Storage is Key

Introduction to large-scale UTES

RVO – Netherlands Enterprise Agency
Robin Horsmans MSc.

28-02-2024 Offenburg

RVO – Netherlands Enterprise Agency

Governmental Agency

”We help you to invest in, develop and expand your organization in the Netherlands and abroad.”

Department of Renewable energy and Climate change

‘Working together for a sustainable Netherlands with a carbon-neutral and circular economy by 2050. We help you with advice, networks, knowledge, subsidies and financing so you can plan, invest and innovate to make your business more sustainable’

Robin Horsmans

”As a project advisor at the heat & subsurface team of RVO, I can apply my geological knowledge to innovative heat storage projects”

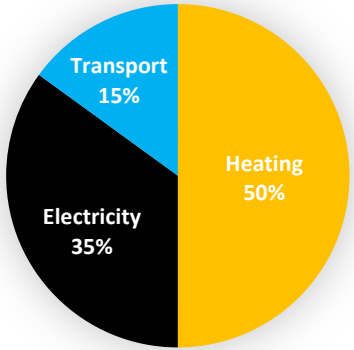
Heat & Subsurface team

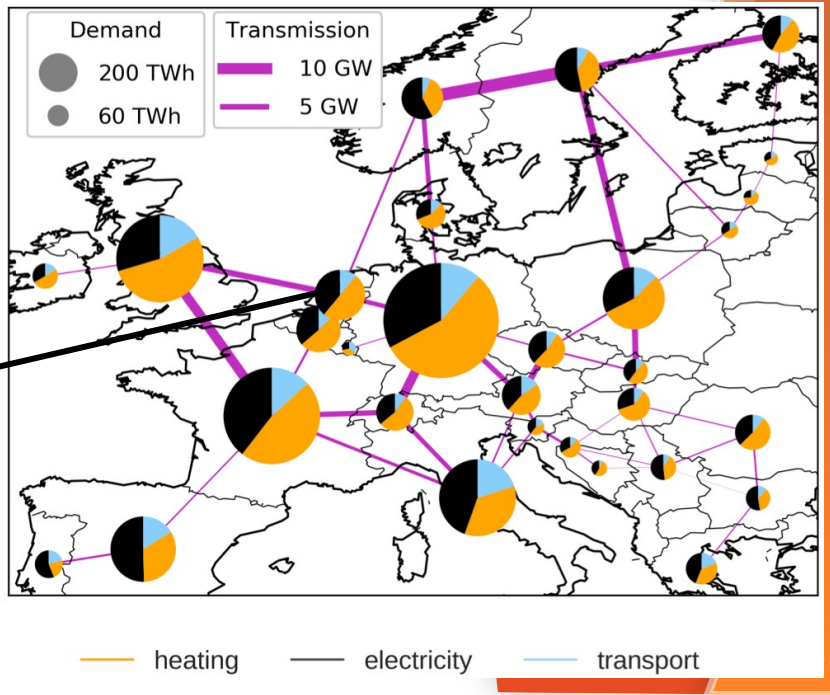
-> with Paul Ramsak

https://english.rvo.nl/

Current Situation

- 50% totale energy demand for heating
- Fossil Fuels
- Supply and demand match

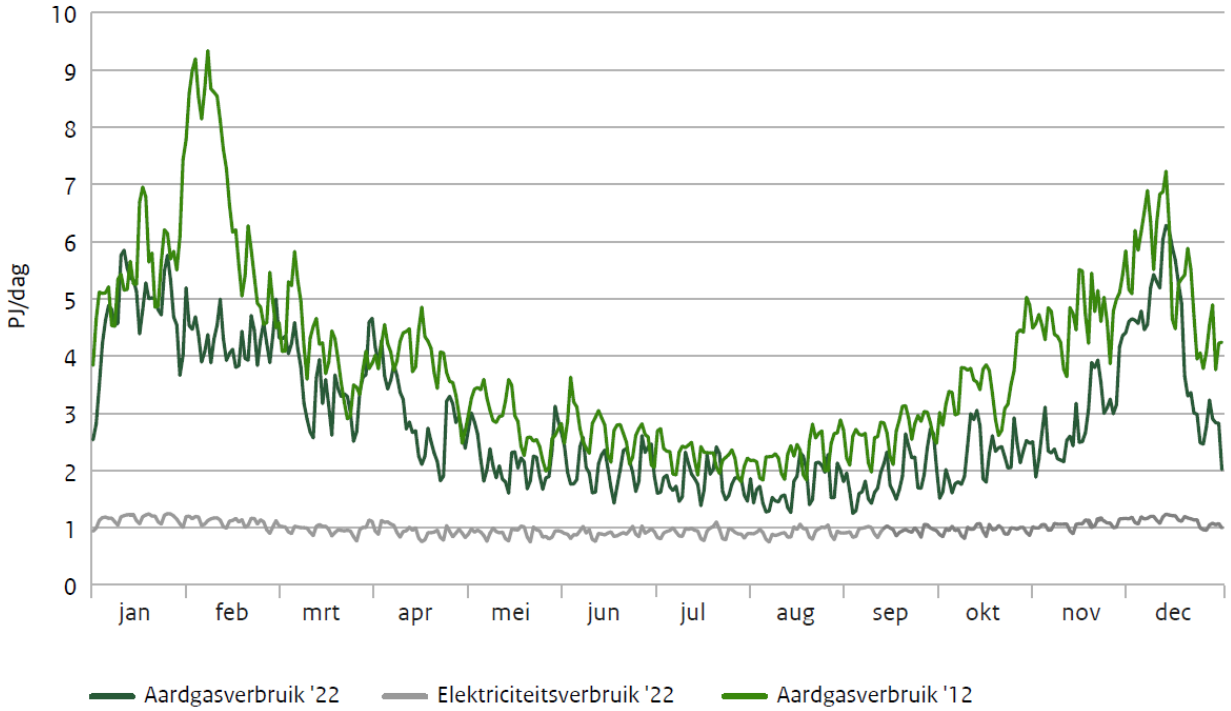




KEV, 2021 & Victoria, M., Zhu, K., Brown, T., Andresen, G. B., & Greiner, M. (2019). *Energy Conversion and Management*, *201*, 111977.

Seasonal Heat Demand

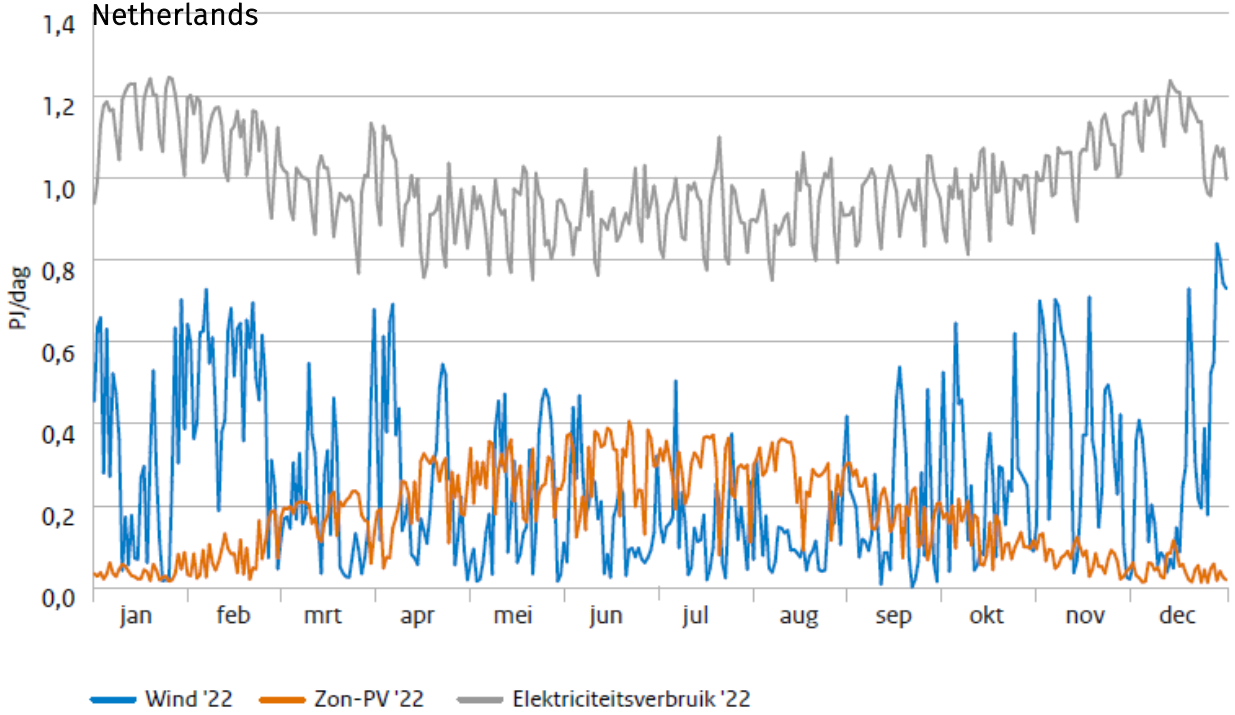
Fluctuations in natural gas- and electricity use in 2022 in the Netherlands



