HEATSTORE WEBINAR SERIES

HOW TO DEVELOP UNDERGROUND THERMAL ENERGY STORAGE (UTES) PROJECTS?

Learnings from the European HEATSTORE project

Host: TNO, The Netherlands

7, 14, 21, 28 Sept. and 5, 12 Oct. 2021 | all 15-16 h (CEST)

Register on www.heatstore.eu

HEATSTORE WEBINAR SERIES 2021

All webinars are at 15 – 16 h CEST

Tuesday 7 Sept. (Holger Cremer, TNO): Challenges in Underground Thermal Energy Storage (UTES)

Tuesday 14 Sept. (Thomas Driesner, ETH Zurich): Advances in subsurface characterization and simulation

Tuesday 21 Sept. (Koen Allaerts, VITO): Integrating UTES and DSM in geothermal district heating networks

Tuesday 28 Sept. (Florian Hahn, Fraunhofer IEG): Abandoned coal mines – promising sites to store heat in the underground

Tuesday 5 Oct. (Bas Godschalk, IF Technology): The ECW Energy HT-ATES project in the Netherlands

Tuesday 12 Oct. (Joris Koornneef, TNO): The role of UTES in the future EU energy system – a moderated table discussion.

heatstore High Temperature Underground Thermal Energy Storage

GEOTHERMICA

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HEATSTORE

- HEATSTORE = GEOTHERMICA ERA-NET co-fund project
- 16.3 M€ | 23 partners in 9 EU countries
- 6 demonstration sites, 8 case studies.
- Coordination: TNO Netherlands Organization for Applied Scientific Research)

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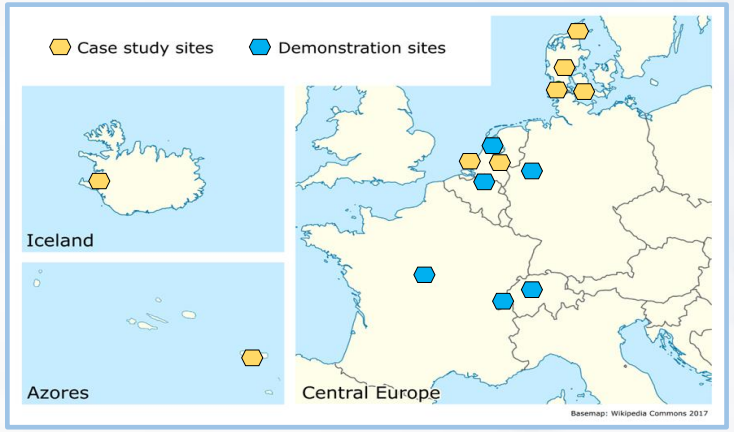

- **Best practice guidelines:** Design & System integration | Business models | Regulatory framework | Stakeholder perception & engagement | Monitoring technical, economic and environmental performance

- Proof and operation of UTES and DSM technologies

Fast track market uptake

Model & design validation

Characterization of UTES

Modelling sub-surface dynamics

Heating system integration & design optimisation

Demonstration

System performance monitoring

- **Roadmap Europe**: Technical future potential UTES and DSM in Europe | New business models | Stakeholder engagement | Roadmap for fast track uptake

Design → **Demonstration** → **Replication and scale-up**

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HEATSTORE – 5 Oct. 2021
The ECW Energy HT-ATES project in the Netherlands

- Bas Godschalk (IF Technology): Convenor & Opening
- Wim Bos (ECW Energy): Why ECW is applying a HT-ATES?
- Peter Oerlemans (IF Technology): The Dutch HT-ATES project: hydro-geological & legal challenges with developing a full-scale HT-ATES system
- Nico Franco Pinto (IF Technology): The Dutch HT-ATES project: design & realisation challenges with developing a full-scale HT-ATES system

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HIGH TEMPERATURE UNDERGROUND THERMAL ENERGY STORAGE IN A GREENHOUSE AREA MIDDENMEER IN THE NETHERLANDS

ecw energy
solid solutions for a sustainable future

Wim Bos

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High Temperature Underground Thermal Energy Storage

if

Bas Godschalk
Peter Oerlemans
Nico Franco Pinto

Webinar Heatstore, October 5th, 2021

THE DUTCH HT-ATES PROJECT: HYDRO-GEOLOGICAL & LEGAL CHALLENGES WITH DEVELOPING A FULL-SCALE HT-ATES SYSTEM

PETER OERLEMANS

CONTEXT FOR HT-ATES DEVELOPMENT IN NL

LT-ATES (< 25 °C)

- Widely applied in NL (>30 years)
- Sustainable heating and cooling
- Huge potential in Dutch subsurface (<500 mbgs)
- Workflows available in all project phases:
  - Permit, Design & Realization, Operation
- Over 2,000 LT-ATES systems

HT-ATES

- Legally similar to LT-ATES
- Builds forth LT-ATES experience and knowledge
- Fits the existing workflows,
- But: High Temperature brings challenges
  - Legal
  - Design

