TU Delft Subsurface urban energy lab for development of geothermal technologies

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2023-10-10
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GEOTHERMICA Initiative & CET Partnership
TRI4 Workshop in Dublin 10/10/2023

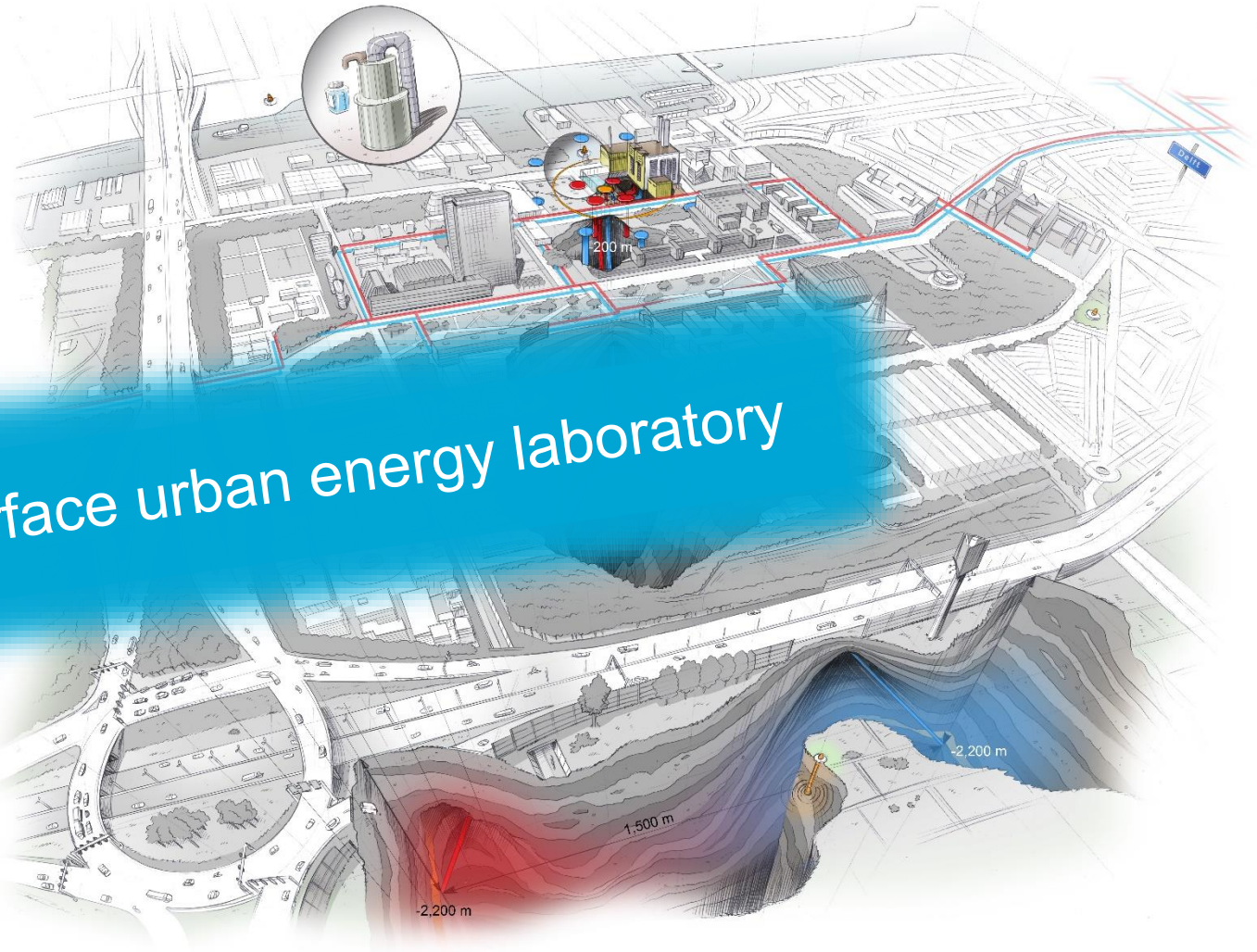
GEOTHERMICA

cet Partnership

Co-funded by the European Union

TU Delft

Delft Subsurface urban energy laboratory



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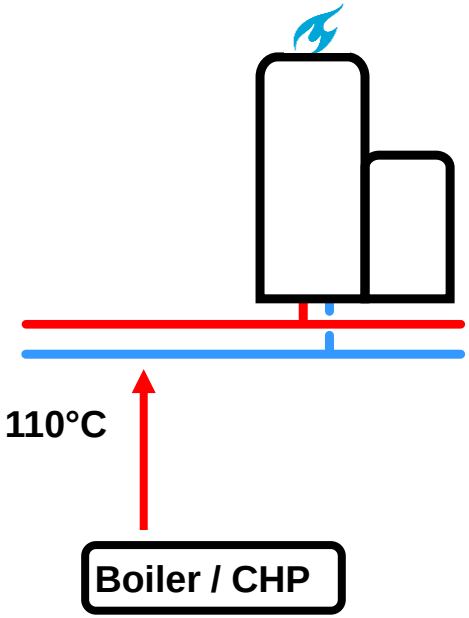
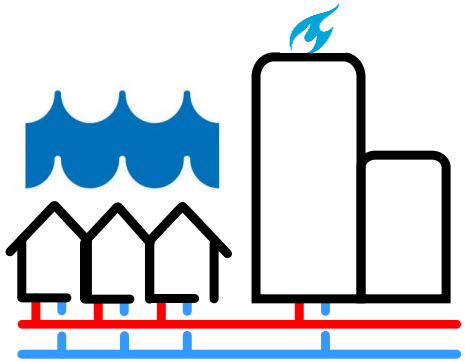
Current



