4-7 NOVEMBER 2024
ROTTERDAM, THE NETHERLANDS

GET2024

GEOTHERMAL ENERGY CONFERENCE

BETTER UTILIZATION OF SHALLOW GEOTHERMAL POTENTIAL

Coen Leo, Teon High Temperature Heat Pumps (5th Nov 2024)

WHAT IS SHALLOW GEOTHERMAL

- There is no clear definition of depth. In the Netherlands we normally mean:

  < 500m : Shallow

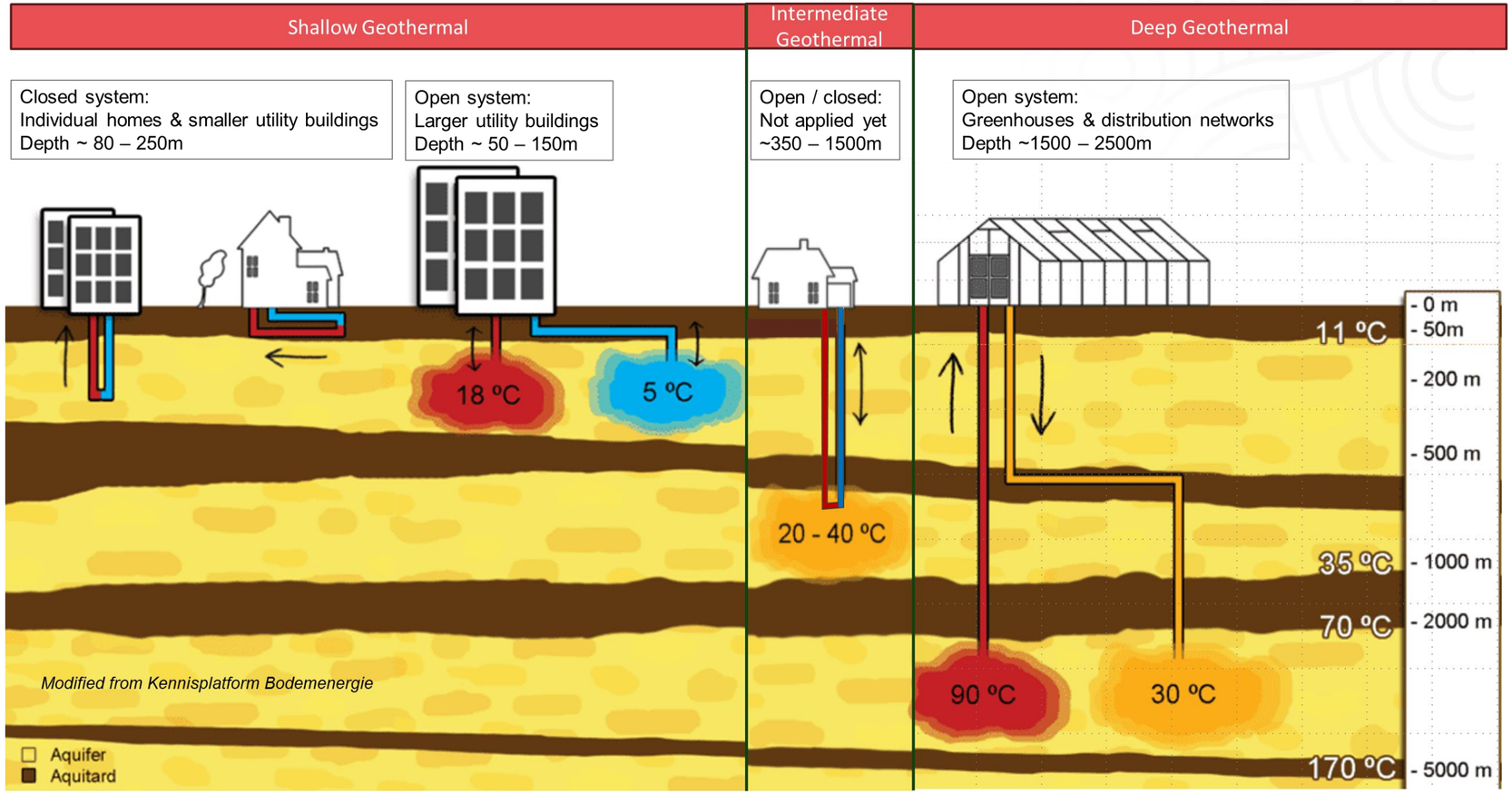
  500 – 1500m : Intermediate

  > 1500m : Deep

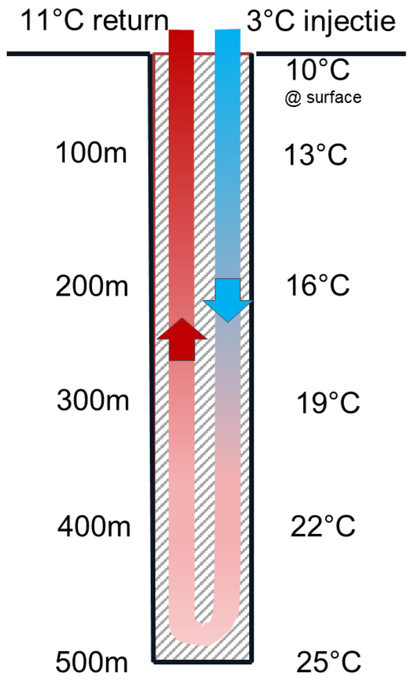
- Type of wells:

  Open (ATES) or Closed (BTES)

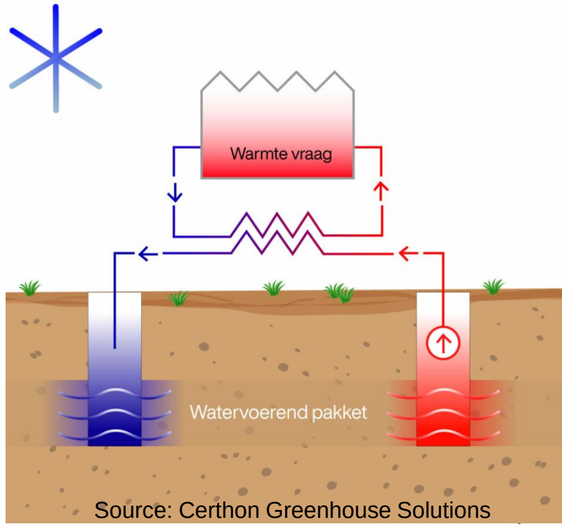
- Our project focus on heat efficiency from shallow and intermediate depth using Closed wells



ADVANTAGES OF CLOSED VERSUS OPEN SYSTEMS



Closed systems	Open systems
Does not need an aquifer	Requires an aquifer
Low investment per well	High investment per well
Low maintenance cost	Relative high maintenance cost
Very long life span	Relative short life span
Flexible and controllable	Less flexibel, reservoir dependent
Low yield per well	High yield per well
Application: Smaller heat consumption projects	Application: Larger heat consumption projects