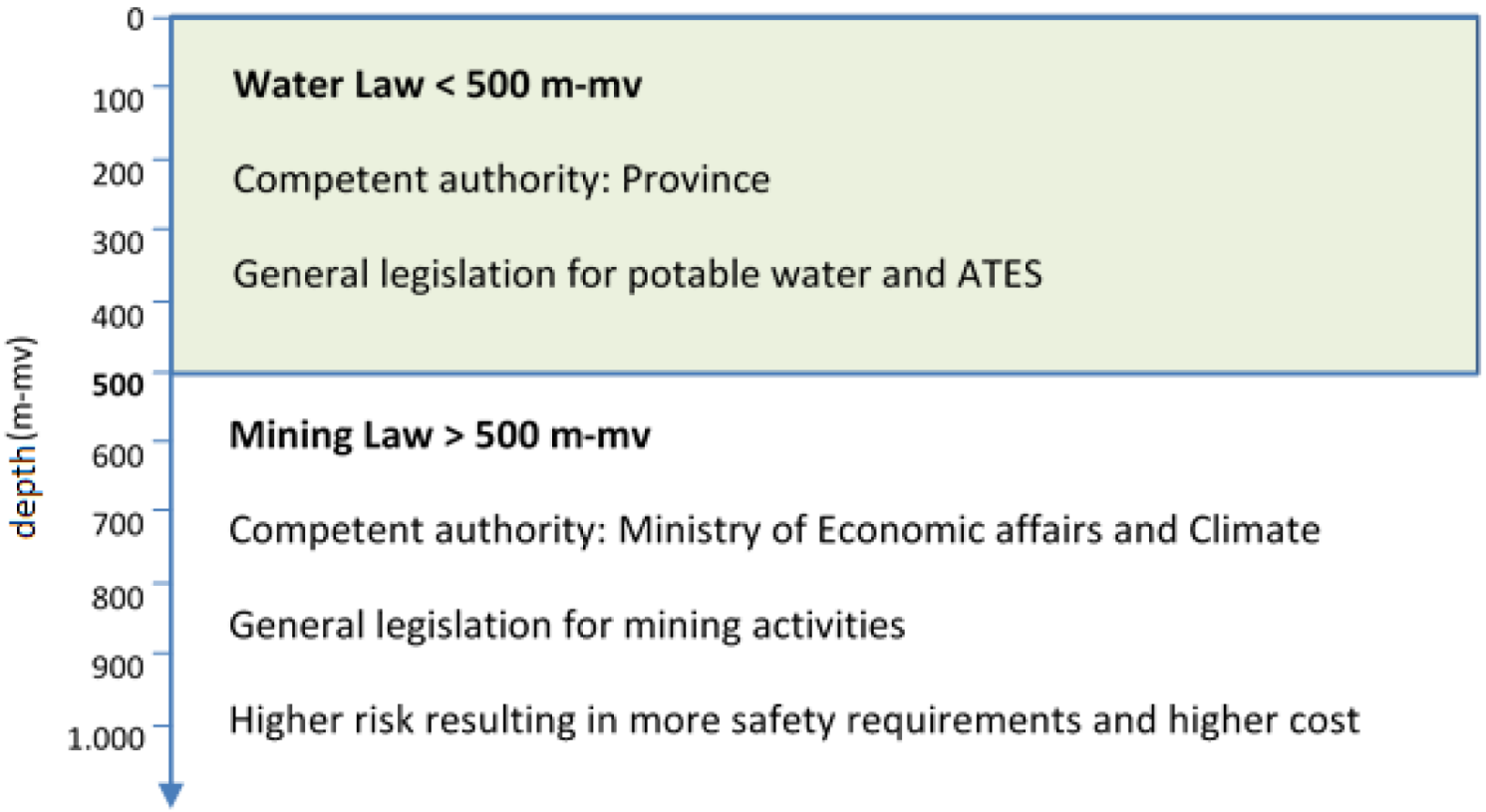
LEGAL CHALLENGES

Legal Framework for HT-ATES:

The Water Law

- < 500 mbgs
- ATES
- Provinces issues permits

- LT-ATES, an assessment framework is available



WINDOW, 2020

LEGAL CHALLENGES

LT-ATES: Assessment Framework exists: the 'BUM'

- Consistent and streamlined permit application process
- Important driver for widespread implementation of LT-ATES systems

Legal differences between LT and HT ATES:

- Temperatures > 25 °C
- Net heat addition to subsurface

LEGAL CHALLENGES

General criteria of the Water Law:

- Interest of the protection of the subsurface is not violated → Groundwater quality, stakeholders
- Effective use of ATES in the subsurface → Recovery efficiency

No specific Assessment Framework for HT-ATES exists (yet)

- Permitting process is complex and outcome is uncertain
- Barrier for HT-ATES initiators in NL