~2024



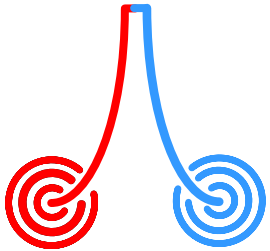
Also deliver to city

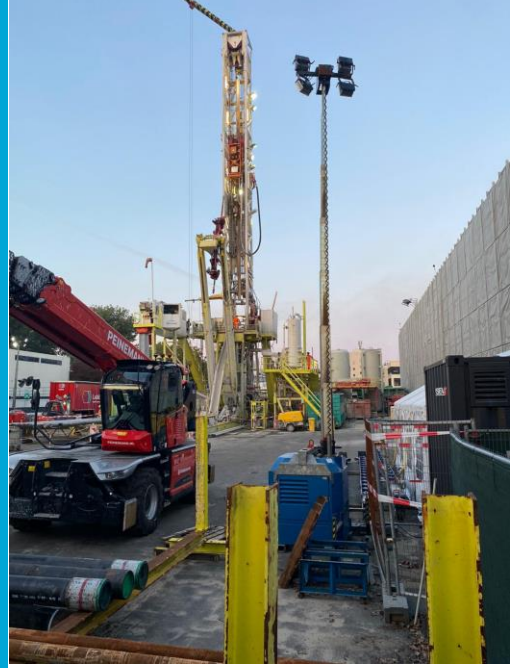
Maximise power
Minimise injection temp

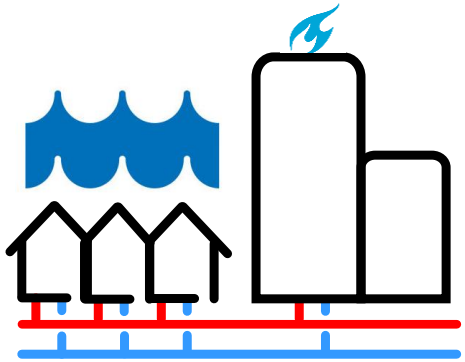
HPC

Boiler / CHP

Backup for peaks





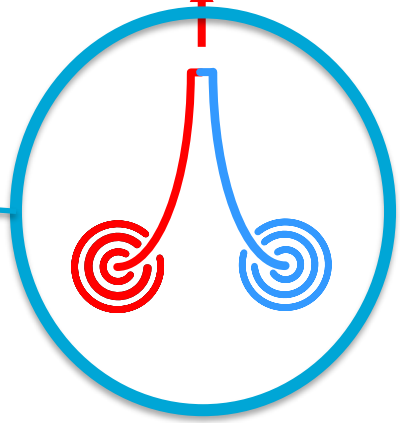


HPC

Boiler / CHP

Backup for peaks

Tomorrow –
session 1, 11:05



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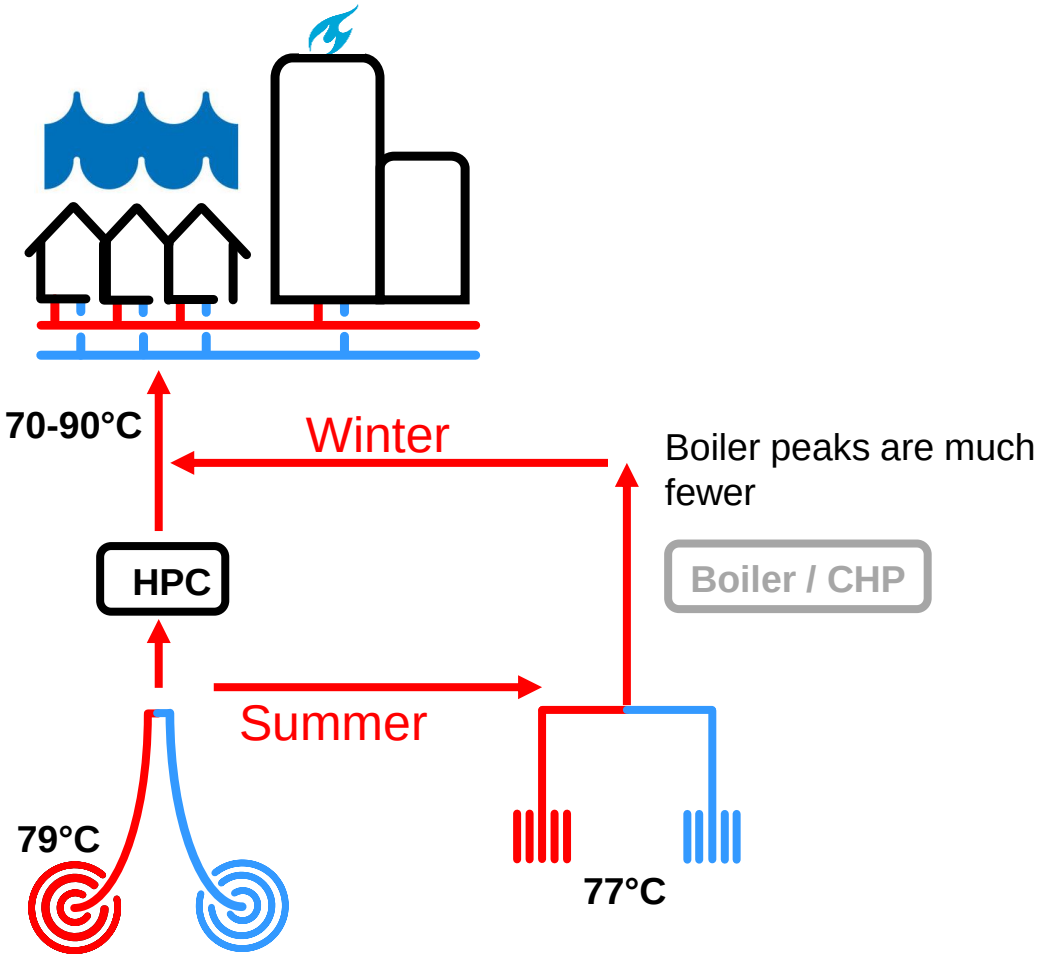
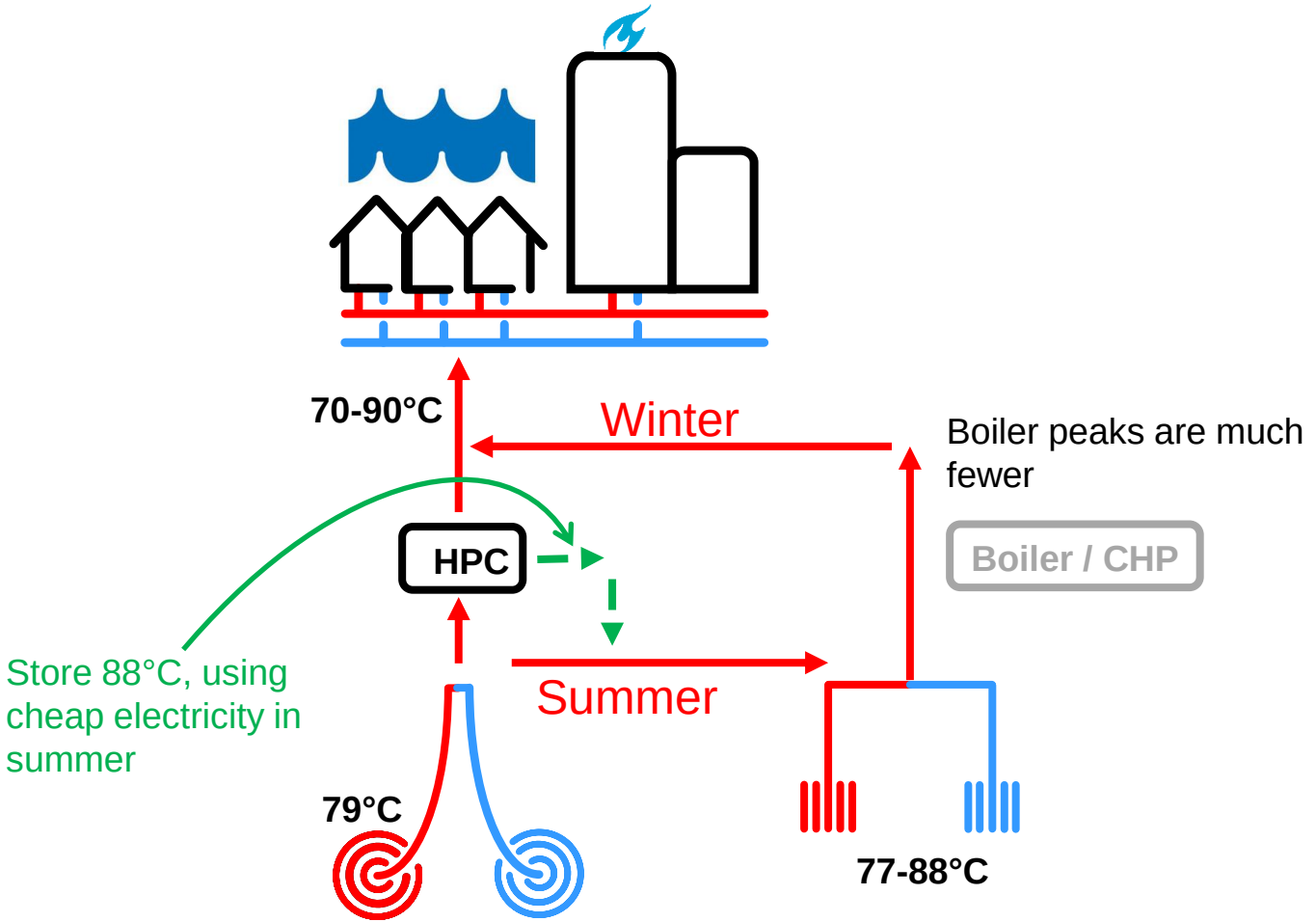
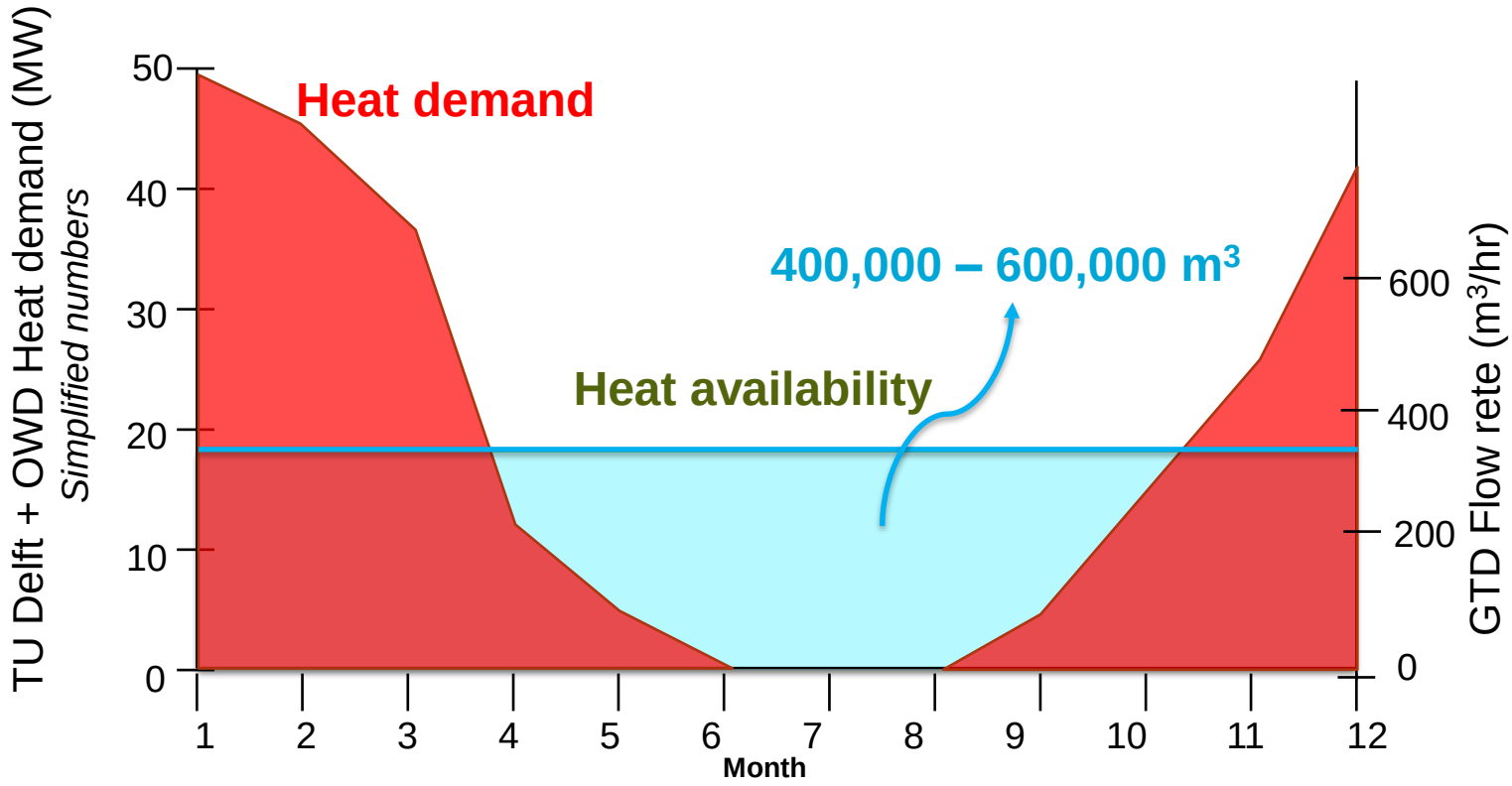
~2025


