

WP1 - Unlocking low temperature geothermal reservoirs: Key insights for exploitation of geothermal energy from medium depths (500-1500 m)

Lies Peters, Pejman Shoeibi Omrani, Andreas Reinicke

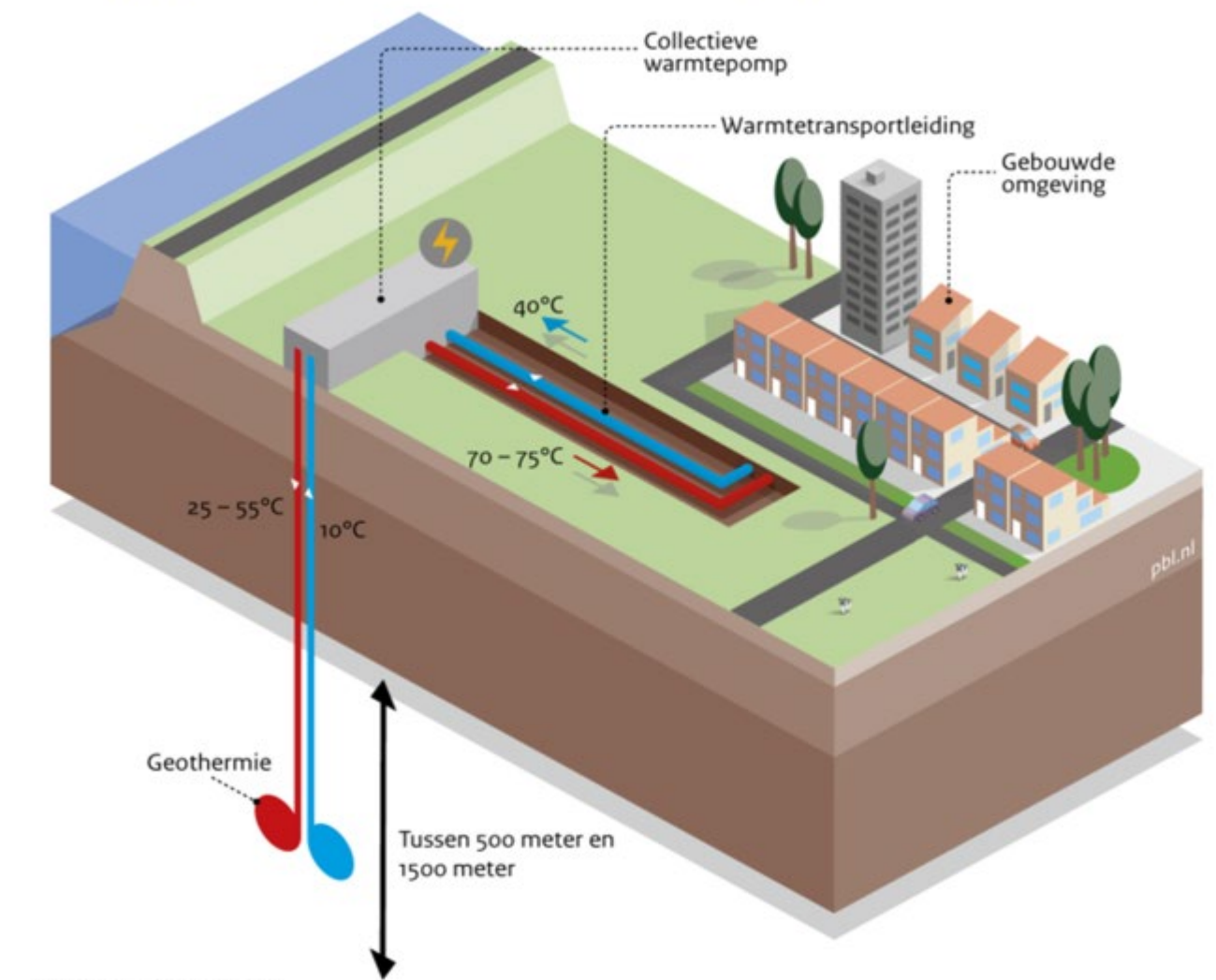


Background on Low Temperature Geothermal (LTG) in the medium depth range (500 -1500 m)