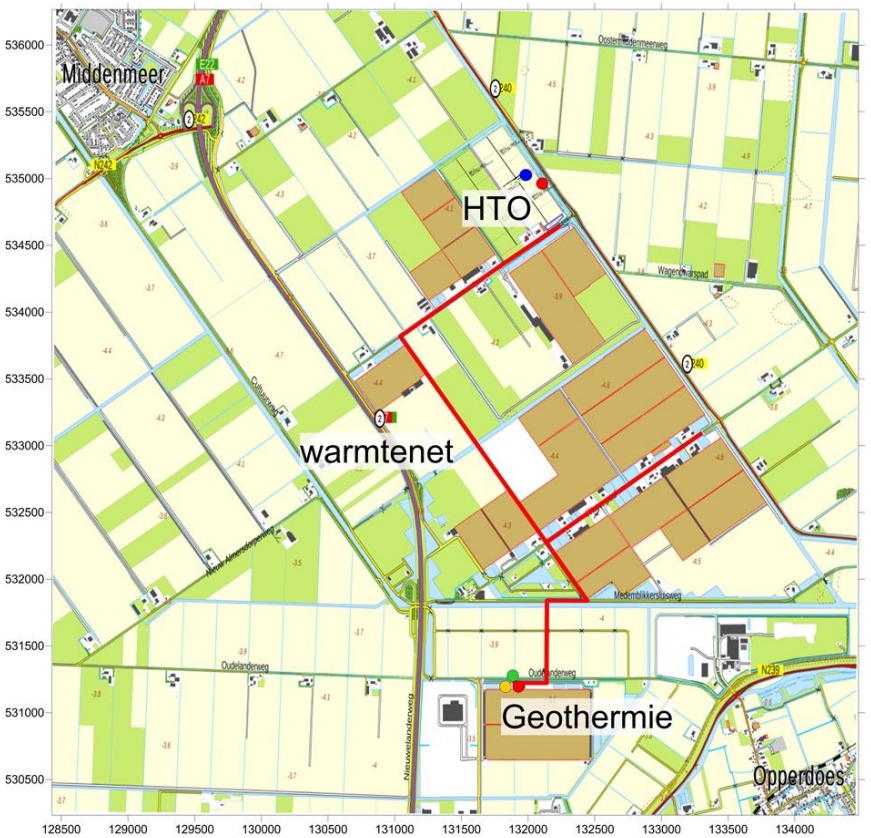
→ More specific assessment criteria are needed for HT-ATES →

WINDOW

WARMINGUP
Innovatief Duurzaam Warmtecollectief

HT-ATES AT ECW IN MIDDENMEER

- How to realize a HT-ATES system?
- Geothermal & HT-ATES concept in Middenmeer
- Timeline at ECW
- Test drilling results (2019): Addressing Hydrogeological questions



HOW TO REALIZE A HT-ATES WELL SYSTEM?

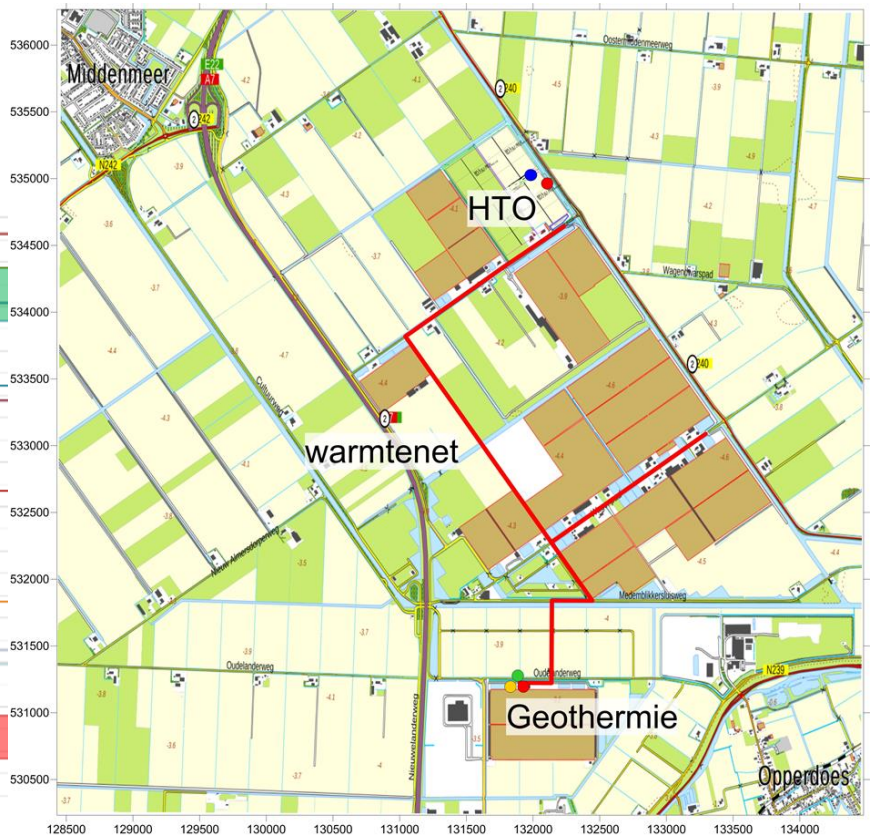
Step 1: "Standing on the shoulders of giants"

→ Use all knowledge and experiences available from earlier HT-ATES projects

Lessons Learned (Heatstore WP1)

- 'Bigger is Better'
- Test drilling before designing the system
- Succesful integration subsurface & surface facilities
- Material selection
- Extensive legal procedure