70-90°C
Winter
Boiler peaks are much fewer
HPC
Boiler / CHP
Summer
79°C
77°C

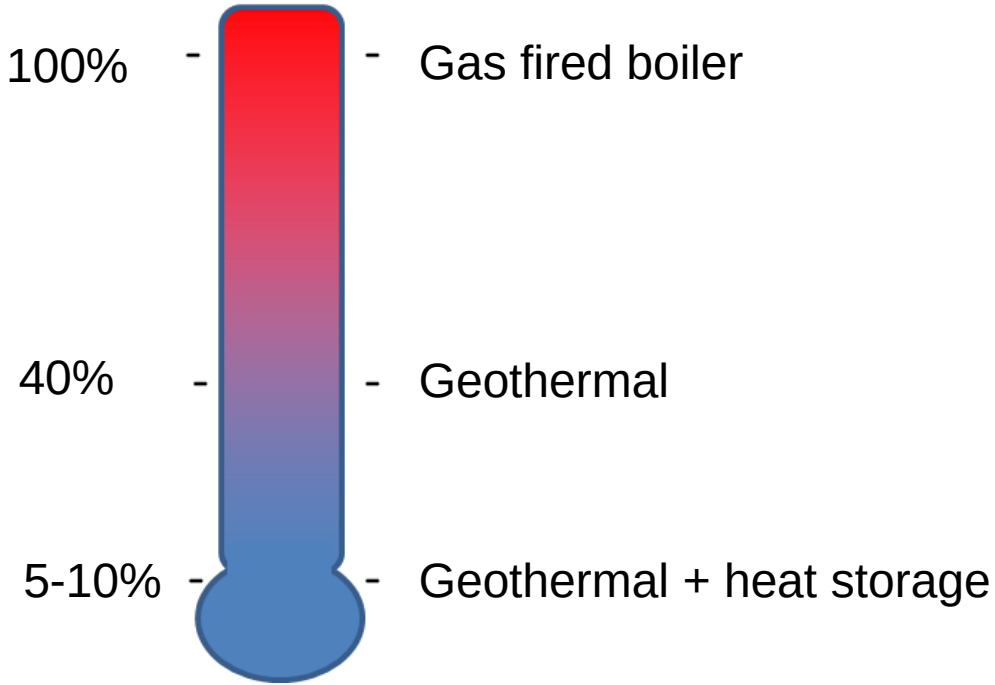
>2025


70-90°C
Winter
Boiler peaks are much fewer
HPC
Boiler / CHP
Store 88°C, using cheap electricity in summer
Summer
79°C
77-88°C

The need for heat storage

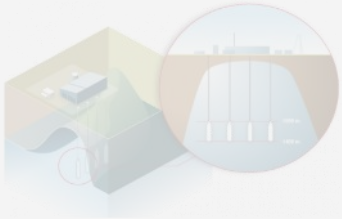


Fossil energy use in DHN



Large scale – seasonal heat storage ? → **Sensible heat storage**

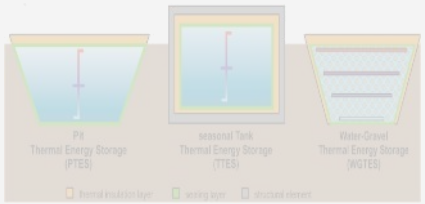
MINES/ CAVERNS



- Salt deposits in mines/caverns can be used to store energy.

