Rijswijk Centre for Sustainable Geo-energy

Vedran Zikovic
vedran.zikovic@tno.nl

Ministerie van Economische Zaken en Klimaat

provincie ZUID HOLLAND

ebn

Rijswijk

TNO innovation for life

Rijswijk Centre for Sustainable Geo-energy

- RCSG is a high-end well technology laboratory with unique combination of world-class facilities for full-scale experimental research
- Open innovation centre enabling the energy transition by investigating geothermal energy, abandoning of existing wells, and subsurface storage of energy(carriers) or CO_2:
  - new drilling techniques
  - cementing end plugging of wells
  - flow and transport of cuttings and fines
  - etc.
- Delivering innovations for safe, reliable and cost-effective well operations

Ministerie van Economische Zaken en Klimaat

provincie ZUID HOLLAND

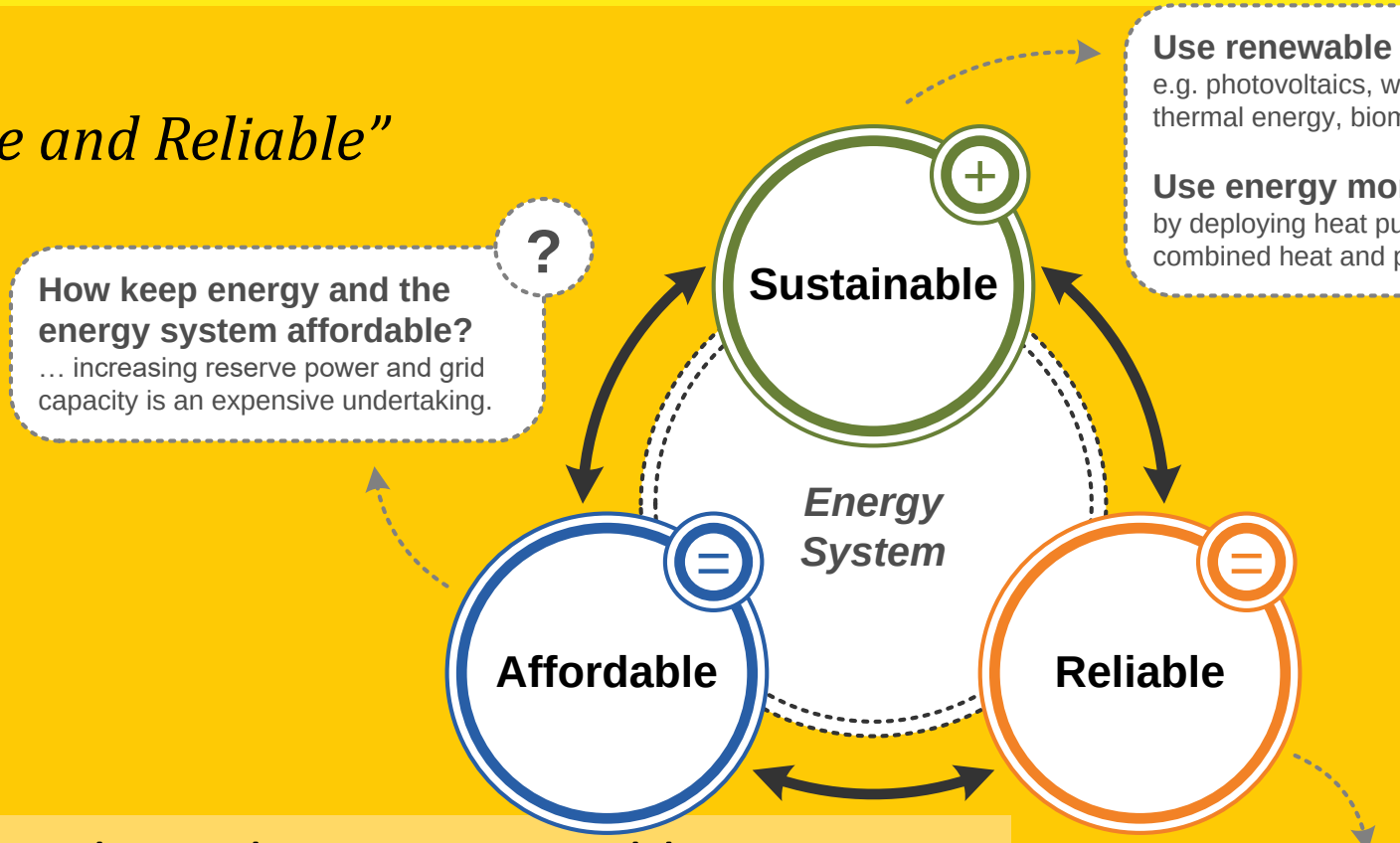
ebn

Rijswijk

TNO innovation for life

The transition from fossil fuels towards sustainable energy sources needs to be accelerated - Paris Agreement & EU Green Deal

"Keeping it Affordable and Reliable"



Use renewable energy sources, e.g. photovoltaics, wind- and hydropower, thermal energy, biomass, biogasses, etc.

Use energy more efficiently, e.g. by deploying heat pumps, electric vehicles, combined heat and power, etc.

!

?

How keep energy and the energy system affordable?
… increasing reserve power and grid capacity is an expensive undertaking.

The subsurface plays a key role in a sustainable energy system, as source of energy (baseload) or as storage medium for heat, CO_2 and hydrogen

?

How to maintain reliability of the system?
… with a clear trend of electrification of energy usage and with more intermittent energy sources in the mix.

