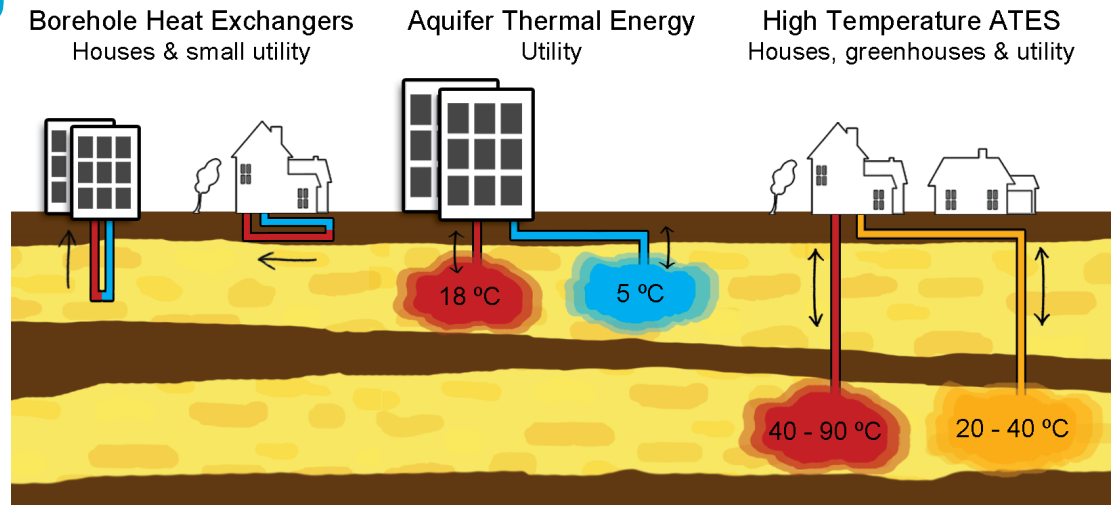
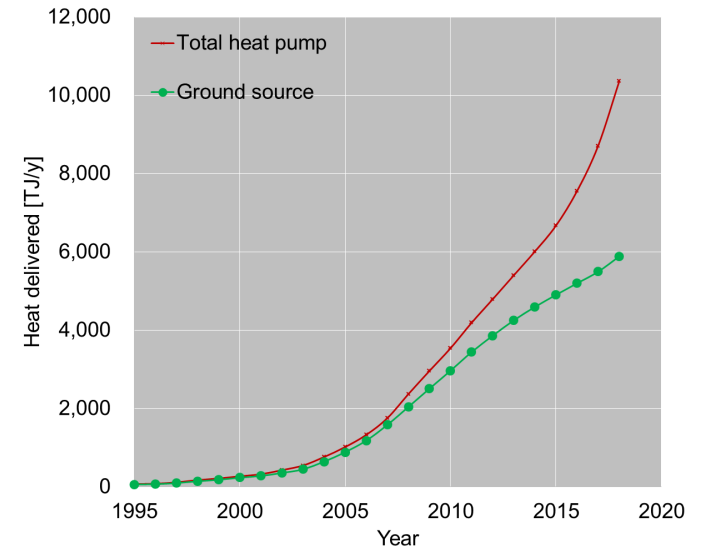
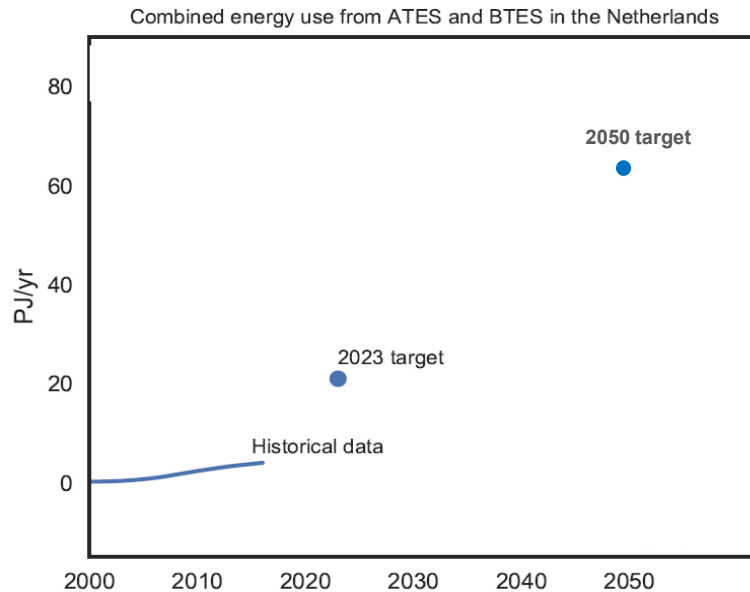