GEOTHERMAL & HT-ATES IN MIDDENMEER



TIMELINE AT ECW

2018
- HT-ATES permit

2019
- Test Drilling
- Well Design

2020
- Well Realization

2021
- Testing Phase
- Operation Started

2019: TEST DRILLING

Research questions

- Presence of storage aquifer
- Properties of aquifer
- Max flow rate

Actions

- Drilling to 471 mbgs
- Tests and measurements

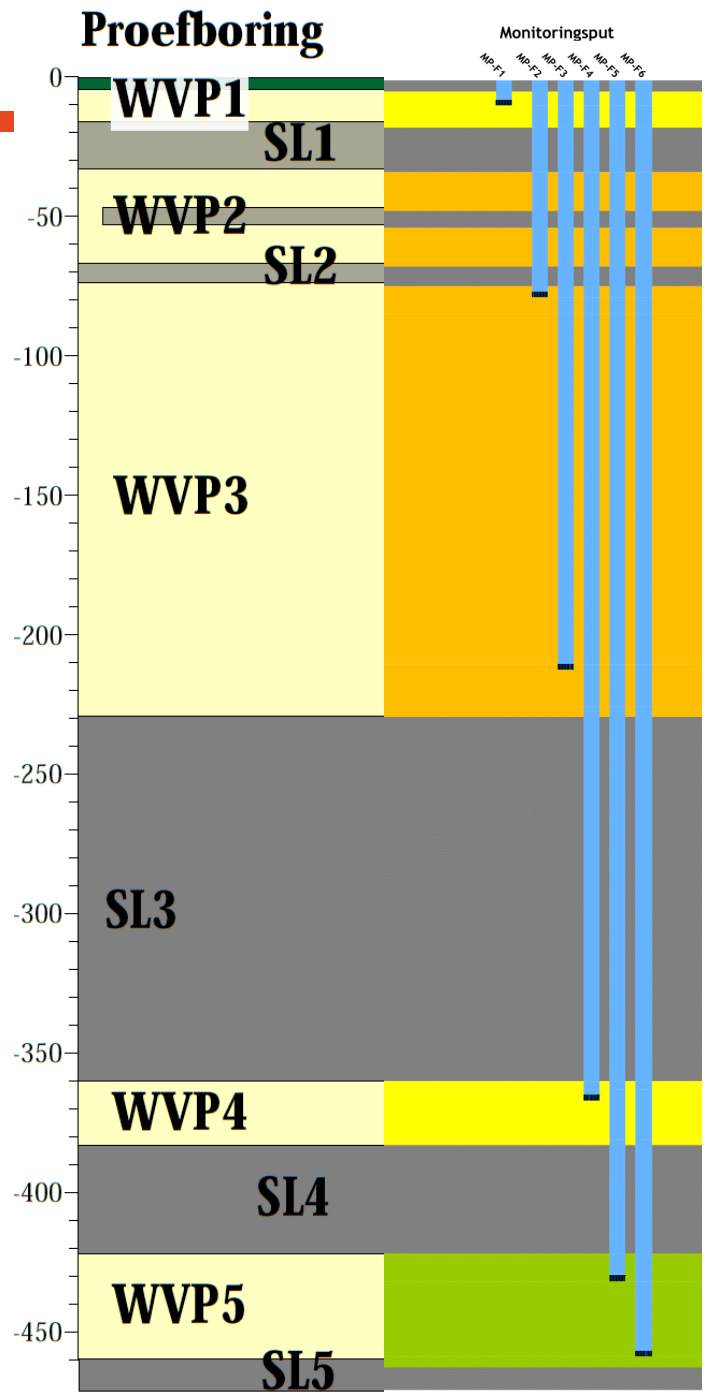
Results

- Detailed information on subsurface
- Input for design

2019: TEST DRILLING

Results

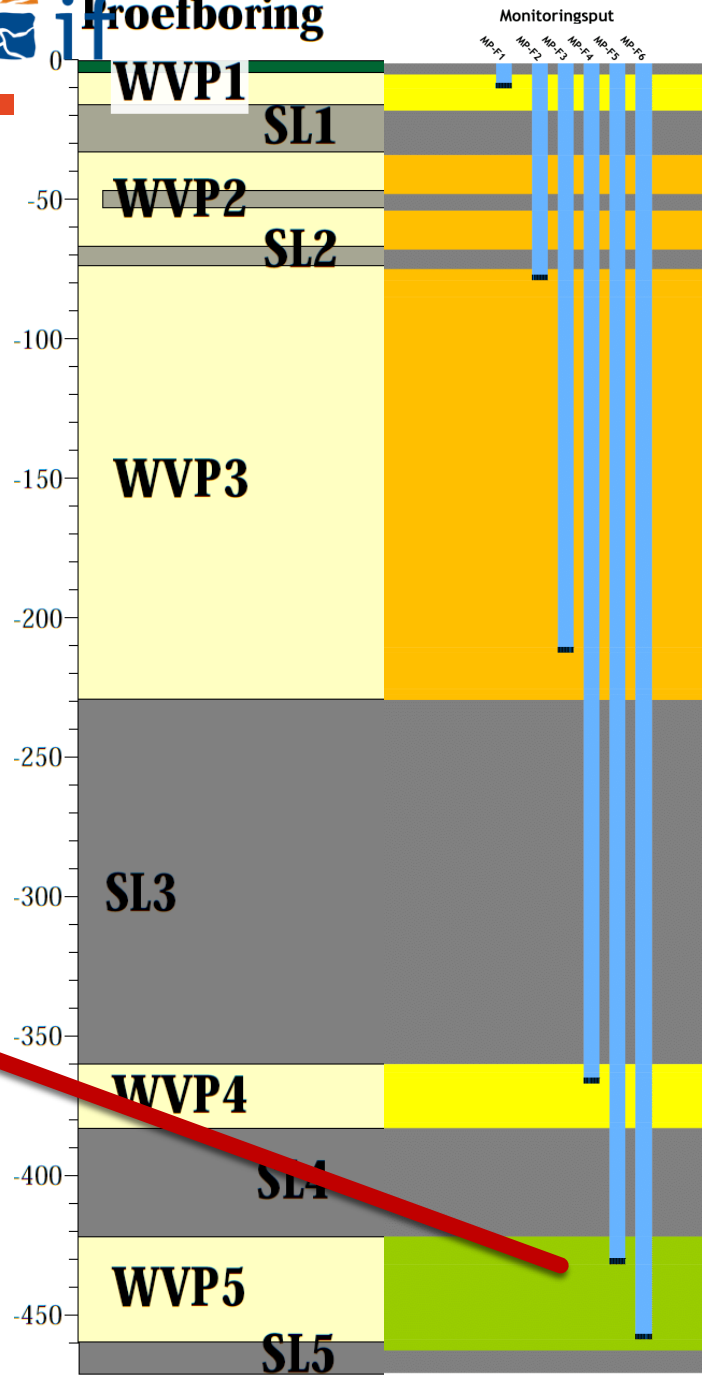
- 2 aquifers found:
  - Aquifer 4: 360 – 383 mbgs → 23 m thick
  - Aquifer 5: 424 – 463 mbgs → 39 m thick