- Temporal variations in demand
  - Day
  - seasons

New Situation

Fluctuations in wind- and solar energy and electricity use in 2022 in the Netherlands



- More sustainable heat
- Mix of renewable heat sources
- Mismatch demand and supply over time

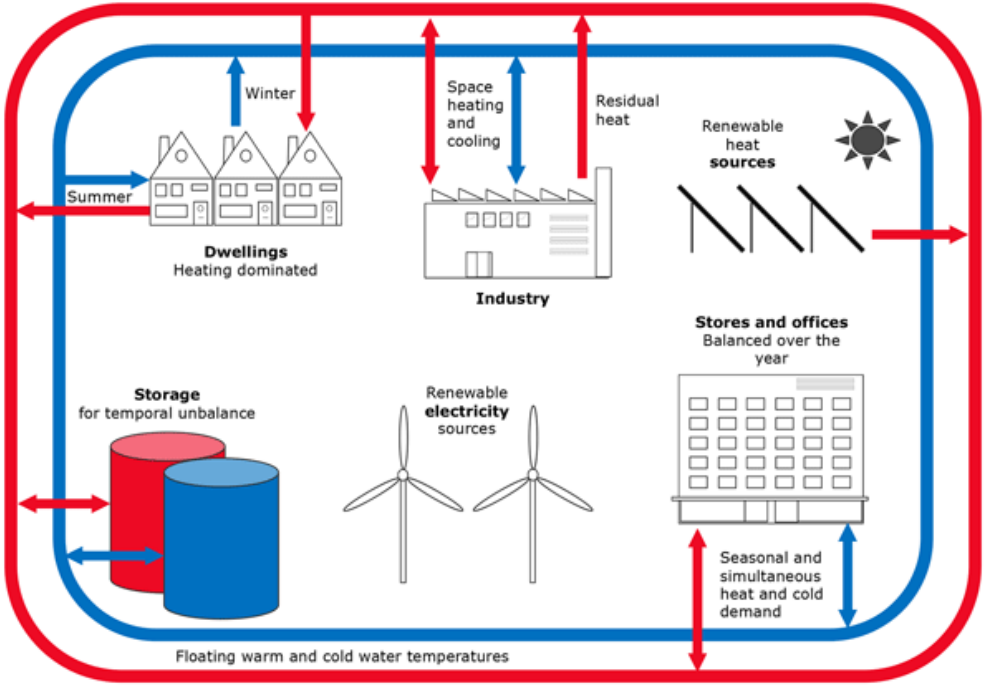
Renewable Sources

- Geothermal
- Waste heat
- Solar heat
- Heat from surface water
- Heatpumps
- Power-to-heat

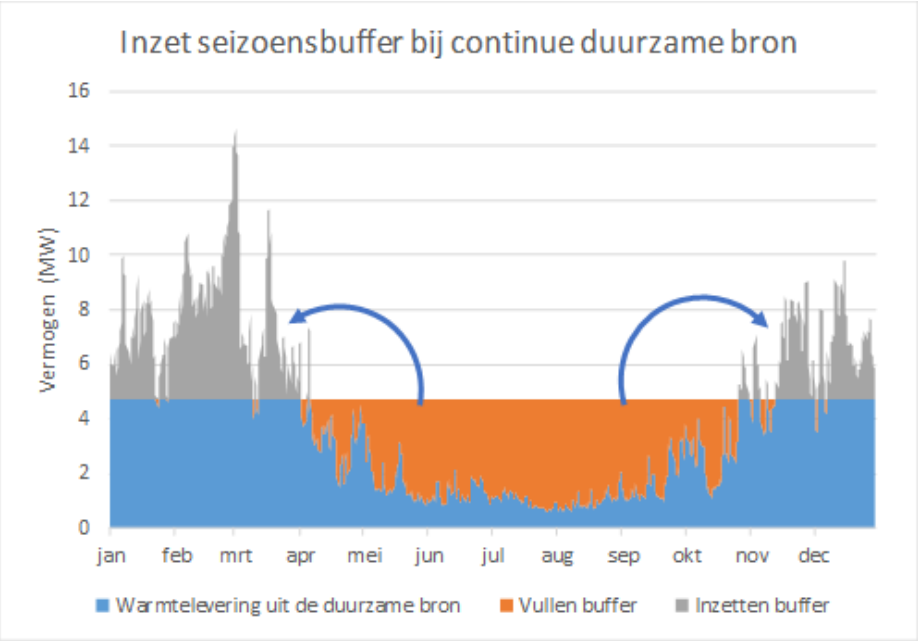
- Renewable cold

Heat networks

- Transporting heat from source to consumer
- Storage is crucial



Why TES?