# ATES and BTES developments in the Netherlands: Optimization and Upscaling

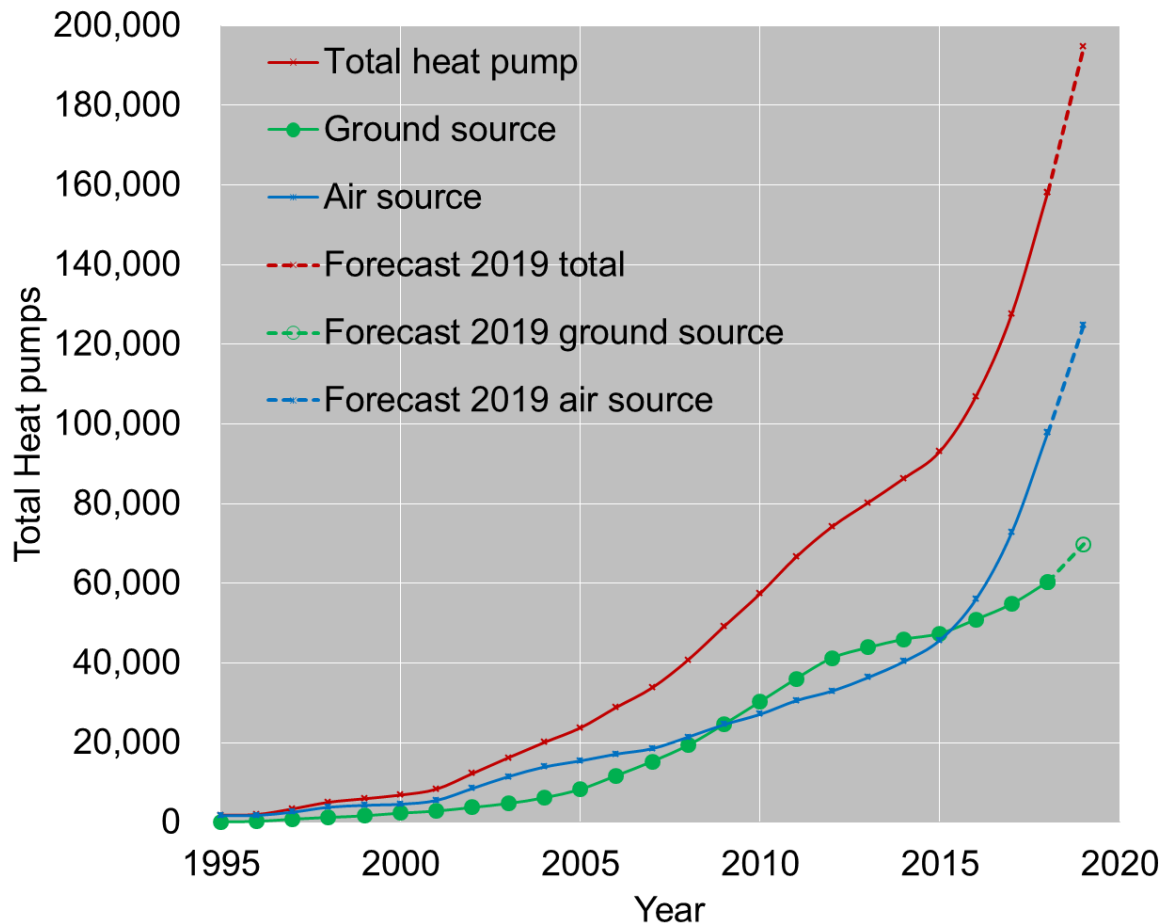


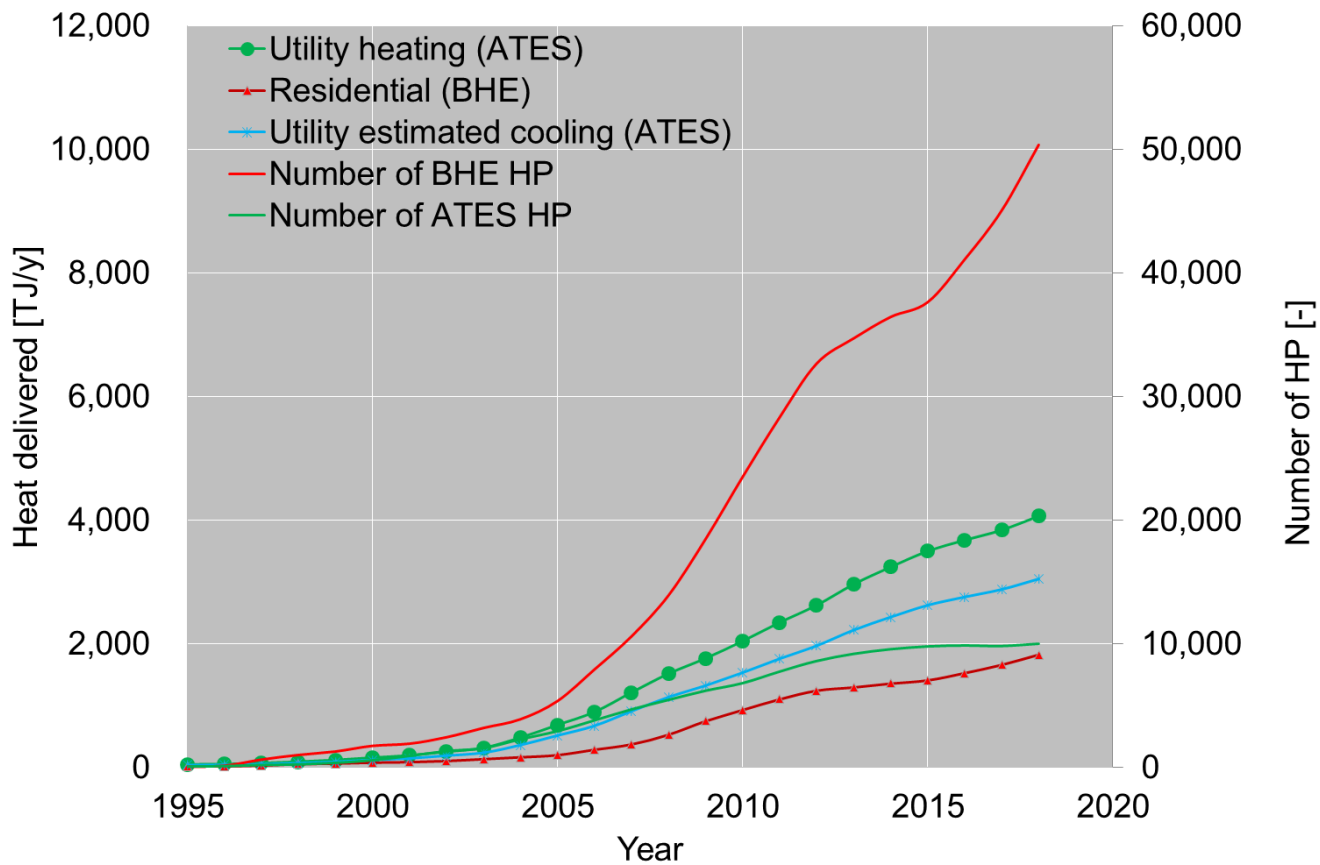
# Heat transition in NL = growth of ATEs & BHE

8,000,000 buildings = 25% of total NL energy use

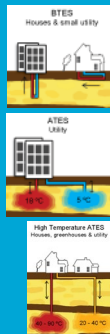


Jaxa-Rozen, Kwakkel, Bloemendal, (under review)





# Legislation situation: permitting



- Reporting obligation
- 6 wk permit procedure
- HT-ATES Pilots allowed
  
- In busy areas: possibility to plan
- Reporting of performance

# Legislation situation: certification

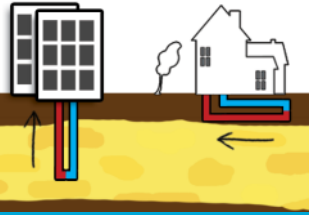
- Design, Build, Operate
- Drilling & completion, Climate installations



# Rationale for certification

- Allow (partly) irreversible disturbances in the subsurface
- GHG emission must go down