- Why LTG?
 - Possibilities for smaller developments with lower investment cost
 - Add to the number of locations with geothermal as a potential source
 - Less corrosive fluids (composition and temperature)
 - Lower seismogenic potential
- Current challenges
 - Drilling deviated and horizontal wells in the relevant depth range in unconsolidated formations
 - Production from fine-grained, unconsolidated formations
 - Poor and uncertain business case
 - Subsurface uncertainty

focus

Ondiepe geothermie (OGT) met collectieve warmtepomp



Geo4all WP1

- Goal
 - **Gather and make available the existing knowledge and experience on technical development**, from existing extractions (oil & gas, geothermal) in medium depth range (500-1500 m),
 - Determine which areas require **further knowledge development** and how this can be achieved.
- Approach
 - Identify relevant developments
 - Collect information from drilling, completions and (if possible) operations from the wells in these developments (mostly from NLOG.nl)
 - Evaluate and summarize the information with an expert group from the partners
 - Identify knowledge gaps and possible research topics

Introduction

Increasing age and (mostly) consolidation
↓

Potential LTG reservoirs

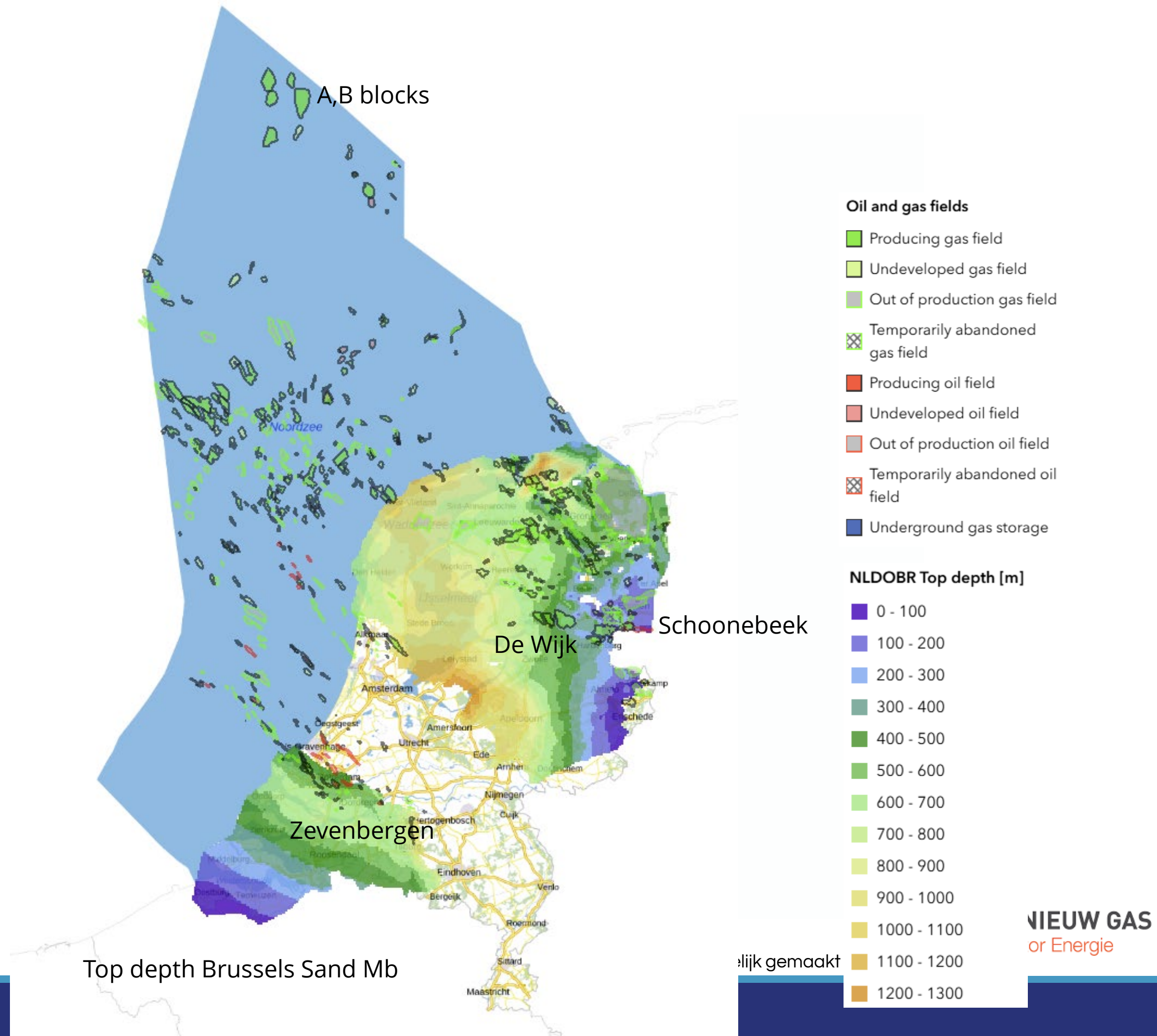
- Upper North Sea group:
 - mostly Breda Subgroup
- Middle and Lower North Sea groups:
 - various sandy members, mostly southern half of NL, most well known Brussels Sand Mb,
- Rijnland Group:
 - Holland Fm and several members of the Vlieland Sandstone Fm. (mostly very local)
- Nieuwerkerk Fm:
 - Delft Sandstone and Alblasserdam Mbs (mostly Alblasserdam Mb at medium depth).