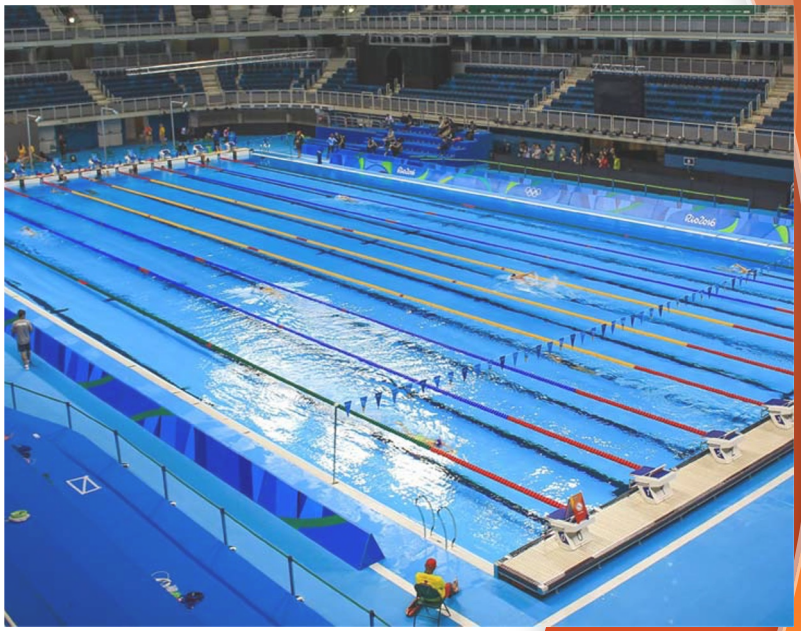


Victoria et al., 2019

- Security of supply of heat
- Affordable heat
- Self-sufficient
- Better use of source

Underground Perspective

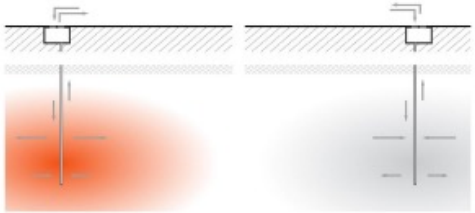
- Major storage volume and potential
  - Example HT-ATES: 100-200 Olympic swimming pools
- Little above-ground use of space
  - Except for PTES



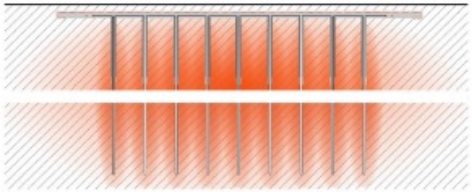
Large-scale UTES

- Seasonal storage for district heating networks

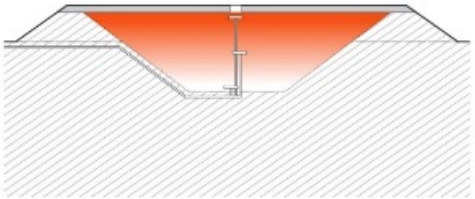
Aquifer thermal energy storage (ATES)



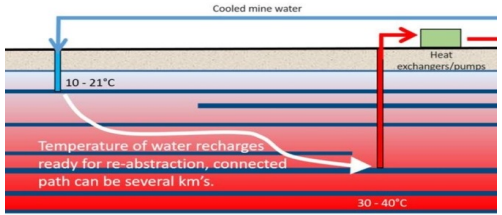
Borehole thermal energy storage (BTES)



Pit thermal energy storage (PTES)

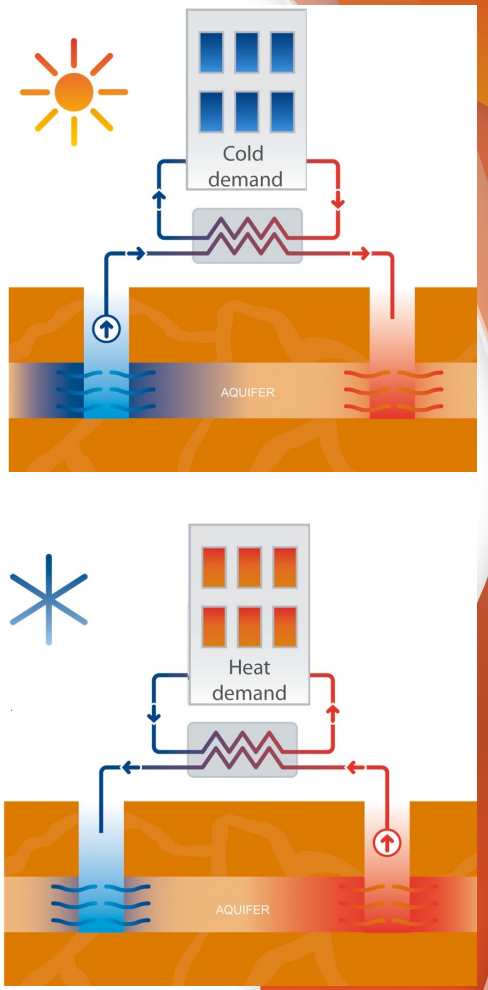


Mine thermal energy storage (MTES)