BTES  
Houses & small utility



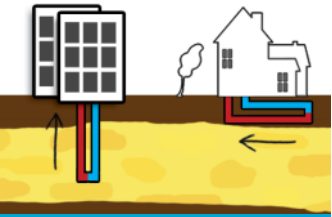
# BTES borehole completion



bodem energie.nl

KWR

TU Delft

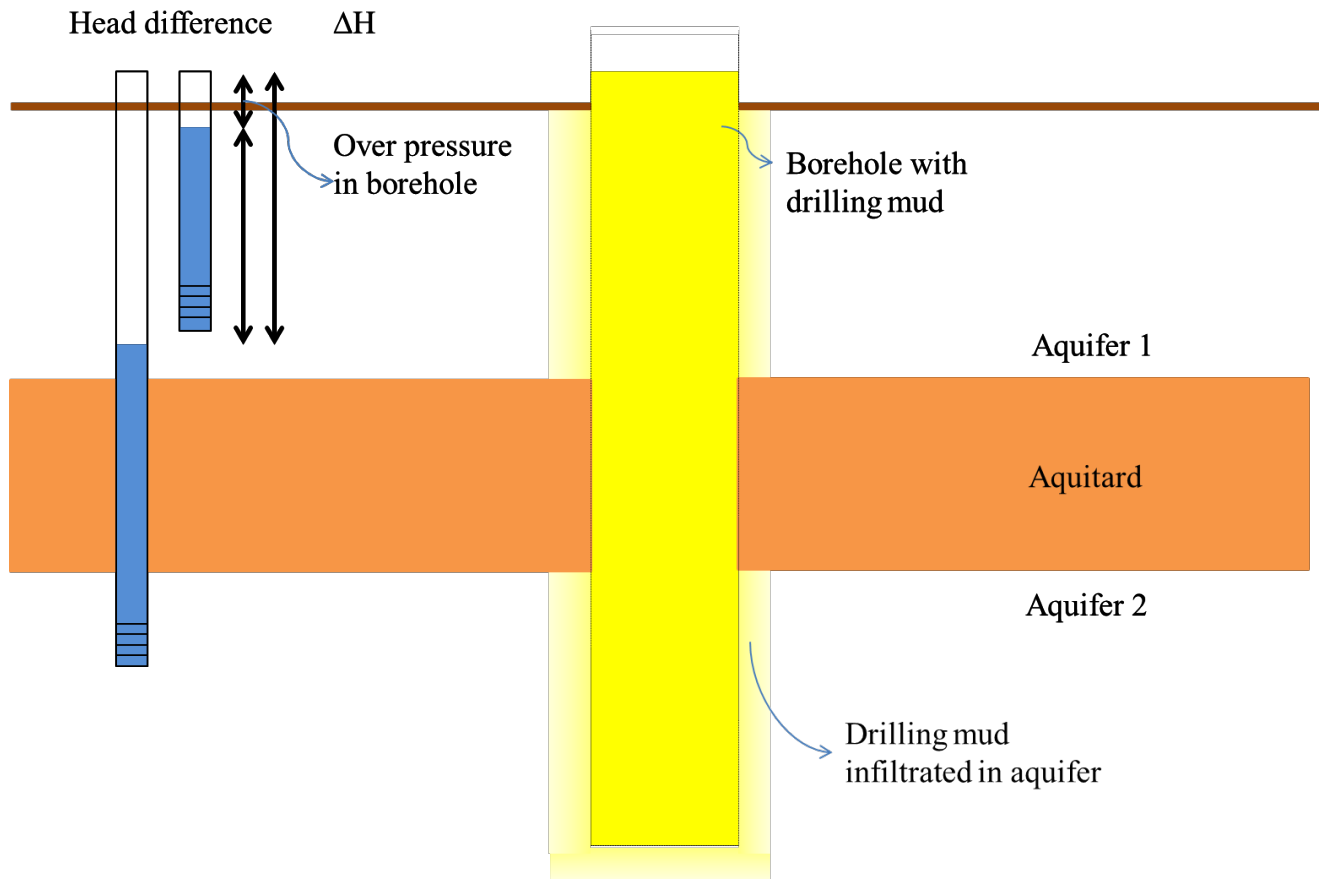


# BTES borehole completion

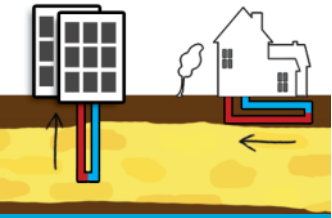
- Clay/bentonite
- Cementing



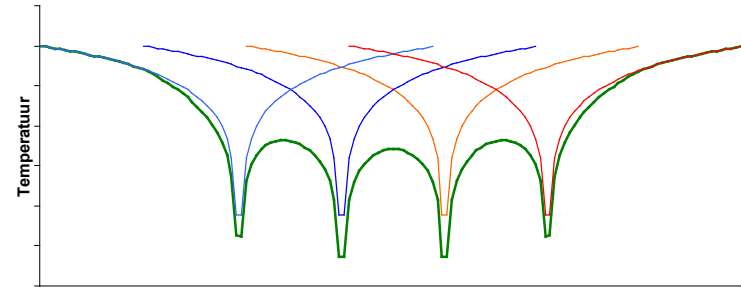
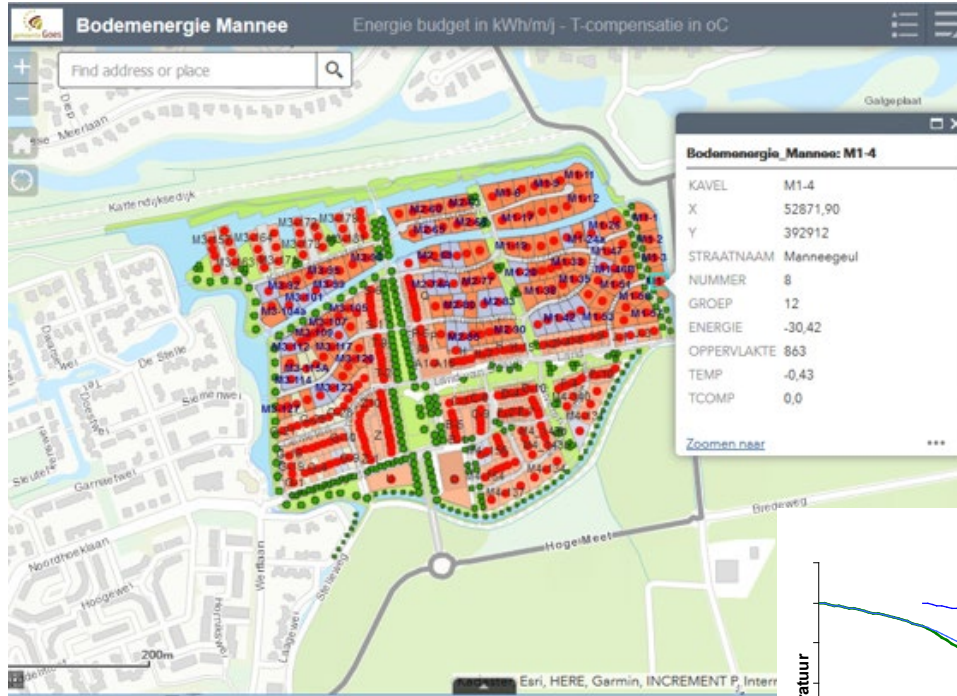
- Verification techniques