Shallow developments (500-800 m)

- Upper North Sea group:
 - oil and gas fields in the A, B and F blocks off shore in the Maassluis Fm primarily
- Middle and Lower North Sea groups:
 - LTG doublet at Zevenbergen in Brussels Sand Mb.
 - De Wijk gas field in oldest layers of Lower NS Group*
- Rijnland Group:
 - Schoonebeek heavy oil field in the Bentheim Sst Mb
- Nieuwerkerk Fm:
 - None included in the analysis

Contents

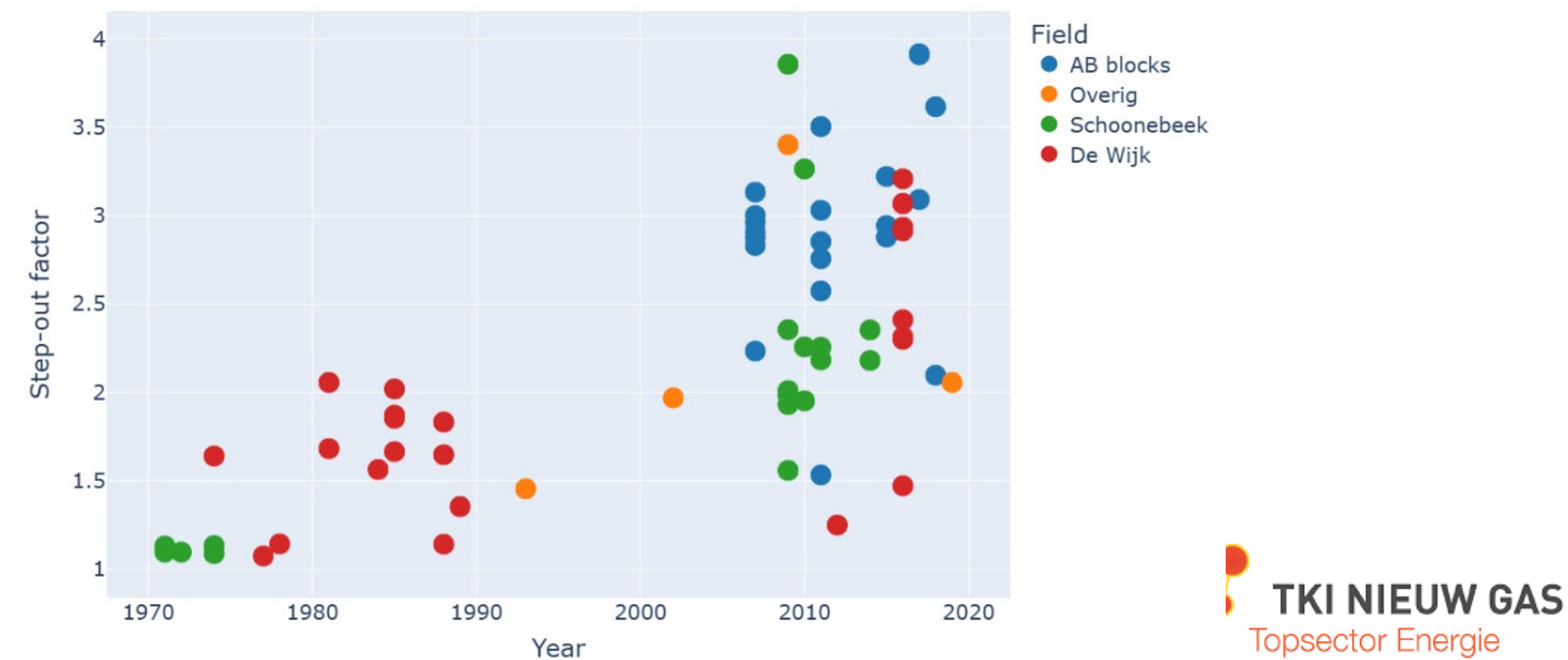
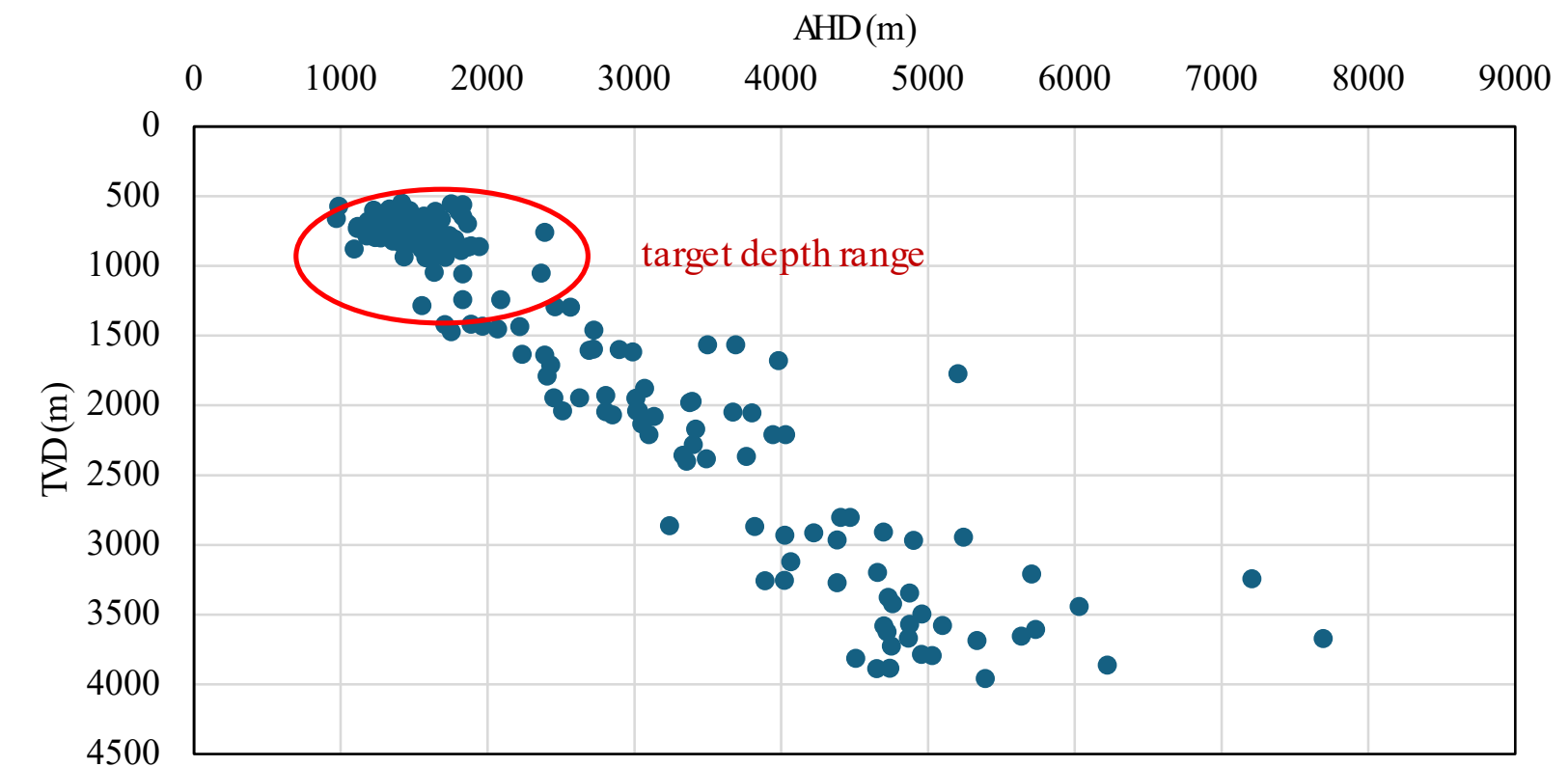
- Drilling
- Completions
- Operations