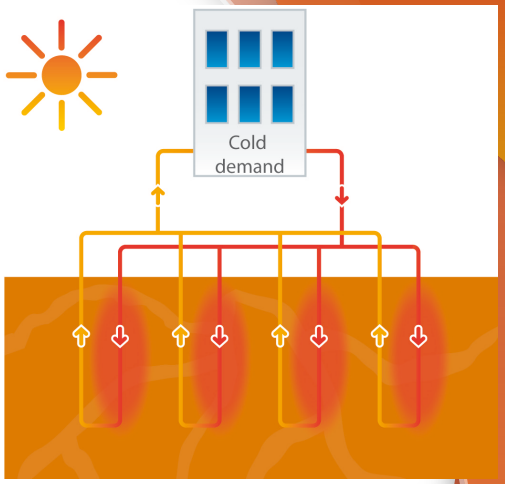
ATES

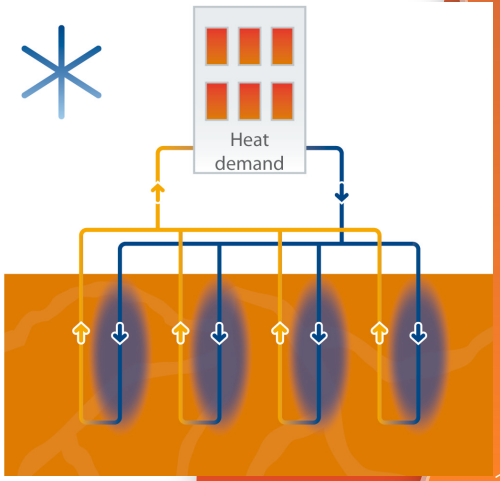
- Open system
- Many examples found in Netherlands & Germany
  - Overview presentation ATES
  - Project presentation ATES Groningen
  - Project presentation Geospeicher Berlin



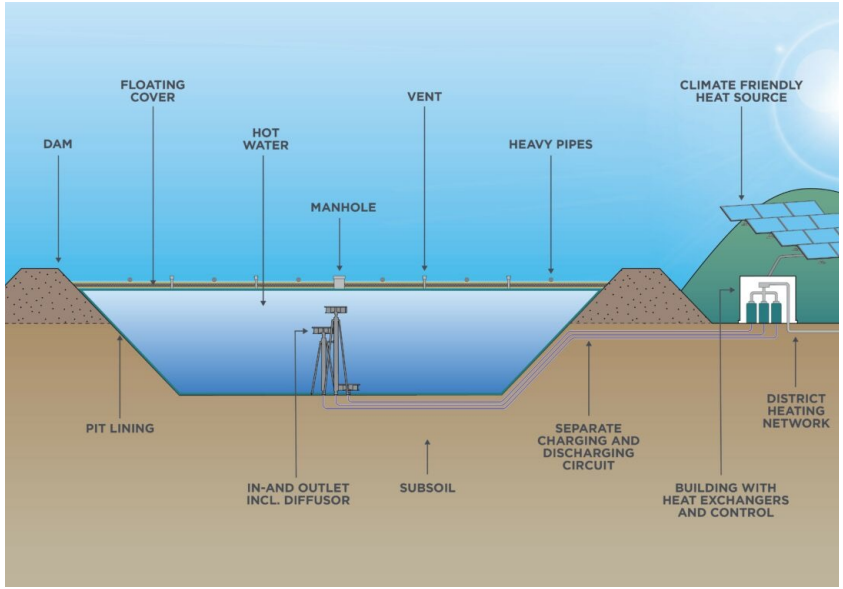
BTES

- Closed system
- Heat exchange with subsurface via conduction
- Examples found in Germany & Switzerland
  - Project presentation BTES Darmstad
  - Project presentation BTES Bern