BTES  
Houses & small utility



# High density use of BTES

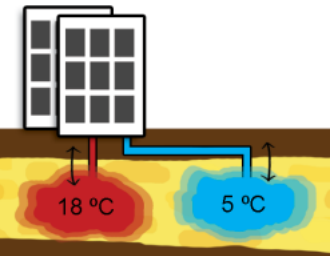


 bodem  
energie.nl

 KWR

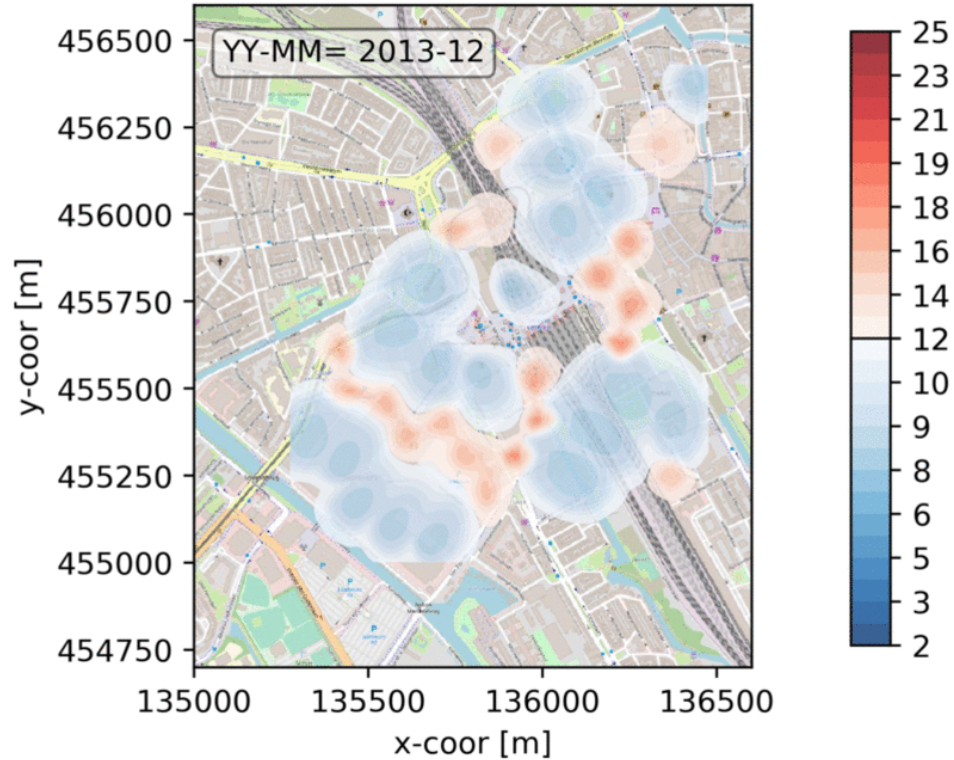
 TU Delft

ATES  
Utility



# High density use Ates

Temp in 1st aquifer[C], day:1440



bodem  
energie.nl

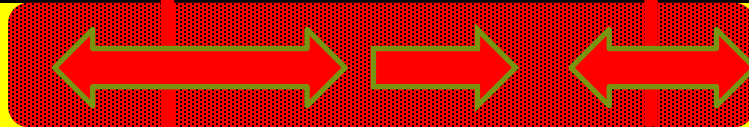
KWR

TU Delft

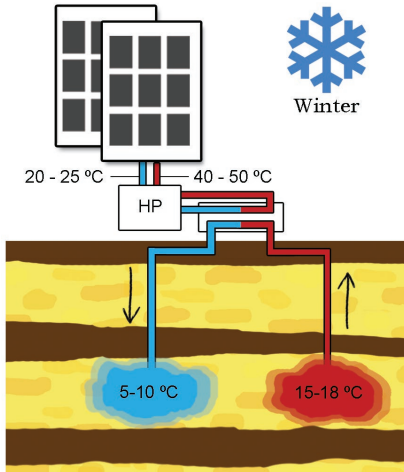
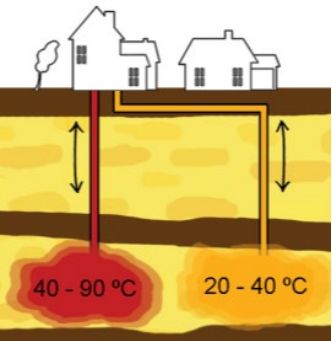
# Subsurface heat transport