Source: Certhon Greenhouse Solutions

CLOSED WELL LOW YIELD SOLUTION

How to improve the disadvantage of LOW yield versus HIGH yield per well

1) Drill deeper

2) Drill cheaper

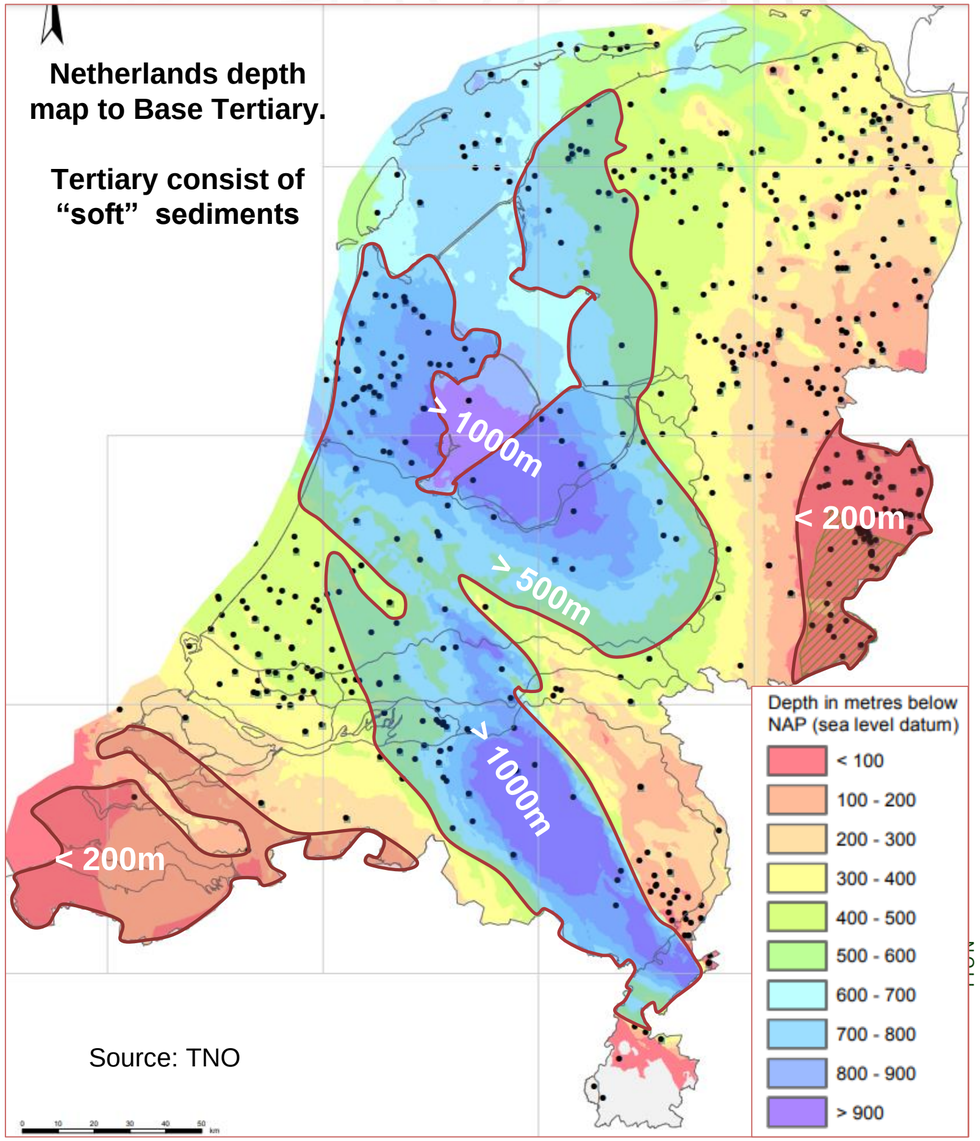
DRILL DEEEEPER

- Standard depth up to now is 80-250m for closed wells, up to 150m for open wells
- Increase standard depth to 500m
  - 500m is administrative depth for shallow geothermal application
  - Increased heat potential (~3 °C / 100m)

    Hence one 500m well replaces seven 100m wells =>

    => Much smaller footprint
- Future wish: Drill closed wells to 1000m (~40 °C)

  - in consultation with authorities



DRILL CHEAPER

- Shallow wells are drilled with small drill pipe rigs with limited depth reach.
  Small rigs are necessary to keep costs down and keep drilling locations accessible.


Source: Conrad Stanen 200 B boormachine tot 250m

Source: Conrad Stanen COMAX 1000 B boormachine tot 800m

- Solution: Drill with coiled tubing
  - Small rig on crawler
  - Drill continuously and fast (ROP 100-150m/hr) to larger depth.
  - CTD drilling gives less rough boreholes => Smooth completion


Original CRC Australia CTD prototype, 1000m

- Result: A 500m or deeper well can be drilled and completed in one day => Drilling costs per meter will be lower with higher yield.

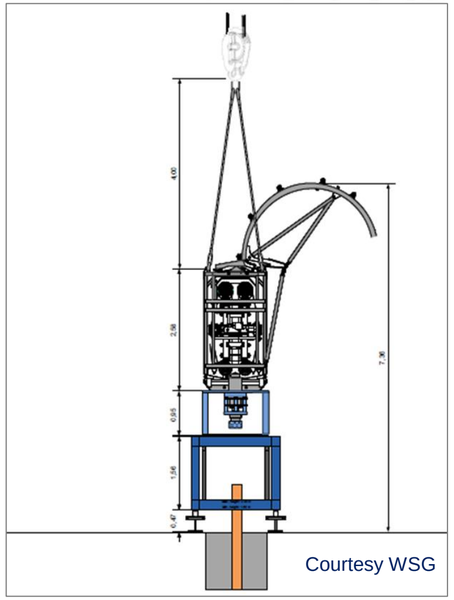
PROJECT 1 - 500M CTD TEST WELL

Well Services Group, TEON and RED will drill a test well for training purposes to 500m depth with a (O&G) coiled tube drilling unit in Emmen, Netherlands.