2019: TEST DRILLING

Results

- Groundwater analysis:
  - Saline groundwater
  - Aquifer 5: high gas (CH_4) content

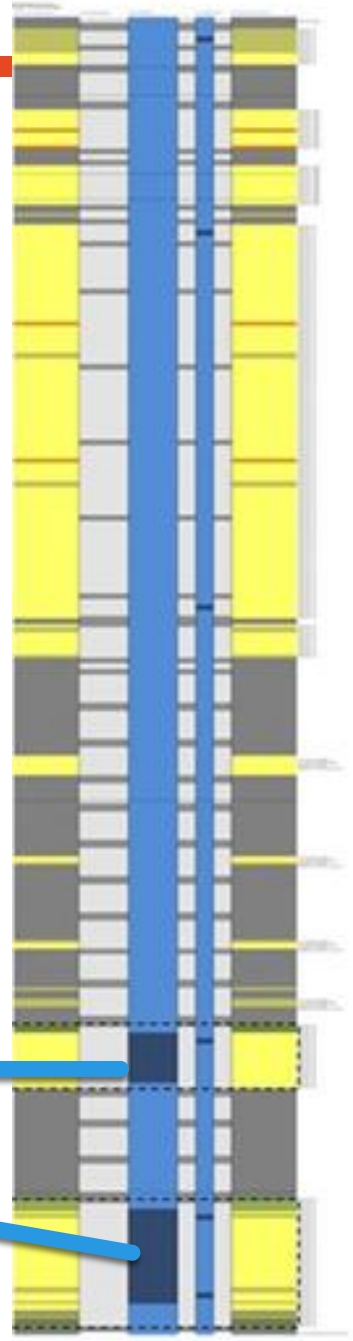


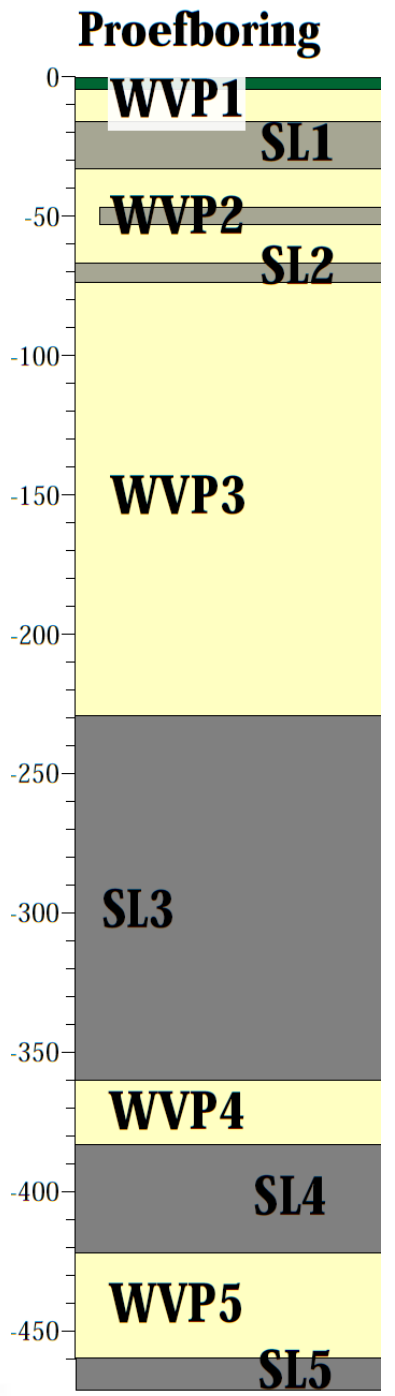
2019: TEST DRILLING

Results

Max flow rate was higher in Aquifer 4

Lower sand production in Aquifer 4



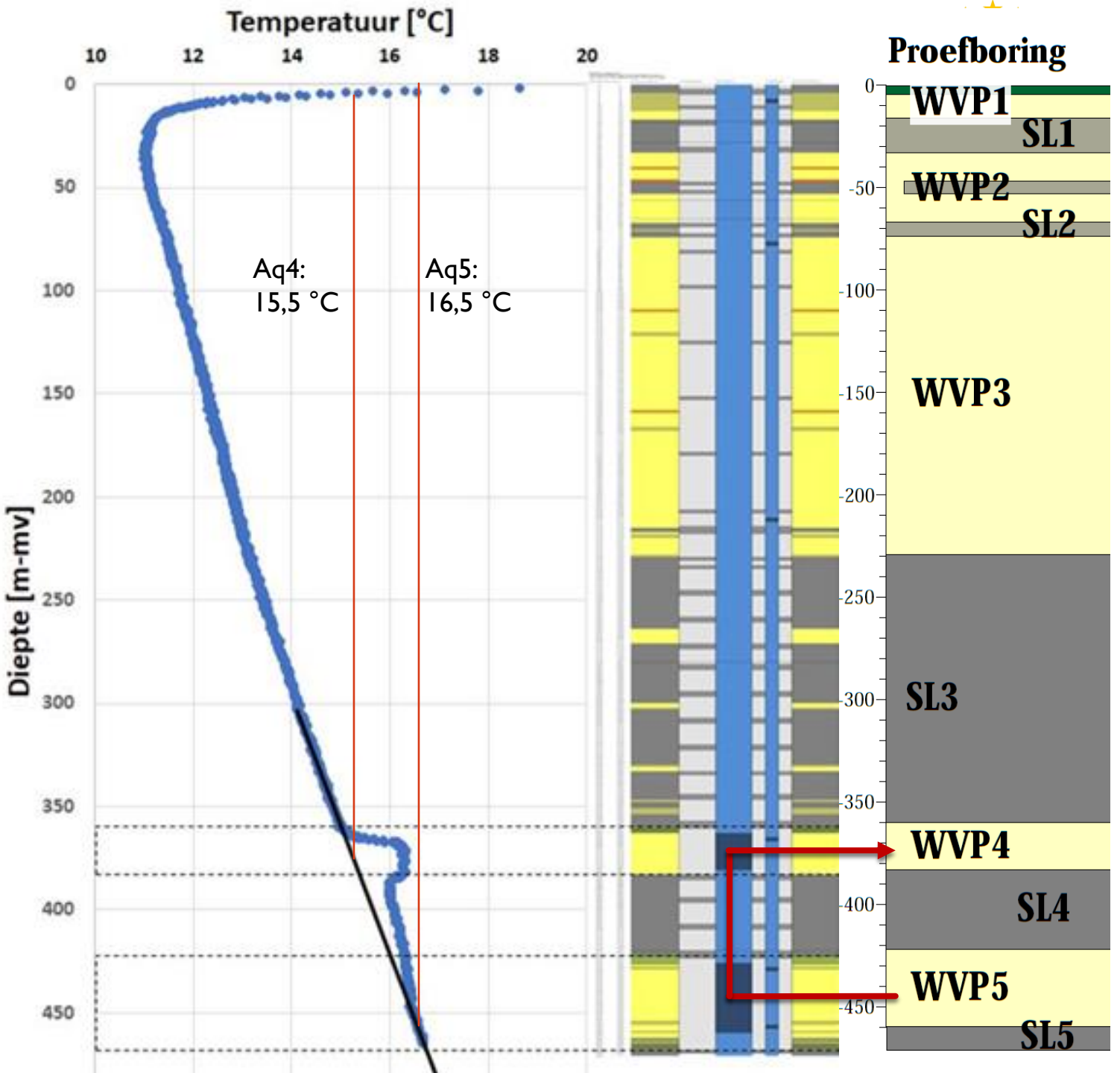


2019: TEST DRILLING