Drilling

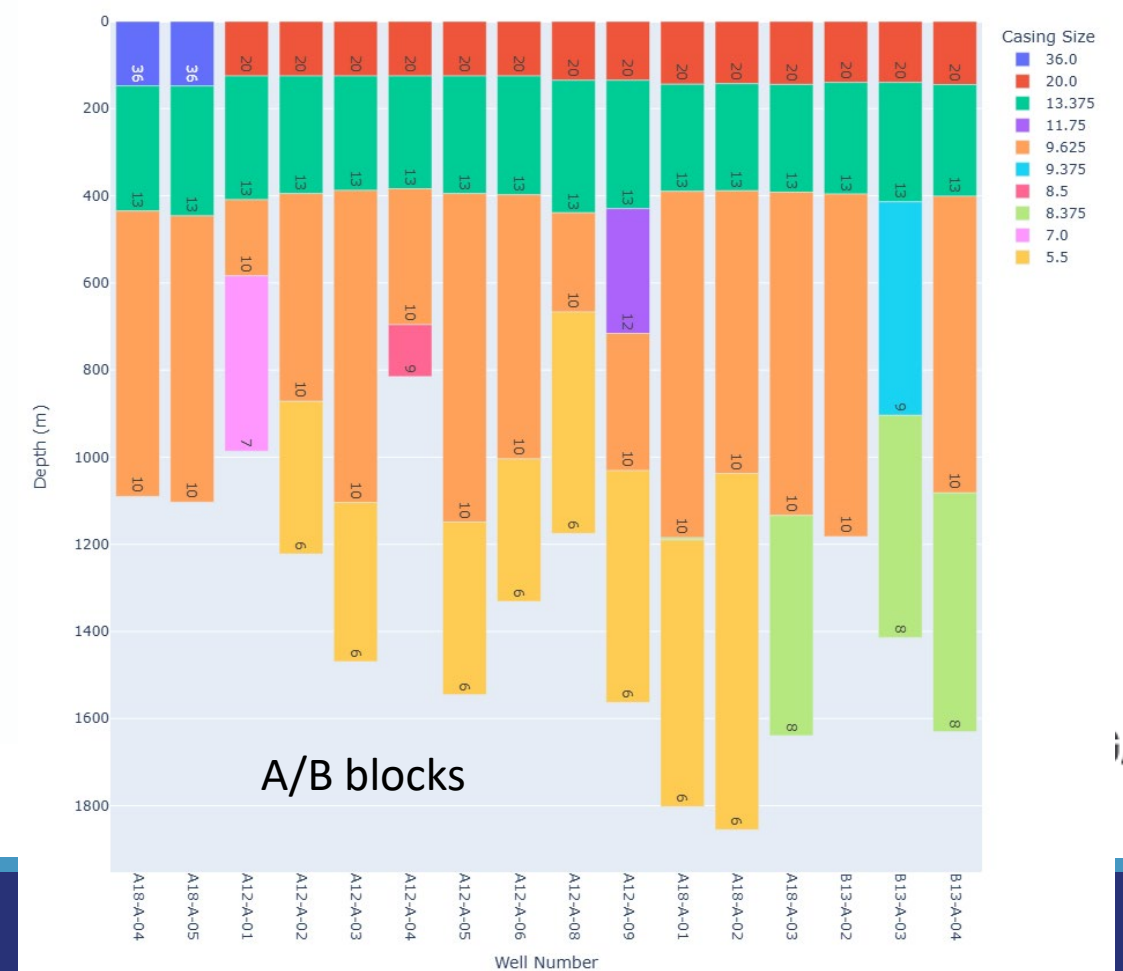
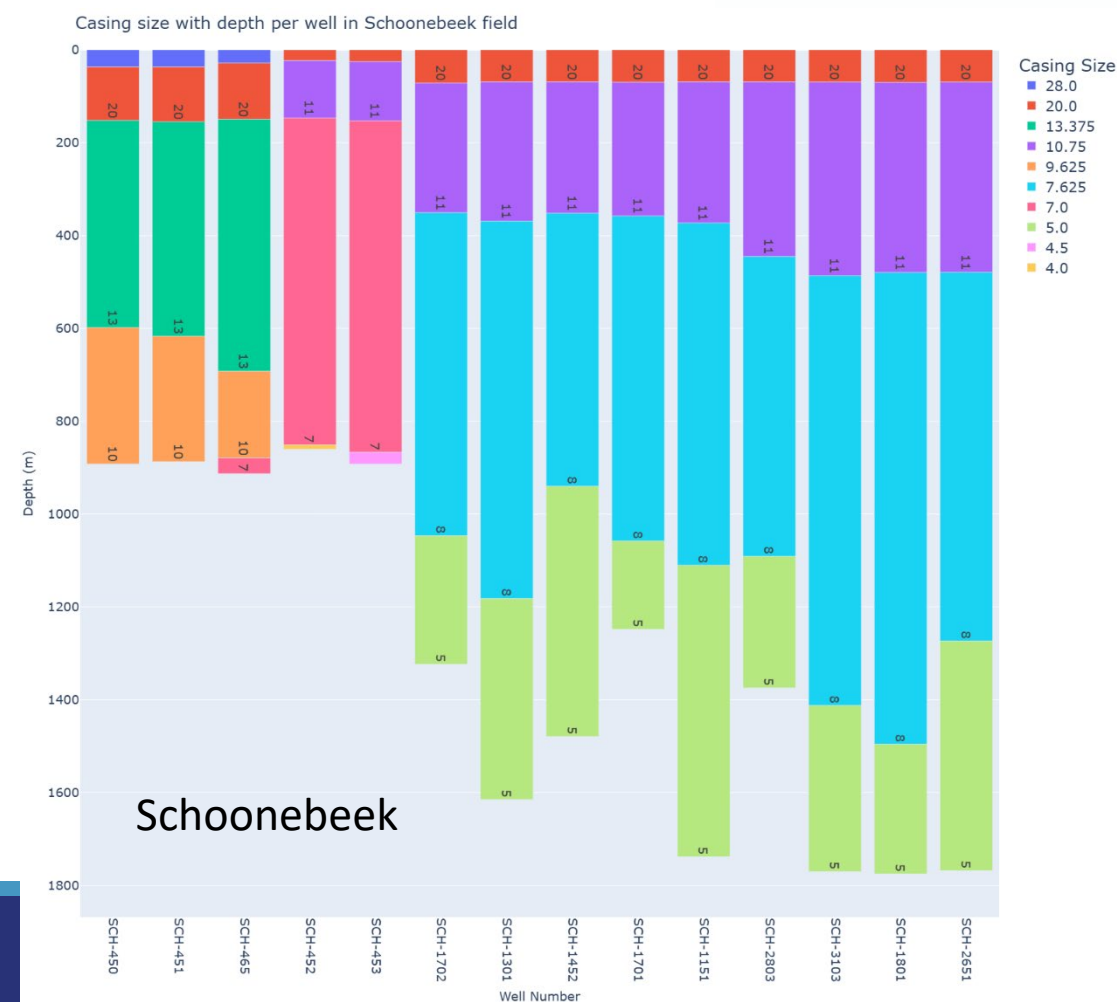
- Depth range challenging for reaching step-out is < 1000 m
- Technological know-how is available in the Netherlands
- Overview of used kick-off depths, DLS, mud properties, well construction duration
- Discussion of geohazards encountered:
 - Clay balling and sticky clays
 - Losses
 - Hard stringers