- Availability is limited
- Losses can be high

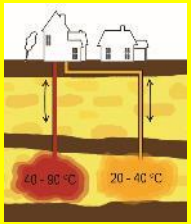
TANKS/PITS



- Offers good insulation and flexibility

- Expensive & limited capacity
- Not always possible in dense urban settings

Underground

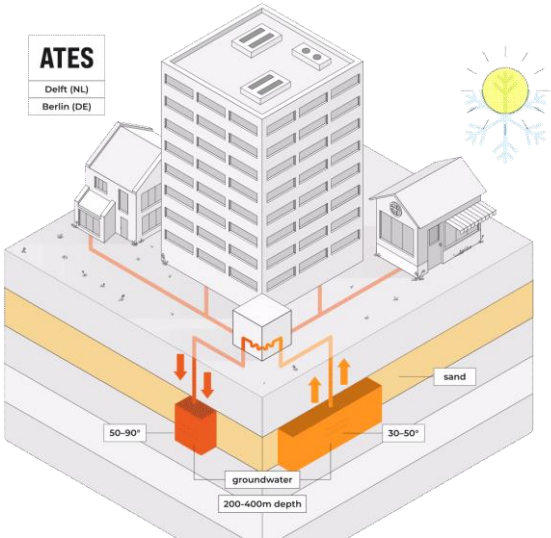


- No space requirement above ground
- Large capacities

- Subsurface infrastructure needed
- Dependent on local geological conditions

ATES legality

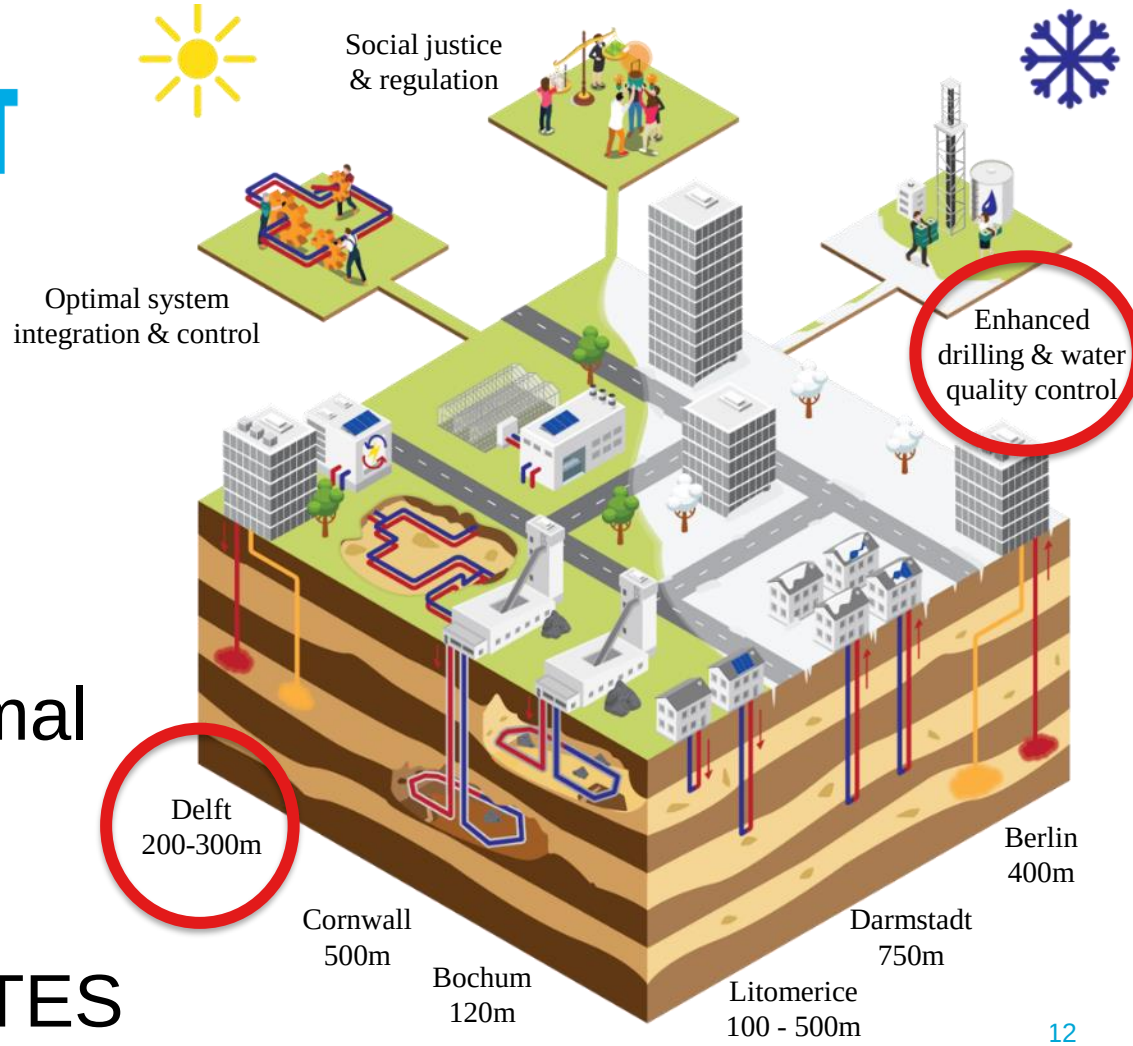
- <25°C standard regulatory framework
- >25°C Permitted by provincial board (GS)
  often as pilot / research projects



PILOTING
UNDERGROUND
SEASONAL
HEAT STORAGE

IN GEO-
THERMAL RESERVOIRS

PUSH IT



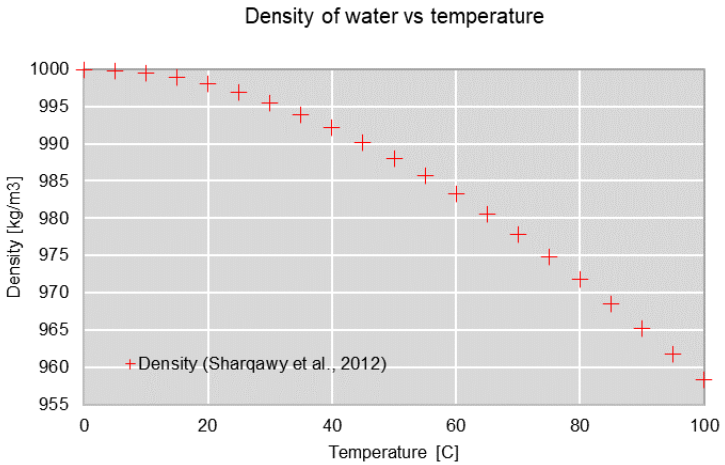
- up-to 90°C
- In geothermal reservoirs
- ATES, BTES & MTES

