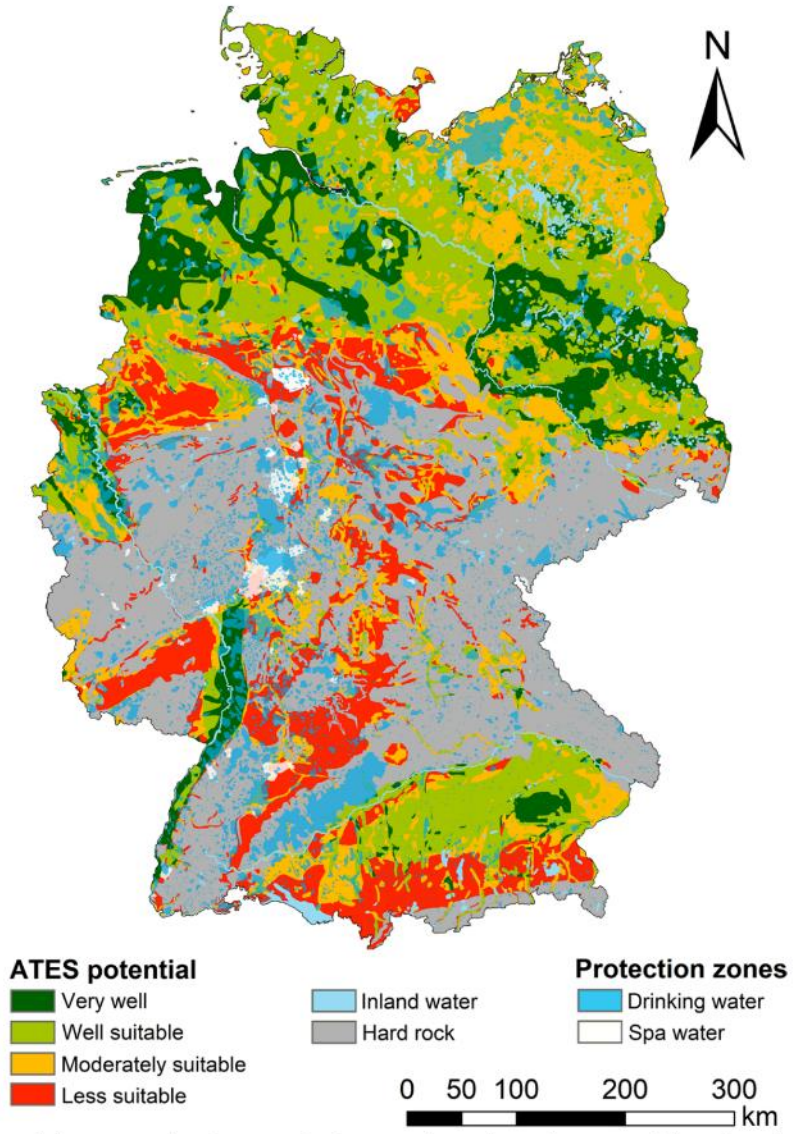


Fig. 8 ATES suitability potential in Germany for the period *near future* (2021–2050) based on the reference criteria weighting scheme. Drinking and spa water protection zones are included. Protection zone data from BfG (2021), LfU (2021), LUBW (2022a; b), HLNUG (2022), MULNV NRW (2022), NLWKN (2021)

Stemmle at al. (2022)

Challenges & opportunities

Challenges

- Access to hydrogeological data
- Permitting procedures and conditions
- Inexperience with the technology and therefore risk avoiding
- Lack of successful implemented systems
- Entrepreneurs who likes ATES

Opportunities

- Implement full scale demonstration projects
- Convince authorities to work on ATES permit procedures and conditions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