Results - Temperatures

- Aquifer 4: 15,5 °C
- Aquifer 5: 16,5 °C

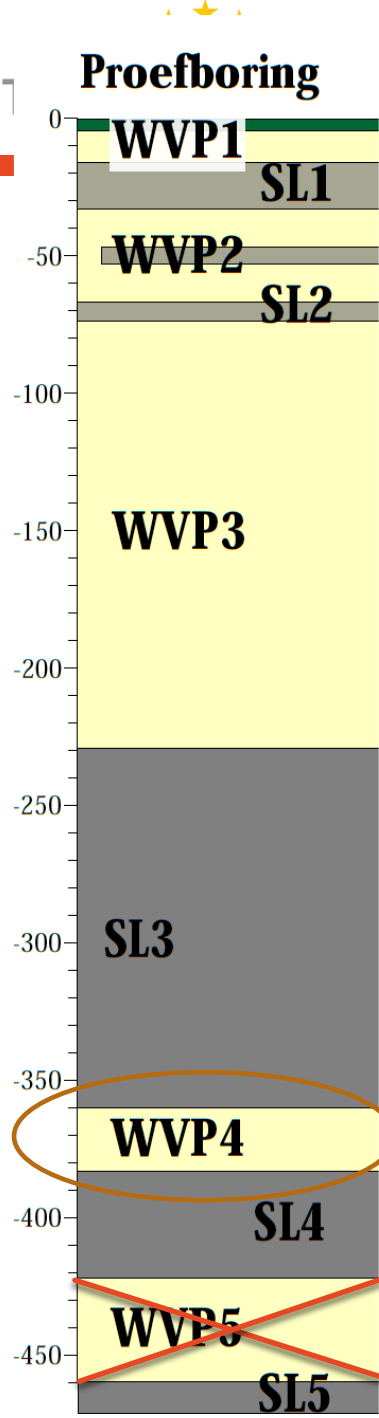
Crossflow from Aq5 → Aq4



2019: TEST DRILLING → CONCLUSIONS

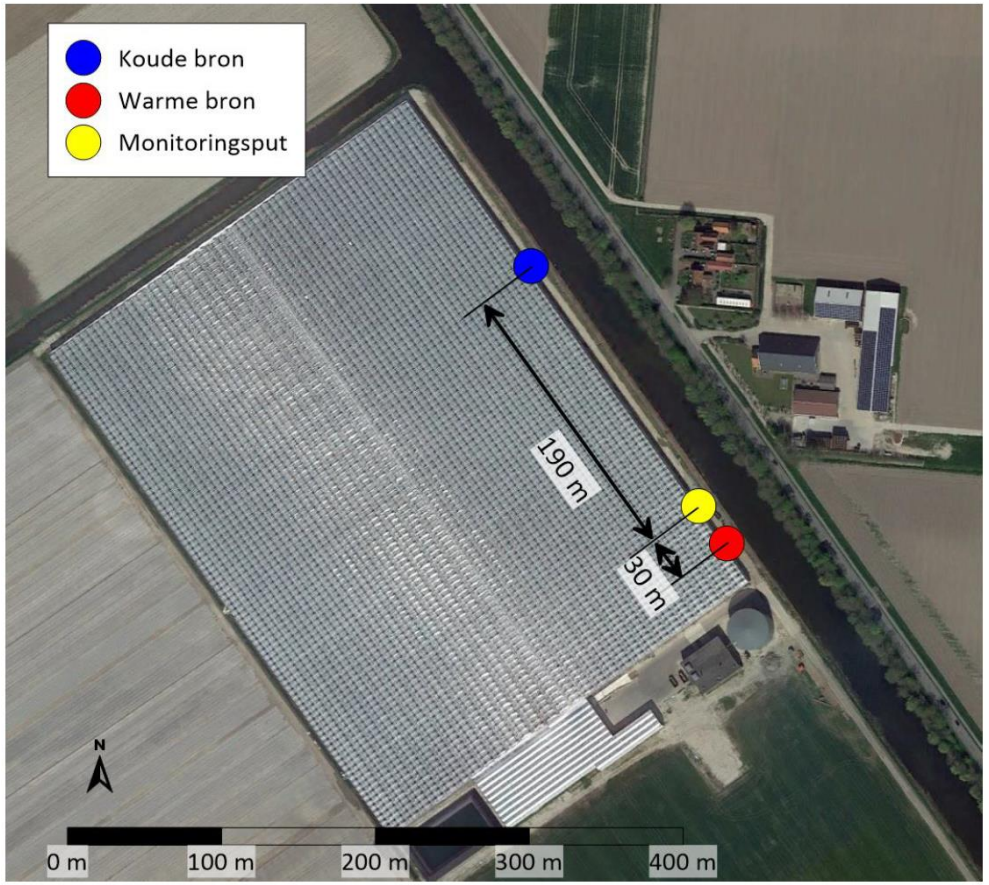
- Aquifer 4 was chosen for HT-ATES:
  - Higher flow rates
  - Lower risk of sand production
  - Lower gas pressure (methane)
  - Best recovery efficiency