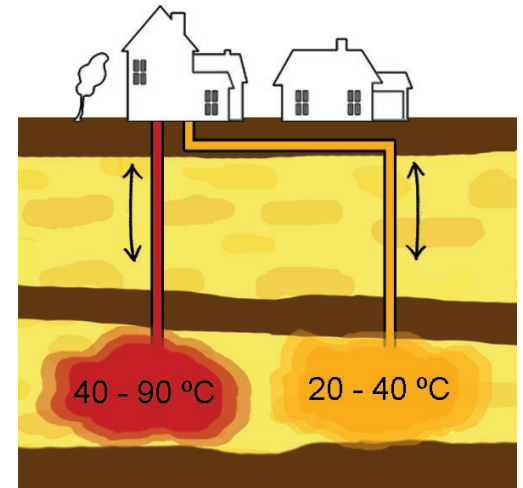
18 °C



# HT-ATES

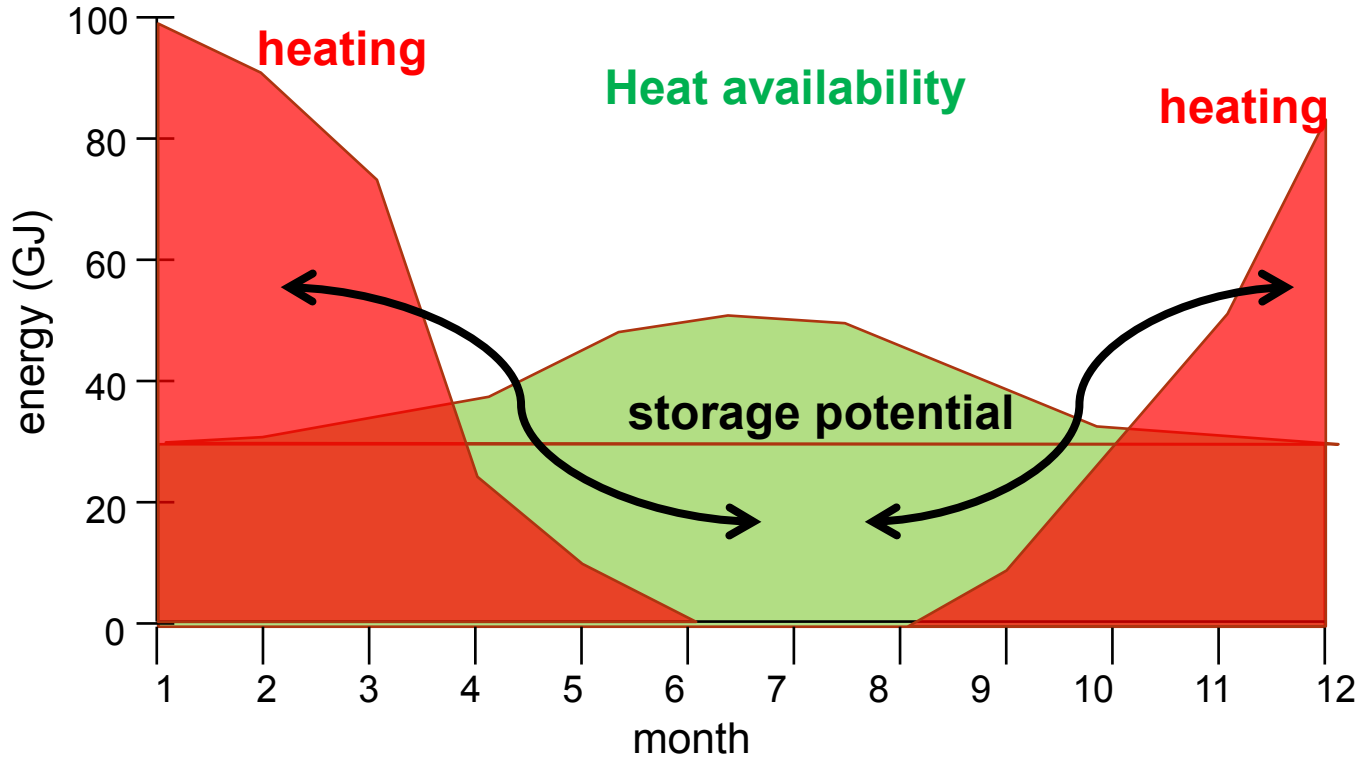


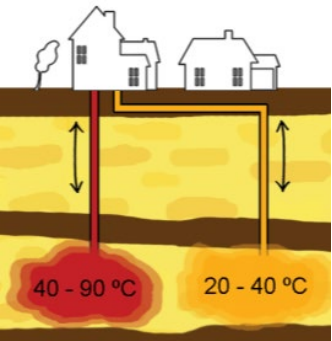
High Temperature ATES  
Houses, greenhouses & utility