WSG Coil Tubing Unit

Demonstrate that with CTD technique:

- a well can be drilled safely within 8 hours to 500m
- the well is (semi) vertical
- The well has a smooth borehole and can be easily completed


Courtesy WSG

PROJECT 2 - TWO 500M WELLS IN PATERSWOLDE

- RED, TEON and WSG will drill two wells to 500m in Paterswolde, Netherlands, with standard rotary drilling technique.
- **Goal**: Supply sufficient heat source for a 30 kW TEON heat pump to heat an old, poorly insulated listed building, housing a museum

- **Demonstrate** that closed wells with a depth of 500m:
  - Can be completed with a 50mm U-tube hose and filled with grout
  - Can deliver more than 20 kW thermal energy per well for at least 25 years
  - Supply 30-40% more heat/m than wells of 100-200m depth =>
    => Research project Geo4all

TEON High Temperature Heat Pumps

RENEWABLE ENERGY DRILLING

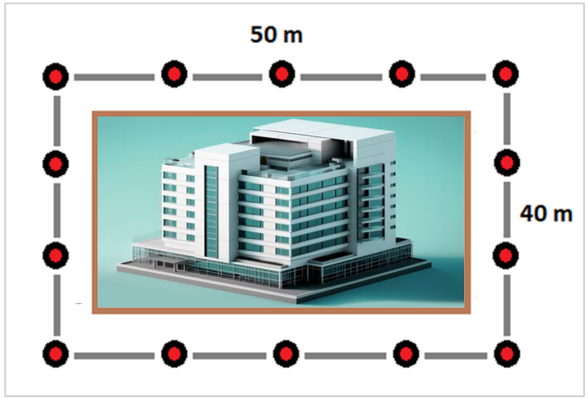
WELL SERVICES GROUP AN EXCELLENCE LOGGING COMPANY

Geo4all Innovation Program · TEON High Temperature Heat Pumps · WELL SERVICES GROUP AN EXCELLENCE LOGGING COMPANY · TNO innovation for life

500M WELL HEAT MODEL EXAMPLES

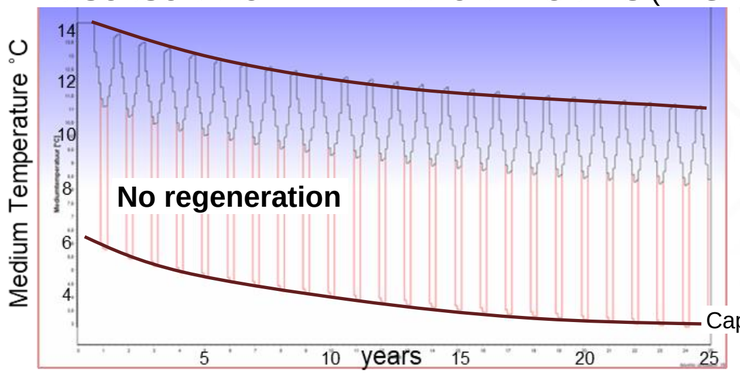
Model:

- Wells 500m depth in square shape, well distance 10m, single probe



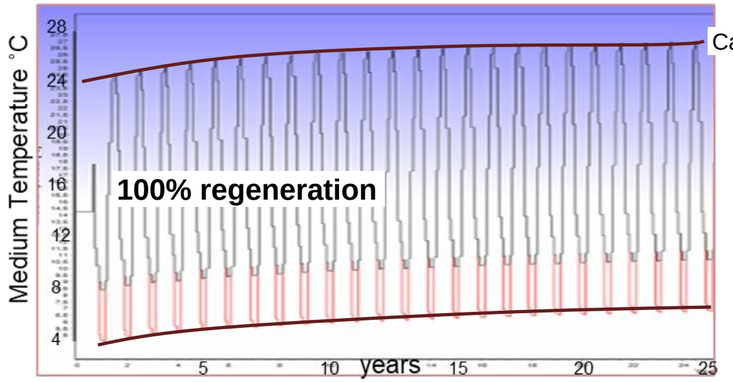
- 25 kW yield per well
- 14 wells give 350 kW
- Assumed 2000 hrs/yr heating time
- Theoretical heat supply **700 MWh/y**
- Probes filled with fresh water

EED SUBSURFACE TEMPERATURE MODELS (***VHGM***)



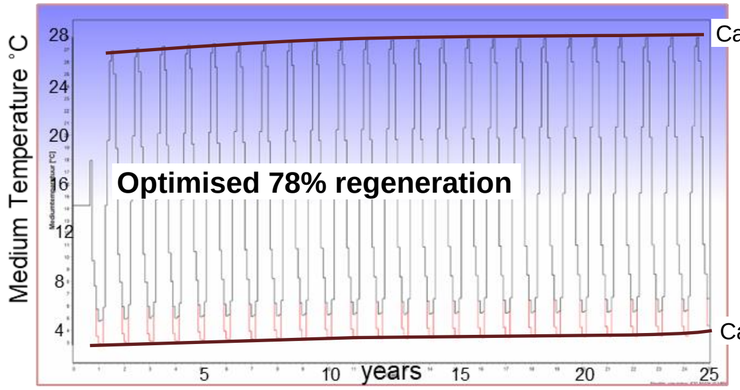
Supply limited by well freezing temperature