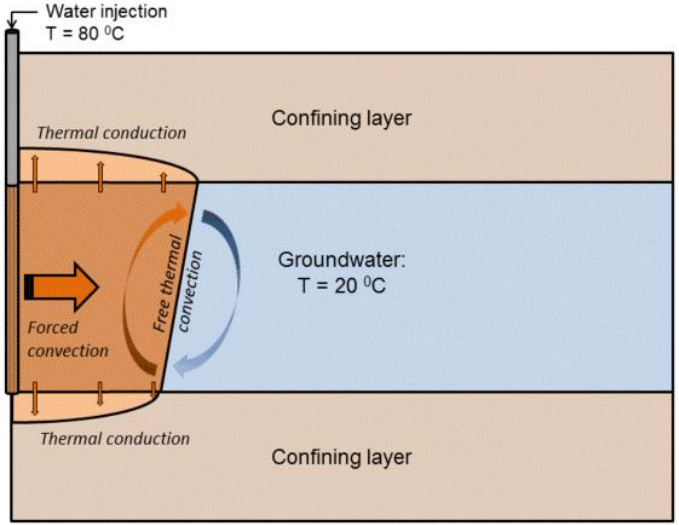
European Commission

TUDelft

Innovation Highlights

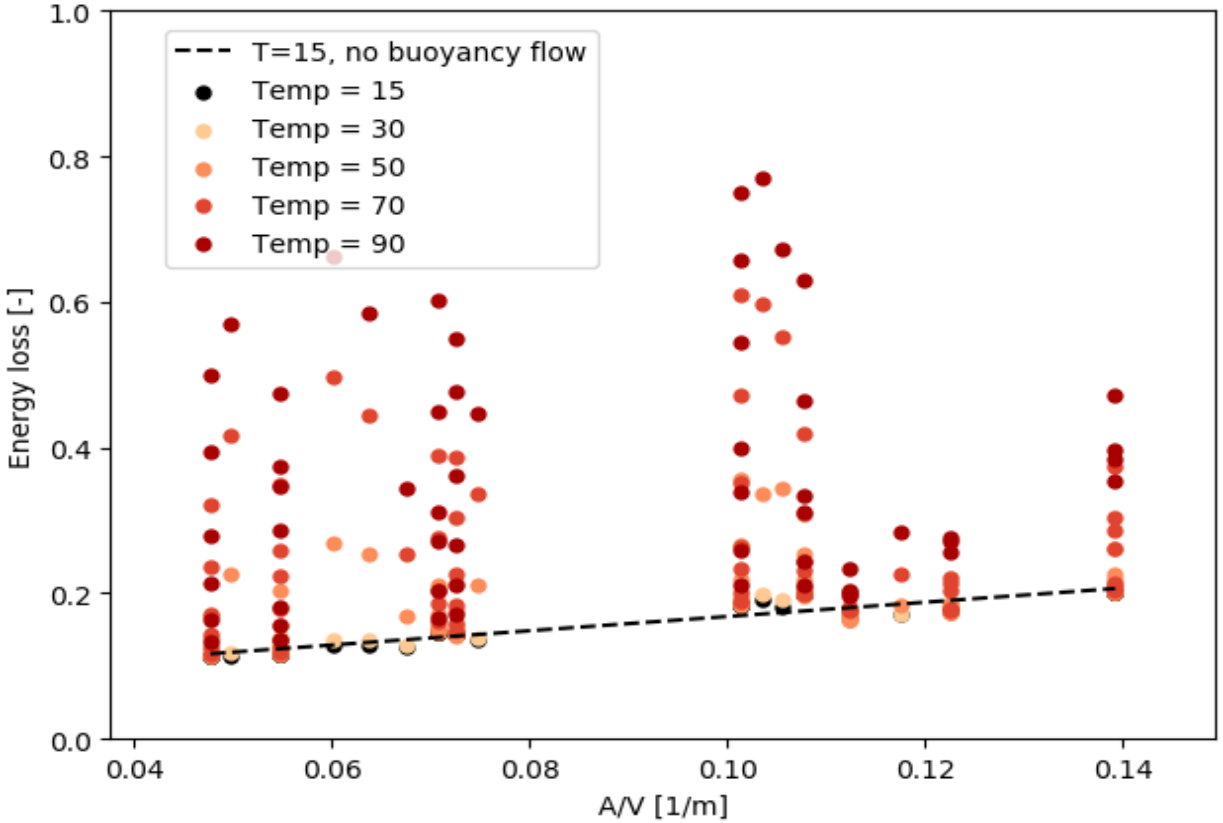
1. Impact & performance
   - Heat distribution / losses
   - Aquifer characterisation



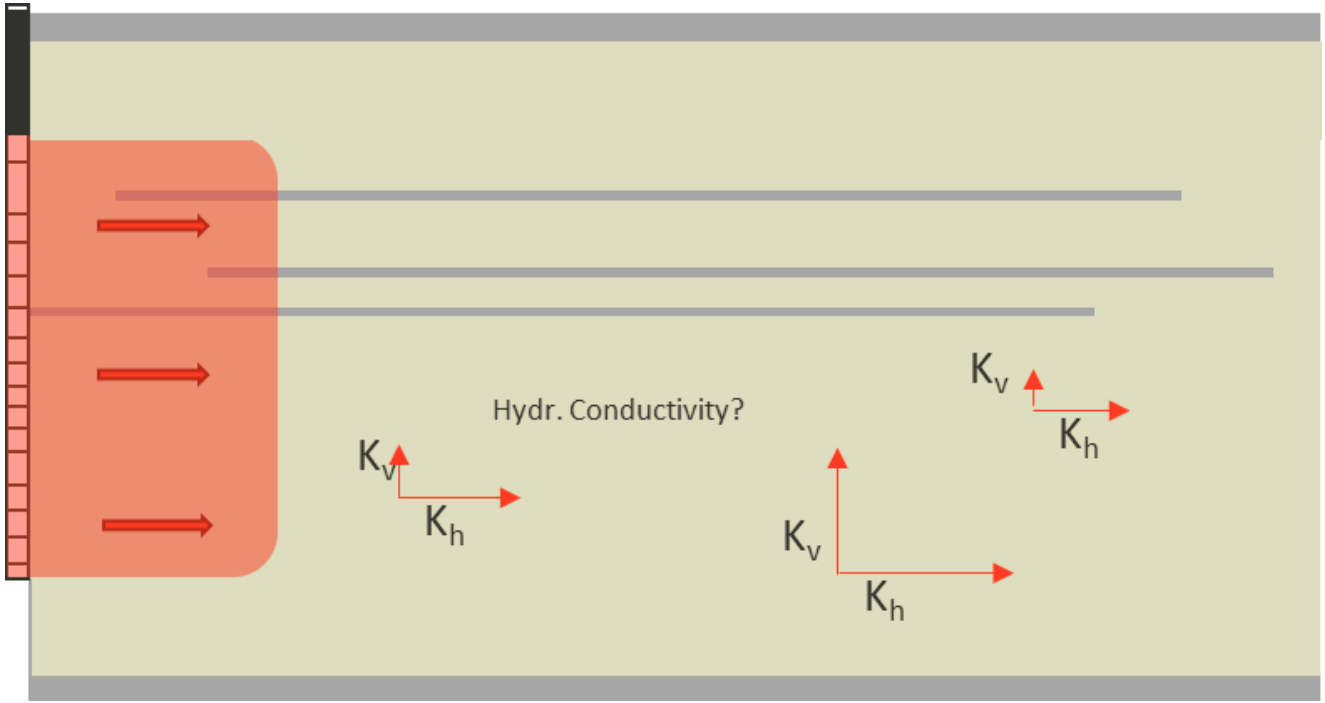


Lopik, J. H. v., N. Hartog and W. J. Zaadnoordijk (2016). "The use of salinity contrast for density difference compensation to improve the thermal recovery efficiency in high-temperature aquifer thermal energy storage systems." Hydrogeology Journal.