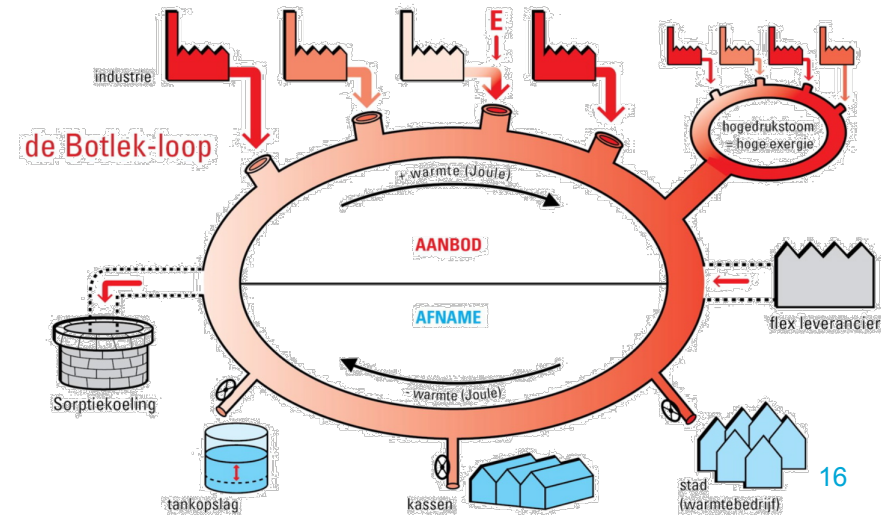
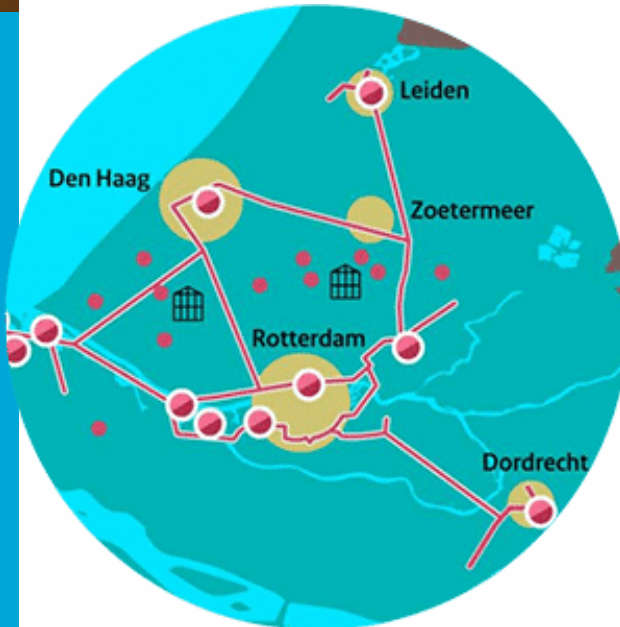
# Mismatch availability of heat