A design was made for HT-ATES in Aquifer 4

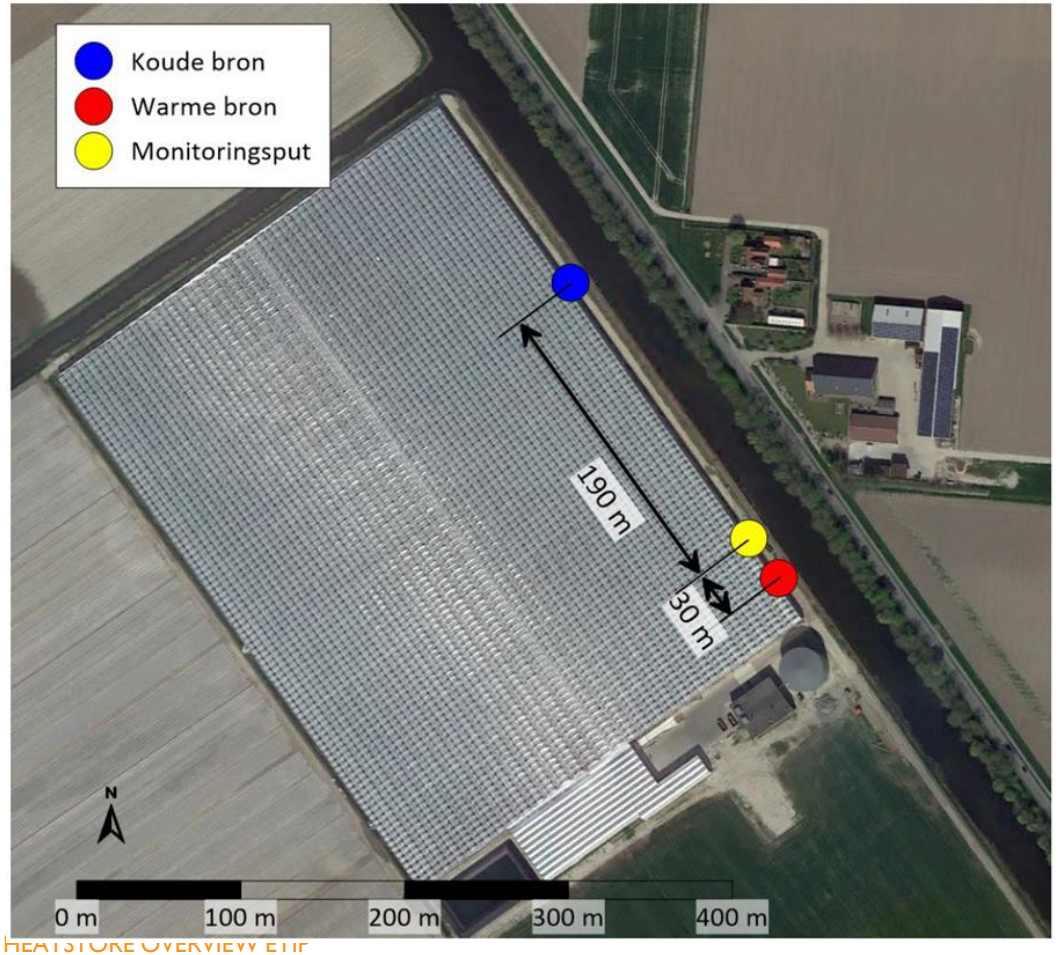


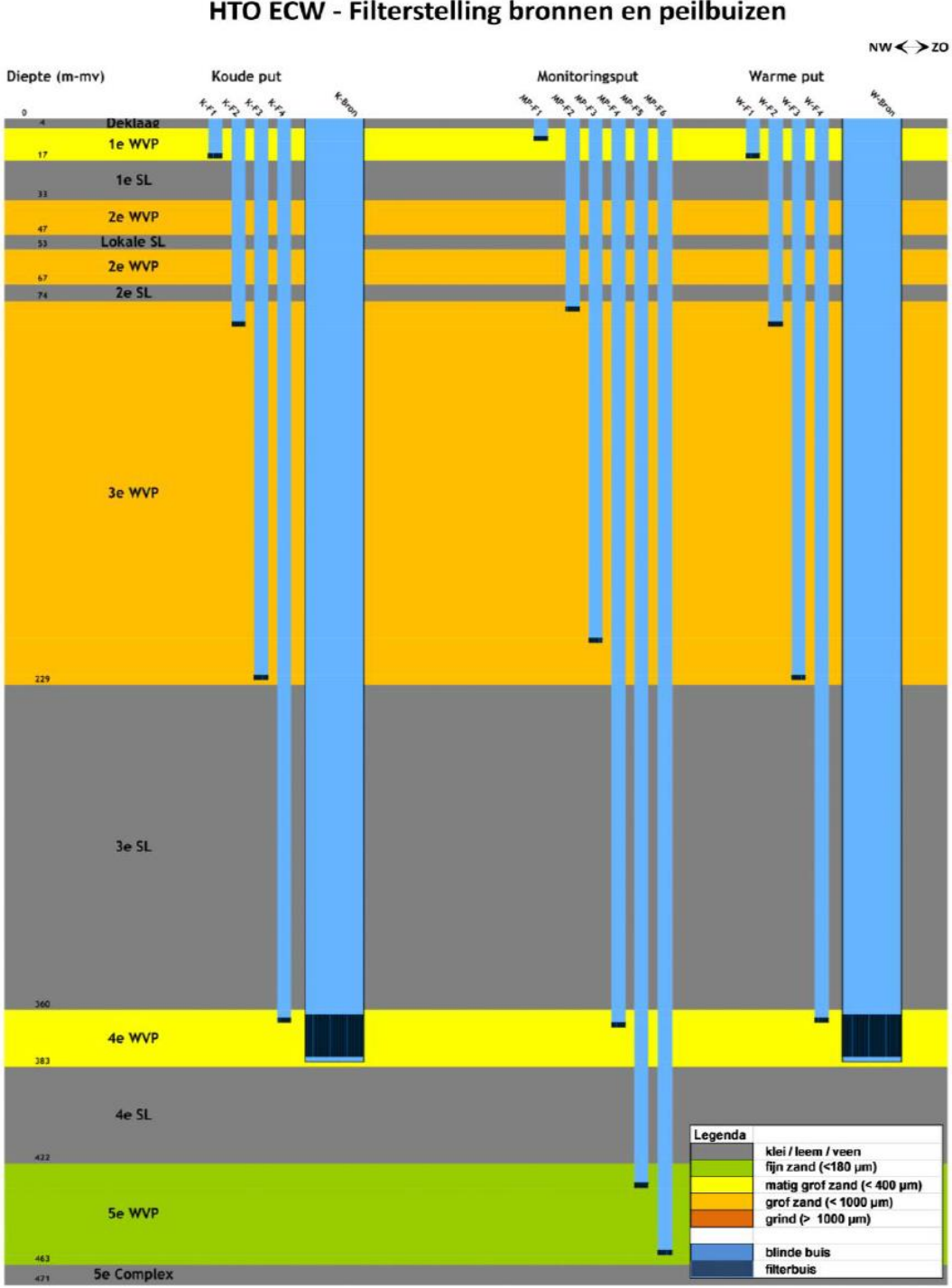
HT-ATES DESIGN CHOICES

- 1 Doublet in Aquifer 4
  - Hot well: 85 °C
  - 'Cold' well: 30 °C
- Test drilling → Monitoring well
  - Groundwater sampling
  - Temperature development



HT-ATES AT ECW: REALIZED SITUATION





CURRENT STATUS & FUTURE PLANNING

Current Status

- Reference measurements were taken in March 2021
- May 2021: Testing Phase: Successful
- June 2021: Start of charging heat: Successful
- Temperature data interpretations (TNO, IF, ECW)

Planning

- Groundwater sampling
- November 2021: Heat recovery

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if

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THANK YOU FOR YOUR ATTENTION

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HEATSTORE (170153-4401) is one of nine projects under the GEOTHERMICA – ERA NET Cofund aimed at accelerating the uptake of geothermal energy by 1) advancing and integrating different types of underground thermal energy storage (UTES) in the energy system, 2) providing a means to maximise geothermal heat production and optimise the business case of geothermal heat production doublets, 3) addressing technical, economic, environmental, regulatory and policy aspects that are necessary to support efficient and cost-effective deployment of UTES technologies in Europe. The three-year project will stimulate a fast-track market uptake in Europe, promoting development from demonstration phase to commercial deployment within two to five years, and provide an outlook for utilisation potential towards 2030 and 2050.

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