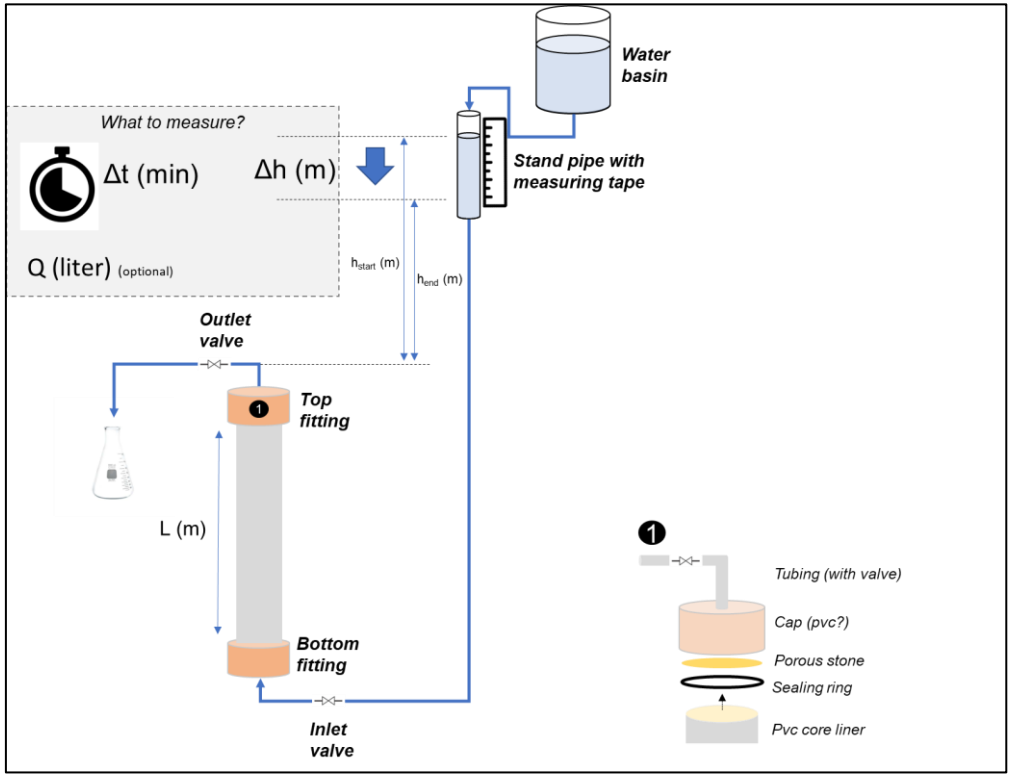
Buoyancy and conduction losses

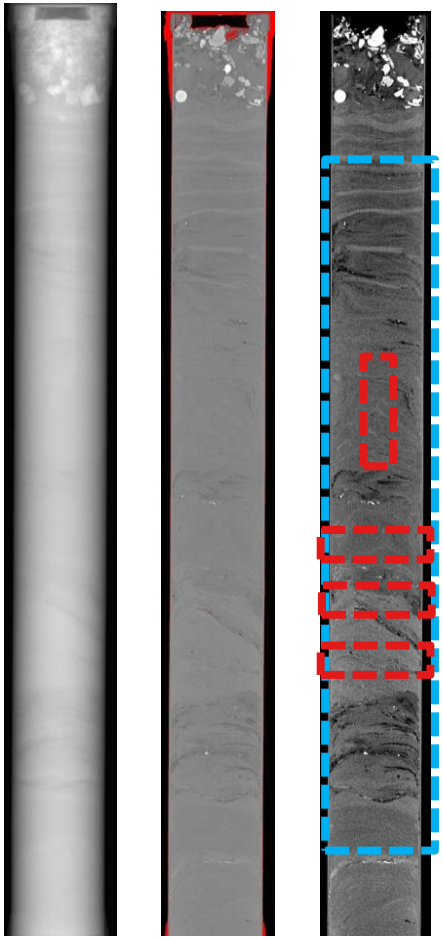


HT-ATES → aquifer conditions

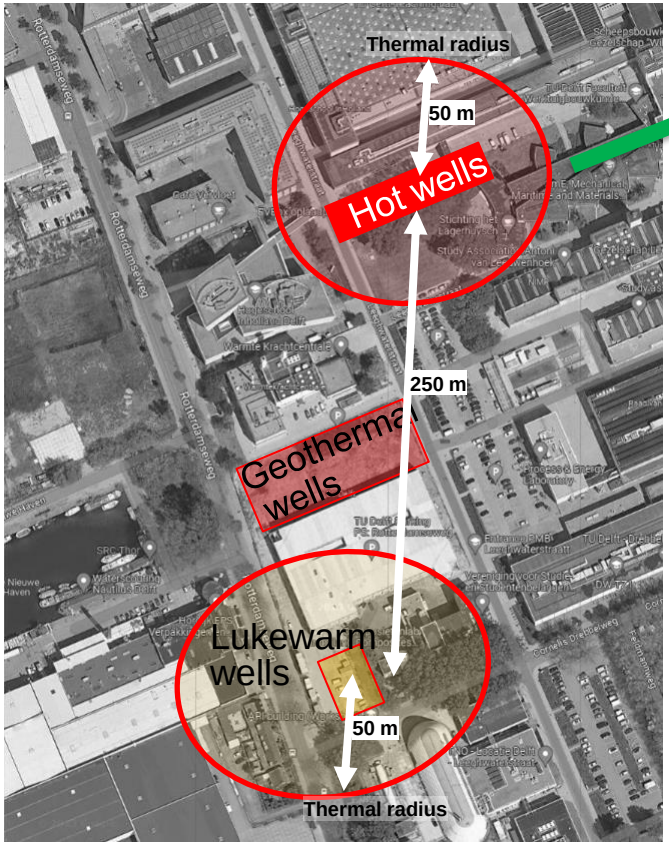


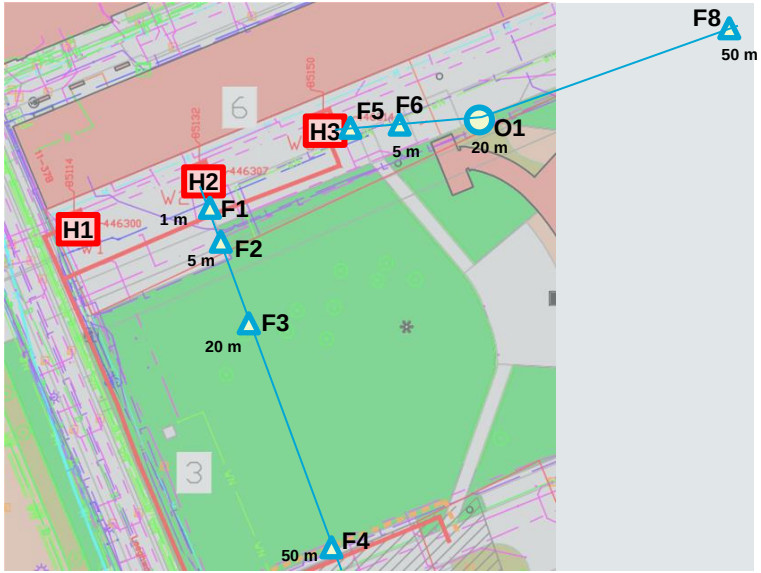
Core analysis and tests

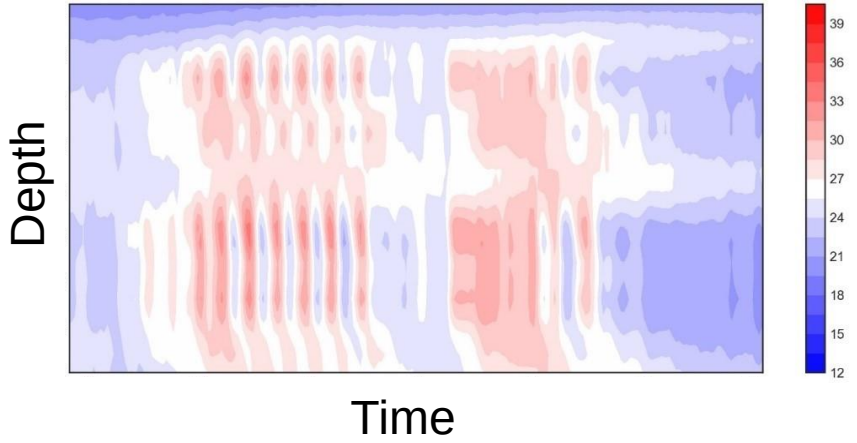




Temperature distribution







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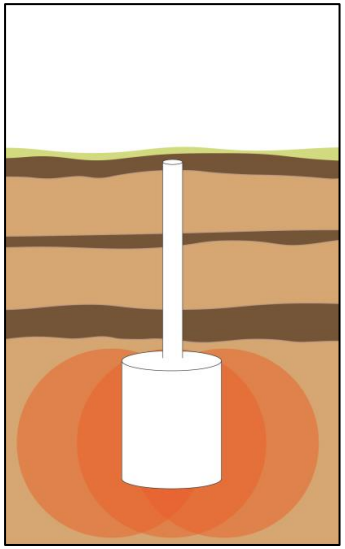
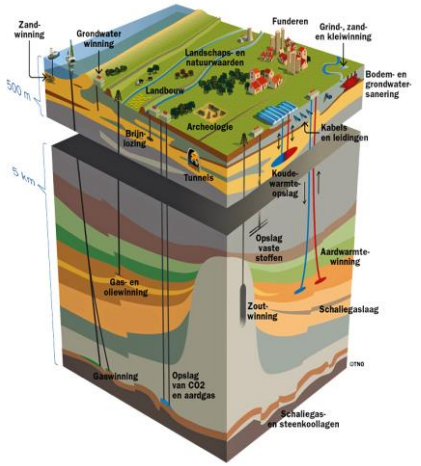
Innovation Highlights