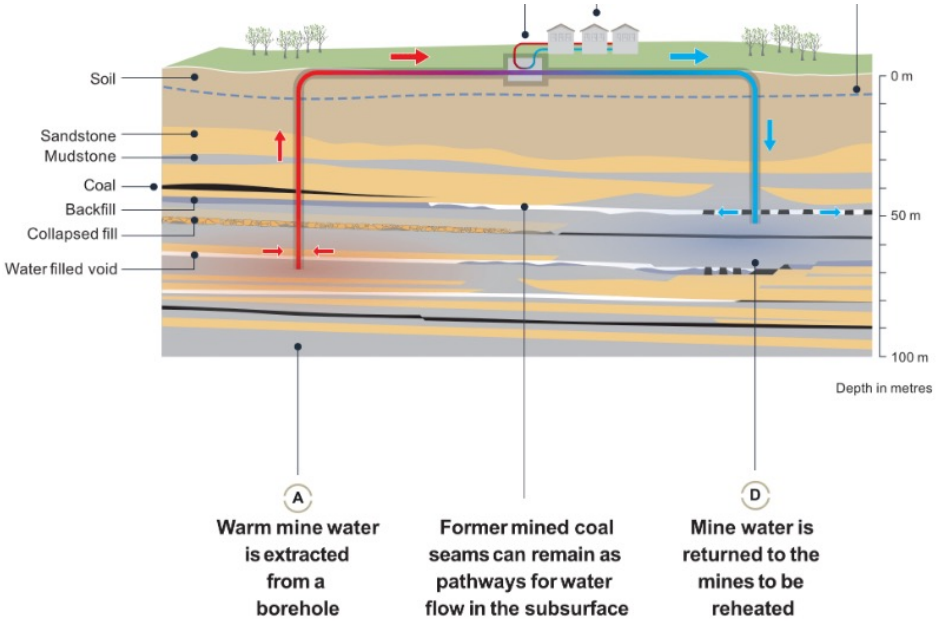
PTES



- Closed system
- Excavated Basins
- Big surface area necessary
- Mostly in less-populated areas
- Examples found in Denmark
  - Overview Presentation PTES
  - TREASURE Project

Glasgow Observatory - Mine water thermal energy | UK Geoenergy Observatories (ukgeos.ac.uk)

MTES



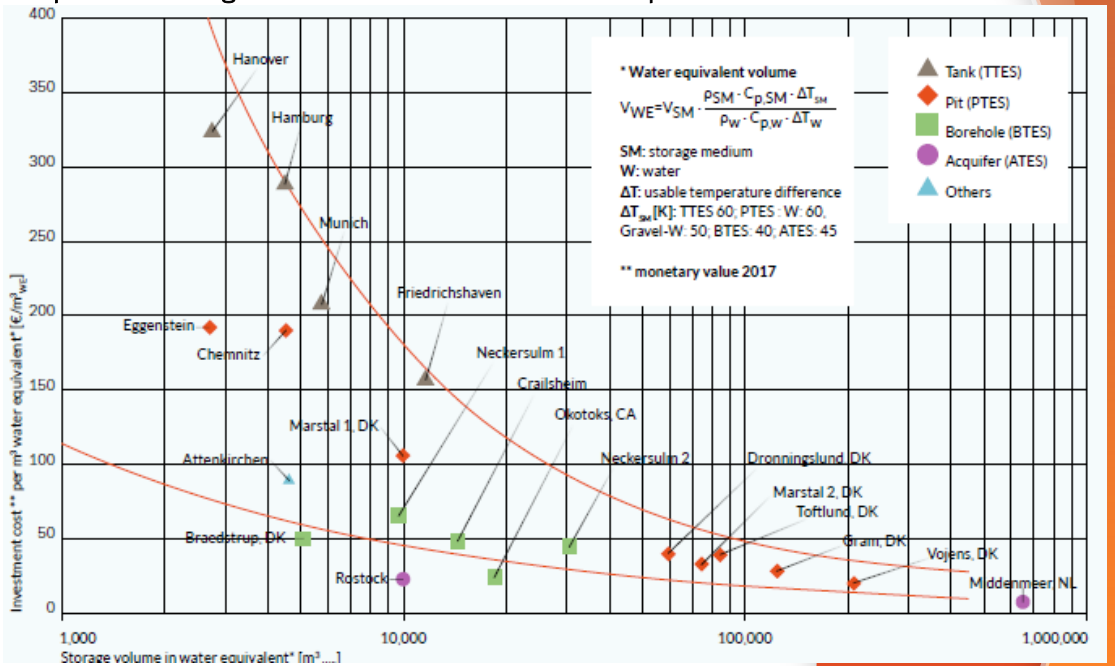
- Open System
- Mining structures store heat
- Examples found in Germany, Netherlands & UK:
  - Mijnwater Project Heerlen
  - MTES Project Bochum
  - STEAM Project UK