Heat supply 320 MWh/y
No cold supply



Supply limited by soil heating limit of 30ºC

Heat supply 620 MWh/y
Cold supply 620 MWh/y



Optimised model

Heat supply **925 MWh/y**
Cold supply 720 MWh/y
Indefinite heat supply >50 years

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GEO4ALL WP3 GOAL FOR CLOSED WELLS

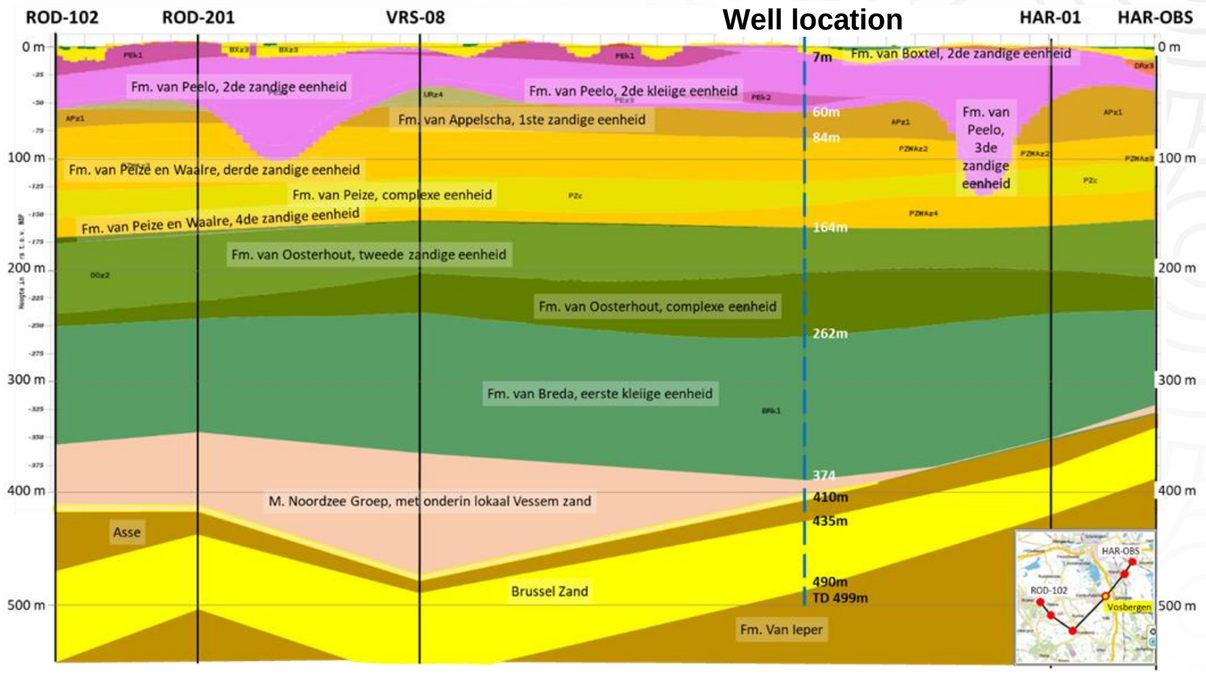
- Provide insights into the performance of deep BHE in different subsurface settings in The Netherlands and recommendations for further developments, as well as improved BHE control through better systems control.

- Evaluate heat flow in these closed loop systems through Distributed Temperature Sensing (DTS) and Multiple Thermal response tests (TRT) using fibre-optic cables

GEO4ALL RESEARCH IN PATERSWOLDE

- The two wells of 500m depth will be equiped with glasfiber cable, possibly inside and outside the probe
- TNO will mature / develop a performance model (tooling) that can predict power output based on a range of sensitivities (subsurface & well design) as well as a standard 2D EED model for comparison
- GR, SP, Caliper and Inclination logs will be run
- Temperature measurement will be read out 2 to 4 times a year during at least two years
- The (3D) groundmodel will be updated with log and temperature data, temperature simulations will be run and calibrated with measurements. Update (software) model.

Paterswolde cross-section



Data analysis to:

- Quantify temperature flow during time over well and per (lithology) layer
- Determine vertical heat distribution and contribution, and compare to EED model (is 1D earth model)
- Determine if grout is a good seal
- Evaluate well heat interference, if any
- Can groundwater flow be determined based on temperature behaviour from the two wells?

END

Questions and Discussion

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