1. Impact & performance
   - Heat distribution / losses
   - Aquifer characterisation
2. Wells
   - Drilling method



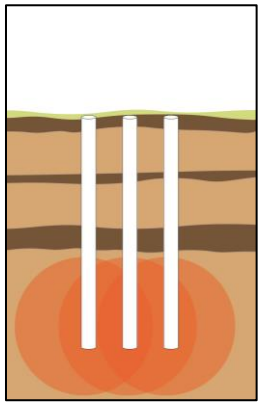
Problem

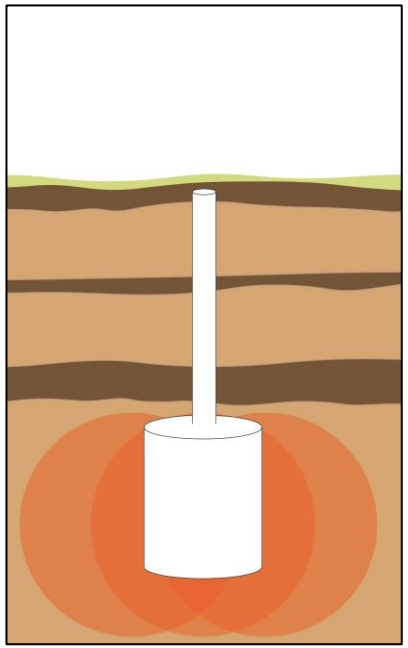


- Busy in the underground
- Utilise more “challenging” aquifers i.e. thin, fine grained, deep
- Capacity, clogging and costs are an issue

Expand borehole diameter at depth

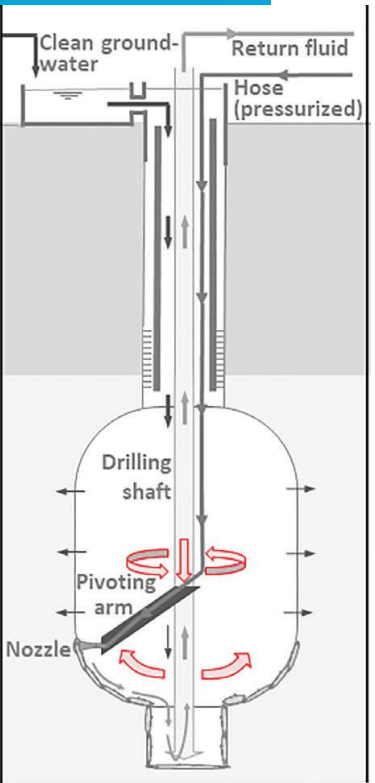
- Potential benefits
  - Reduce drawdown i.e. pumping costs
  - Reduce mechanical clogging
  - Reduce drilling costs





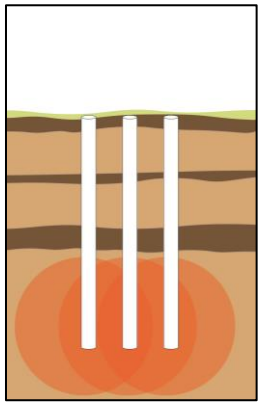
Expand borehole diameter at depth

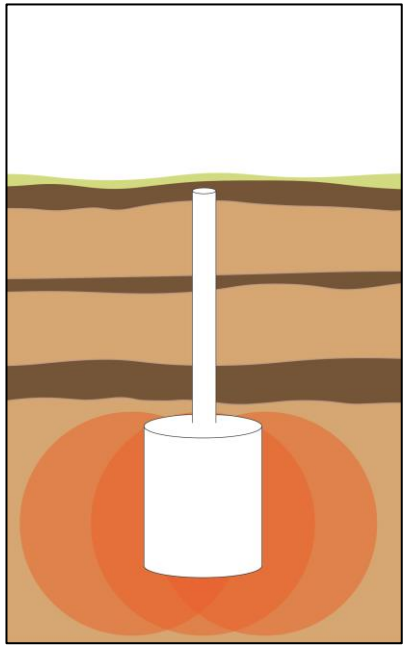
Under reaming by Jetting



Potential benefits

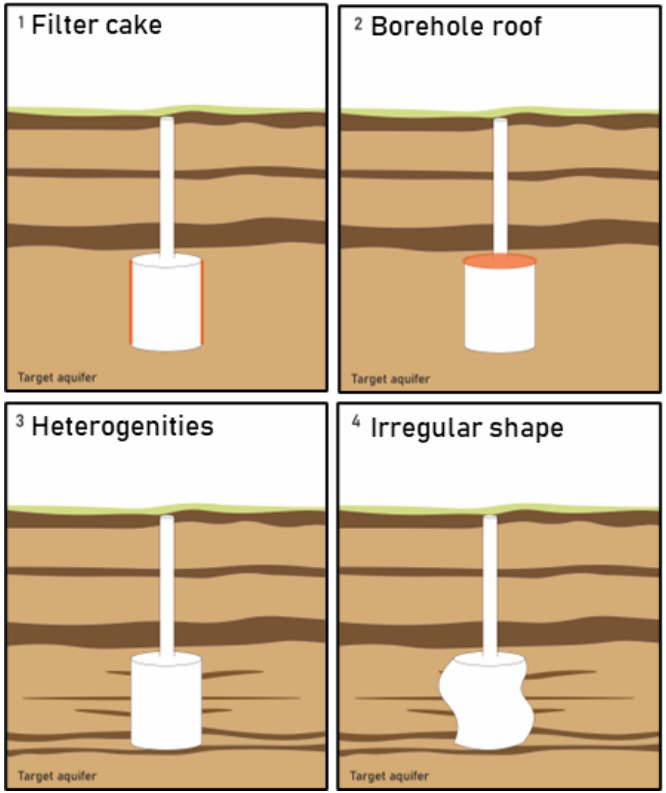
- Reduce drawdown i.e. pumping costs
- Reduce mechanical clogging
- Reduce drilling costs

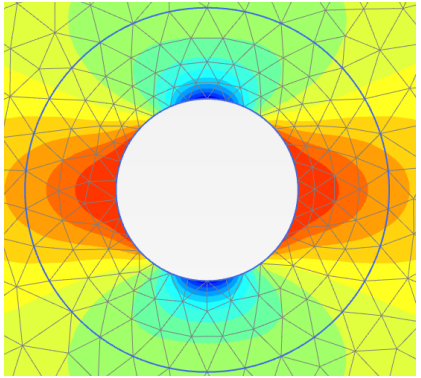




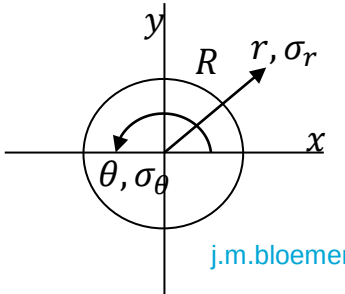
Method suitable for
Expansion of borehole in unconsolidated formations