Glasgow Observatory - Mine water thermal energy | UK Geoenergy Observatories (ukgeos.ac.uk)

Comparison between UTES

- The bigger the volume, the more cost-effective
- ATES most cost-effective

Specific storage cost of UTES demonstration plants:

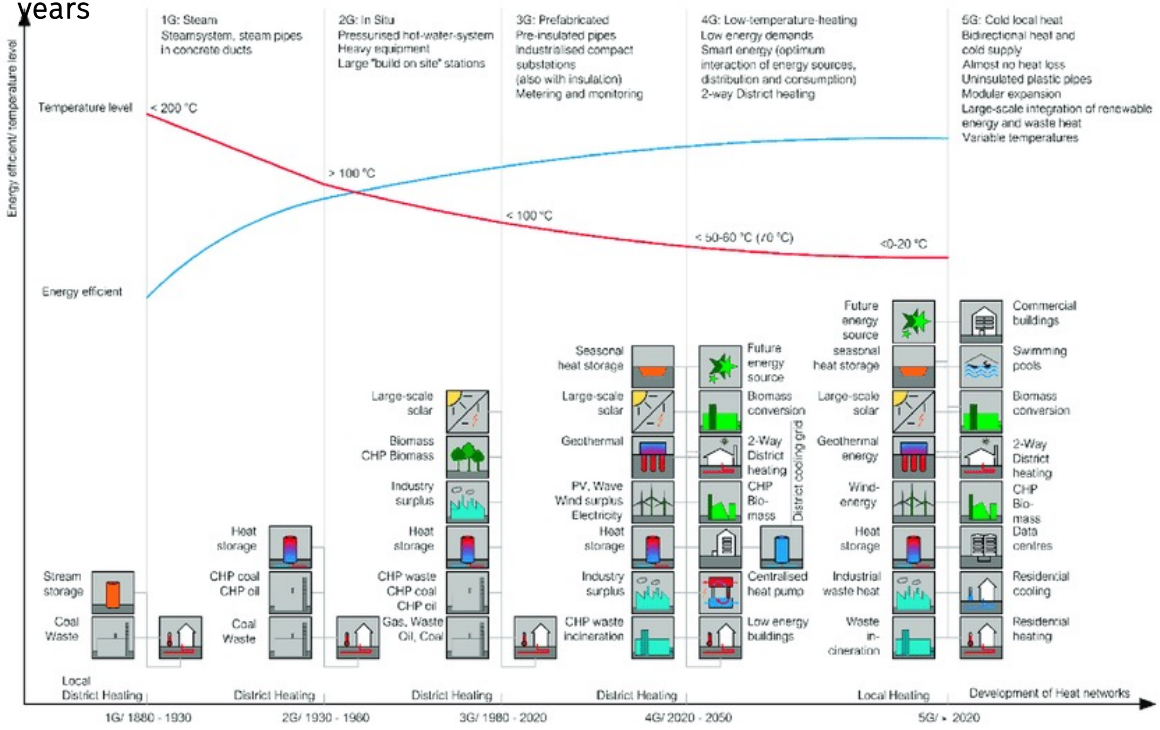


HEATSTORE – Roadmap for flexible energy systems with underground thermal energy storage towards 2050.pdf

UTES Applications

- Grid-Scale
  - heat networks
- Integration with Renewable Energy Sources
- Industrial Processes & Greenhouses

District heating networks from the first to the 5th generation over the last 150 years



Further development of the graphic in accordance with Lund et al. 2014 [6] (p. 9.)

UTES Advantages & Challenges

Advantages:

- More sustainable heat
- Affordable heat
- Efficient use of source
- Cost-effective
- Resilience
- Large volumes in subsurface
- Little surface area (not PTES)

Challenges:

- Spatial Planning
- Lack of showcases
- Subsurface knowledge
- Regulatory framework