Many wells exist with sufficient step-out



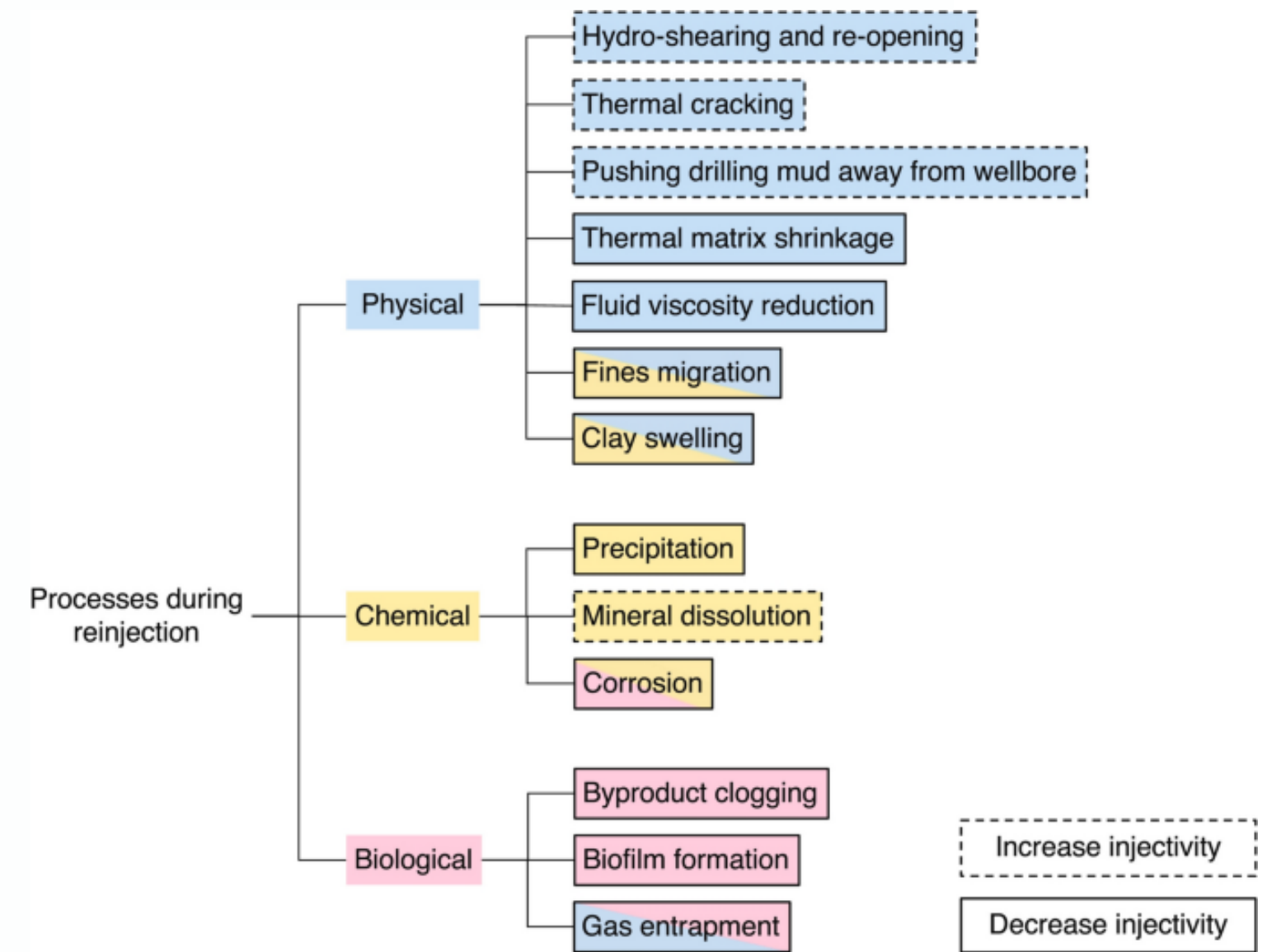
Completions

- Development of completions over time
- Move to slim hole → not for LTG
- Different fines/sand control:
 - De Wijk: 3.5 inch cemented with perforations (deviated wells)
 - A/B blocks: expandable screens (horizontal wells)
 - Schoonebeek: Standalone screens (horizontal wells)
 - Zevenbergen: Standalone screens (sub-horizontal wells)
- Erosional limits could be reevaluated



Operations

- Learnings oil&gas wells are of limited use (different fluids, rates, pressures)
- Learnings decrease in injectivity Zevenbergen doublet: microbiological issues, but root-cause analysis not available (yet)
- Learnings shallow applications too conservative



Overview of mechanisms underlying injectivity decline or enhancement during reinjection (Luo et al., 2023)

For horizontal: well bore instability

Conclusions & Recommendations

- Biggest knowledge gap on production related issues (maximum safe rate, maximum pressure) + impact of those on completions because production related parameters are very different.
- Uncertainty on subsurface conditions (incl fluids) creates uncertainty on all aspects of the development
- Main recommendations for further research:
 - Smaller rigs with compact well control
 - Understanding the impact of temperature, salinity, pore throats and stress on fines migration and clogging and relation to sand production to improve max/min pressure and flow velocity.
 - Better understanding of the business case will help identify key R&D areas

Many topics already addressed in:

MOOI DIAMETER

Developing **I**nsights for **A**ccelerating

Medium deep geo**T**h**ER**mal

3 Work Packages:

- Well design
- Characteristics suitable reservoir rocks
- System integration Low-T geothermal

Dissemination

- Report and excel database with well information will be made available on Geo4all website, WP 1 page
- Presentation at GET 2025 in Rotterdam on 29 October