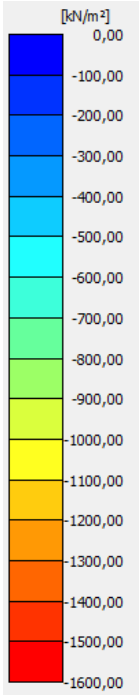
Expanded Diameter Gravel Well (EDGW) Principles and Challenges → wellbore stability





σ_y for R=1 m

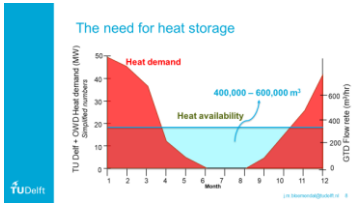




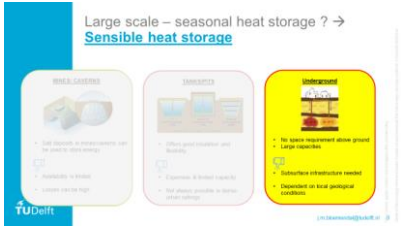
Innovation Highlights

1. Impact & performance
2. Wells
3. System integration and control
4. Societal

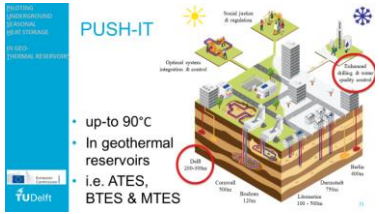
Take home

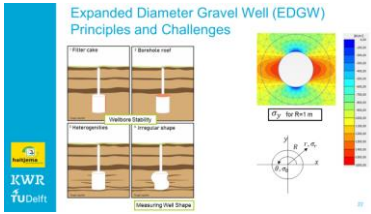


- Large scale seasonal heat storage is needed
- Underground accommodates capacity for seasonal storage



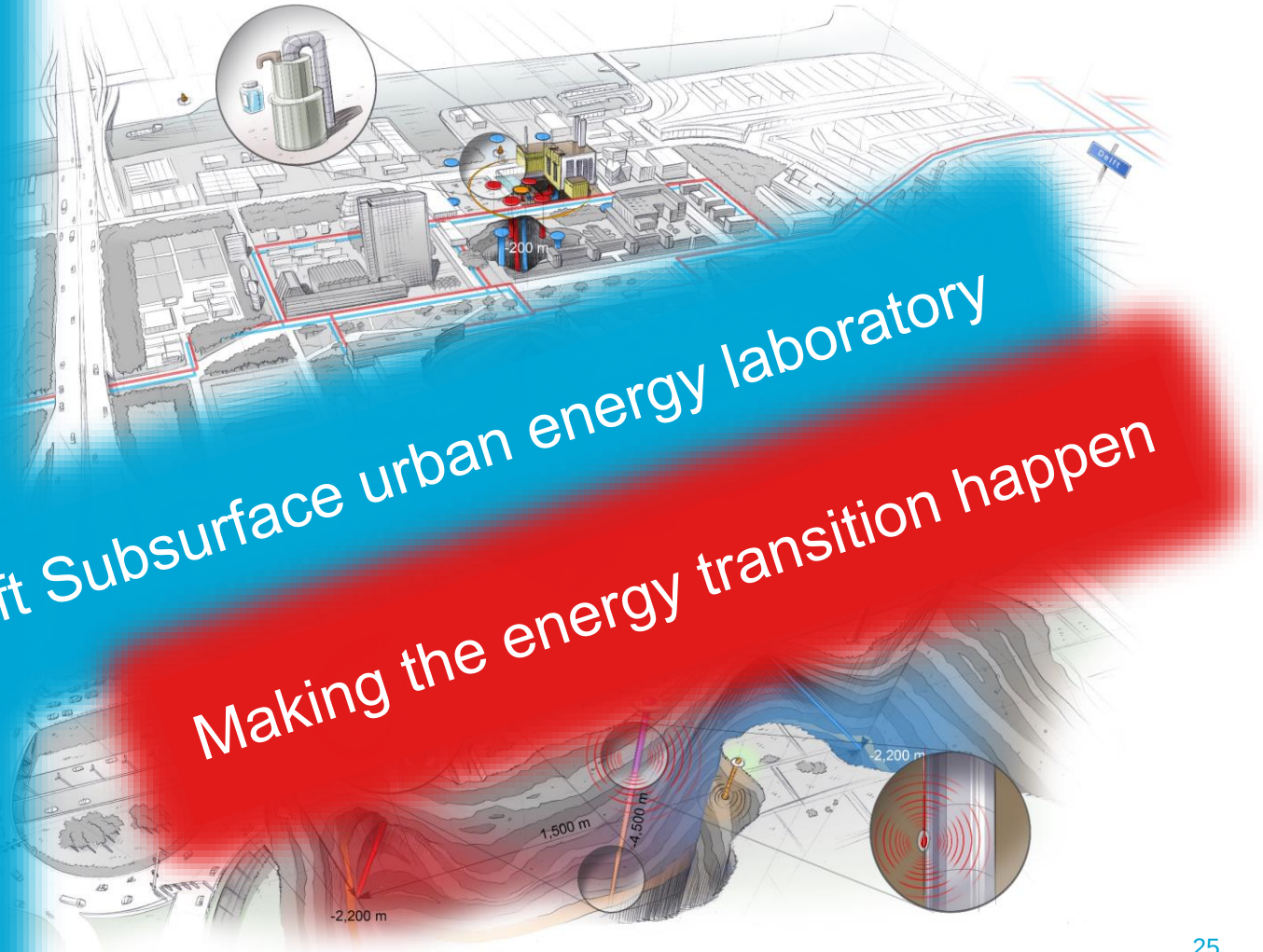
- Via fundamental research at demo's towards cheap and robust seasonal heat storage in the underground





Novel combination of geothermal & HT-ATES

World-wide unique research & education infrastructure



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MSc Sustainable Energy Technology

Electrical Energy track


Wind Energy


Solar Energy


Waste & CHP


Energy Storage


Power Engineering

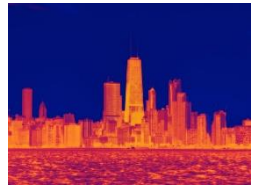

Economics & Society


Electric Mobility

Heating and Cooling track


Heat Sources


LS Heat Systems


Heat in Buildings


Power Engineering


Economics & Society


Waste & CHP

NEW!!
1-9-'23


Solar Energy

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PUSH IT
www.push-it-thermalstorage.eu

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Contributions from:
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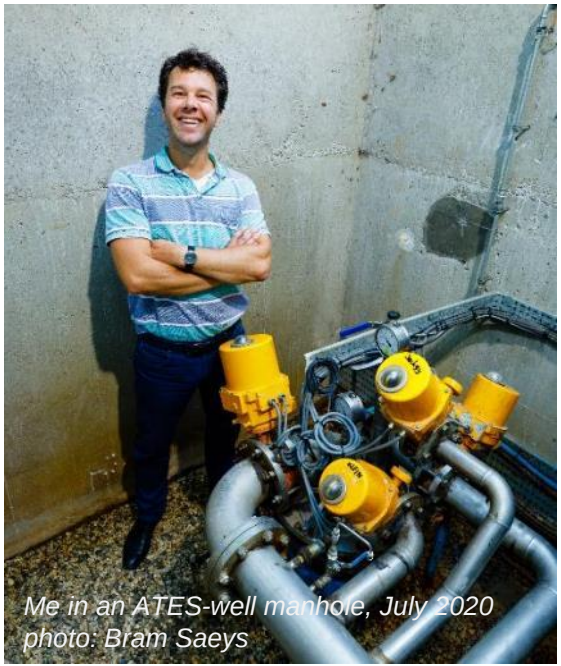

Me in an ATES-well manhole, July 2020
photo: Bram Saeys

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