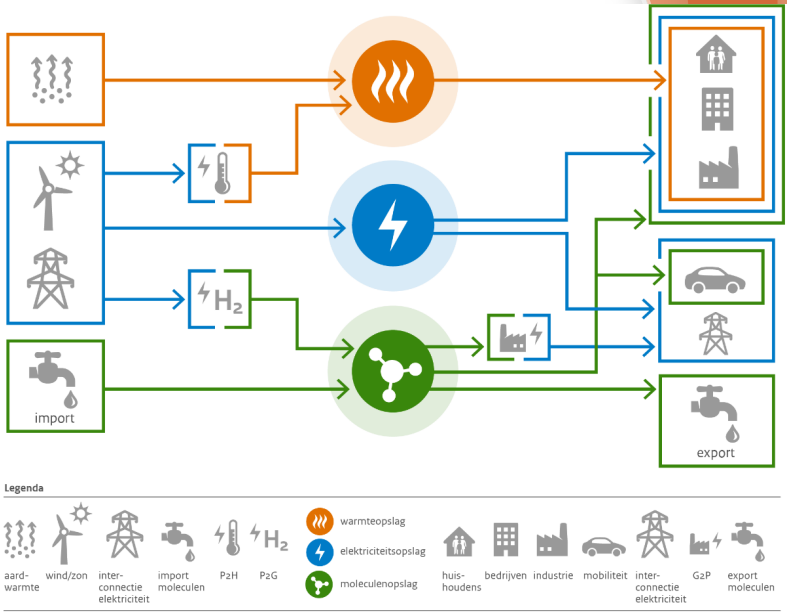
-> Innovations

Policy and Regulatory Landscape

- Increasing attention
  - in multiple countries
  - in IEA & GEOTHERMICA
- Netherlands
  - LT-ATES present and continued development to other UTES
  - Roadmap Energy Storage

Netherlands Roadmap Energy Storage

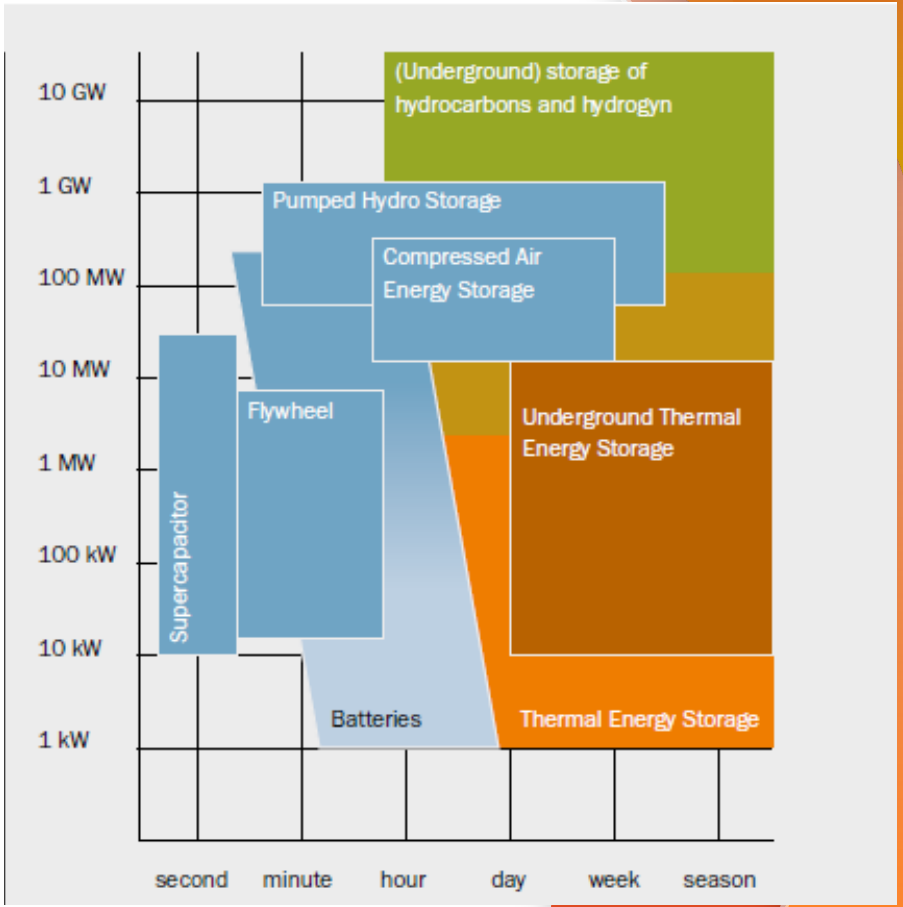
- System thinking
  - intertwining electricity, hydrogen and heat
- Heat is local



Routekaart Energieopslag voorjaar 2023 (overheid.nl)

System Thinking

- Different fields of application
- UTES reinforces other types



Routekaart Energieopslag voorjaar 2023 (overheid.nl)

Future Potential

- Heat networks
  - Existing & new
- Potential is huge
- Need for:
  - further technical developments
  - adapted subsidy system
  - better models
  - social dialogue

Storage is key

- Heat transition
- ATES, BTES, PTES, MTES
- Sustainable existing and new heat networks
  - Look for district heating potential in Europe; IEA DHC or Euro Heat & Power
- It’s already possible
  - Project presentations
- We will witness the breakthrough of heat storage