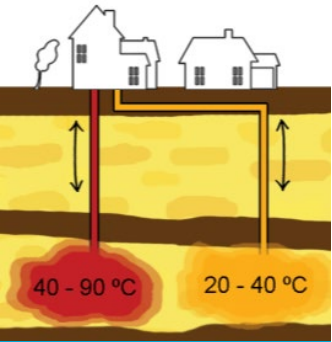




# Integration in heat-networks

- Redundancy in supply and off-take

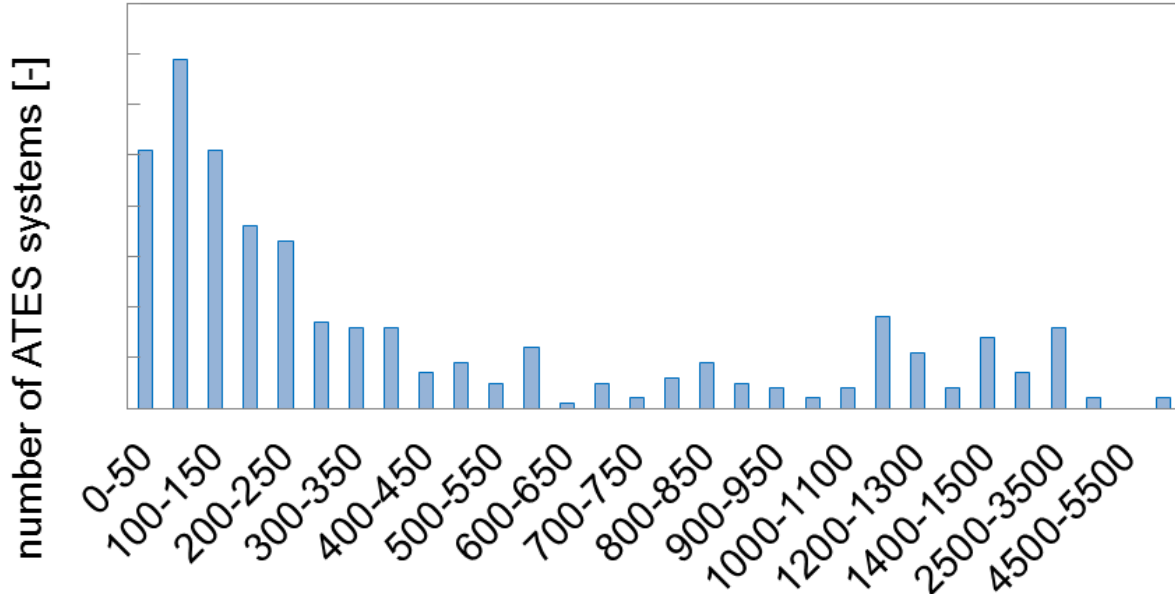




# Existing buffer at heat network A'dam

22,000 m<sup>3</sup> ≈ 10TJ

just enough to cover a weekend

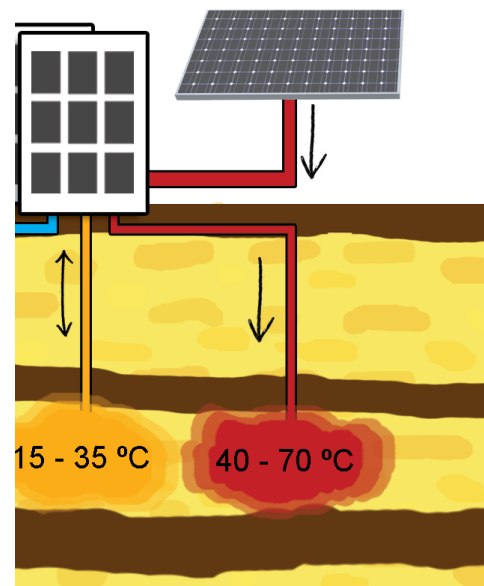
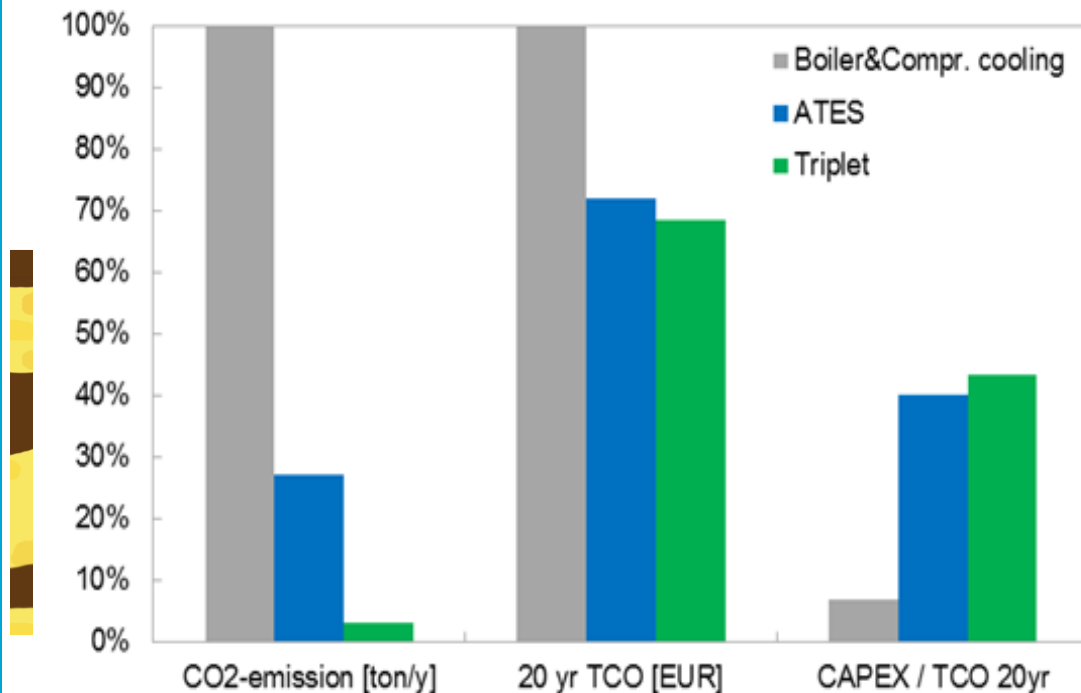


LT-ATES Permit capacity x1000 [m<sup>3</sup>/y]



warmte,

# L&HT-ATES → Triplet



Bloemendal, v. Wijk, Hartog, Pape (H2O-online, 2017).

# ATES and BTES developments in the Netherlands: Optimization and Upscaling