RCSG part of Geological Survey of the Netherlands

Leading in Lowland Geology, applied 3D-modelling, Fluid dynamics, and Data management

GEO-RISKS

Seismic hazard and risk assessment

Abandonment and long-term effects

Risk toolbox

GROUNDWATER

Hydrogeological modelling

Groundwater quantity trends

Groundwater quality & emerging pollutants

ENERGY TRANSITION

CO_2 transport & storage

Geothermal energy

Energy storage assessments

System integration

Environmental footprint of hydrocarbon production

Ministerie van Economische Zaken en Klimaat

provincie ZUID HOLLAND

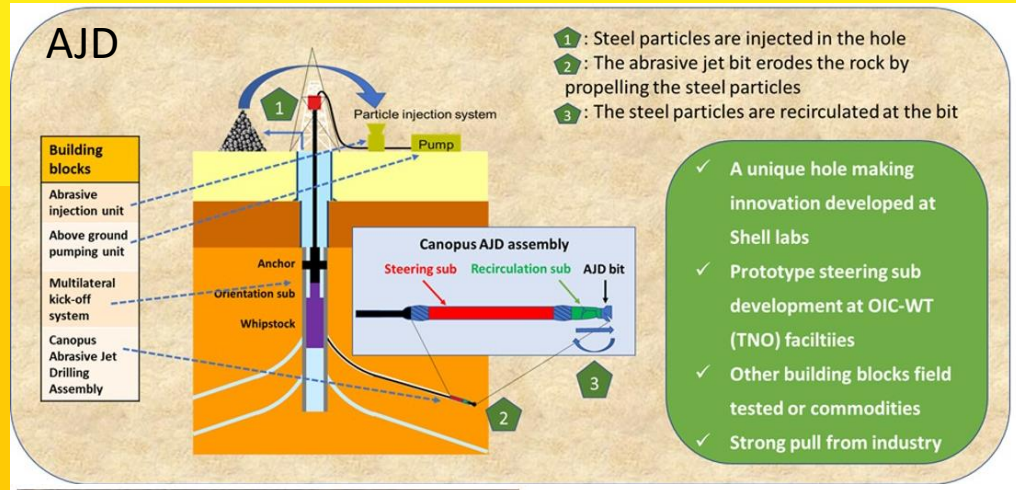
ebn

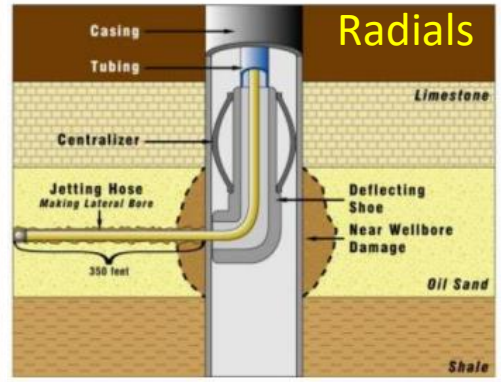
Rijswijk

TNO innovation for life

Demonstration and development of new drilling technologies

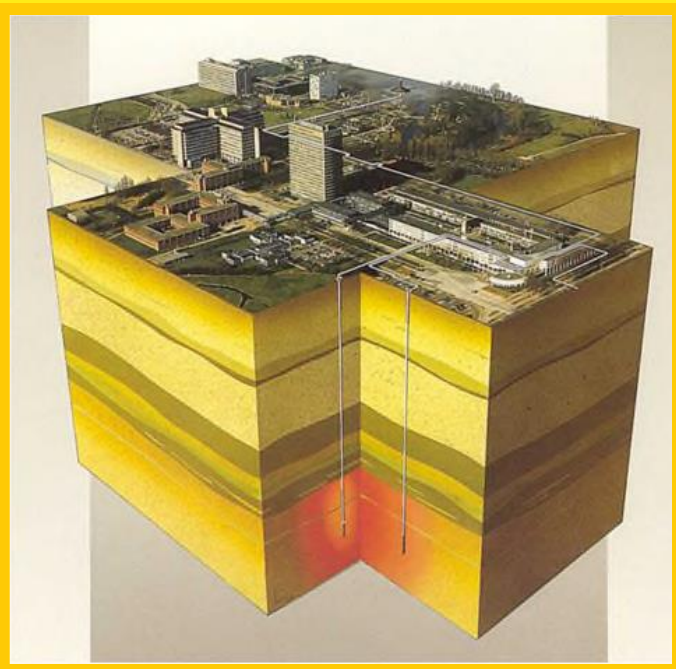
- Horizontal drilling considered key to increase power for geothermal sites: limiting surface impact of operations
- Several technologies are currently investigated
  - Horizontals through abrasive jet drilling
  - Multilaterals through ECI-RSS
  - Radial Drilling
- Several experimental set-ups used
  - Rig & test well
  - Cutting flow loop
  - 50T drilling unit





High Temperature Aquifer Thermal Energy Storage

- Storage of thermal energy in the subsurface is an economically competitive option compared to other storage options
  - inject hot water (70-90°C, and up to 125°C) into aquifers during summer, produce hot water from aquifers in winter.
- Similar concept for WKO proven and fully mature in the Netherlands
  - Some projects with storage > 40°C have been executed in the Netherlands, e.g. in De Uithof (Utrecht Science Park)
- However, the number and scale of possible projects is rapidly increasing, driven by the energy transition targets (for 2030 and 2050), with involvement of major players and stakeholders
- <u>More knowledge development and demonstrations needed for safe, reliable, cost-effective and robust application on a large scale within an appropriate legal context</u>



Heat storage

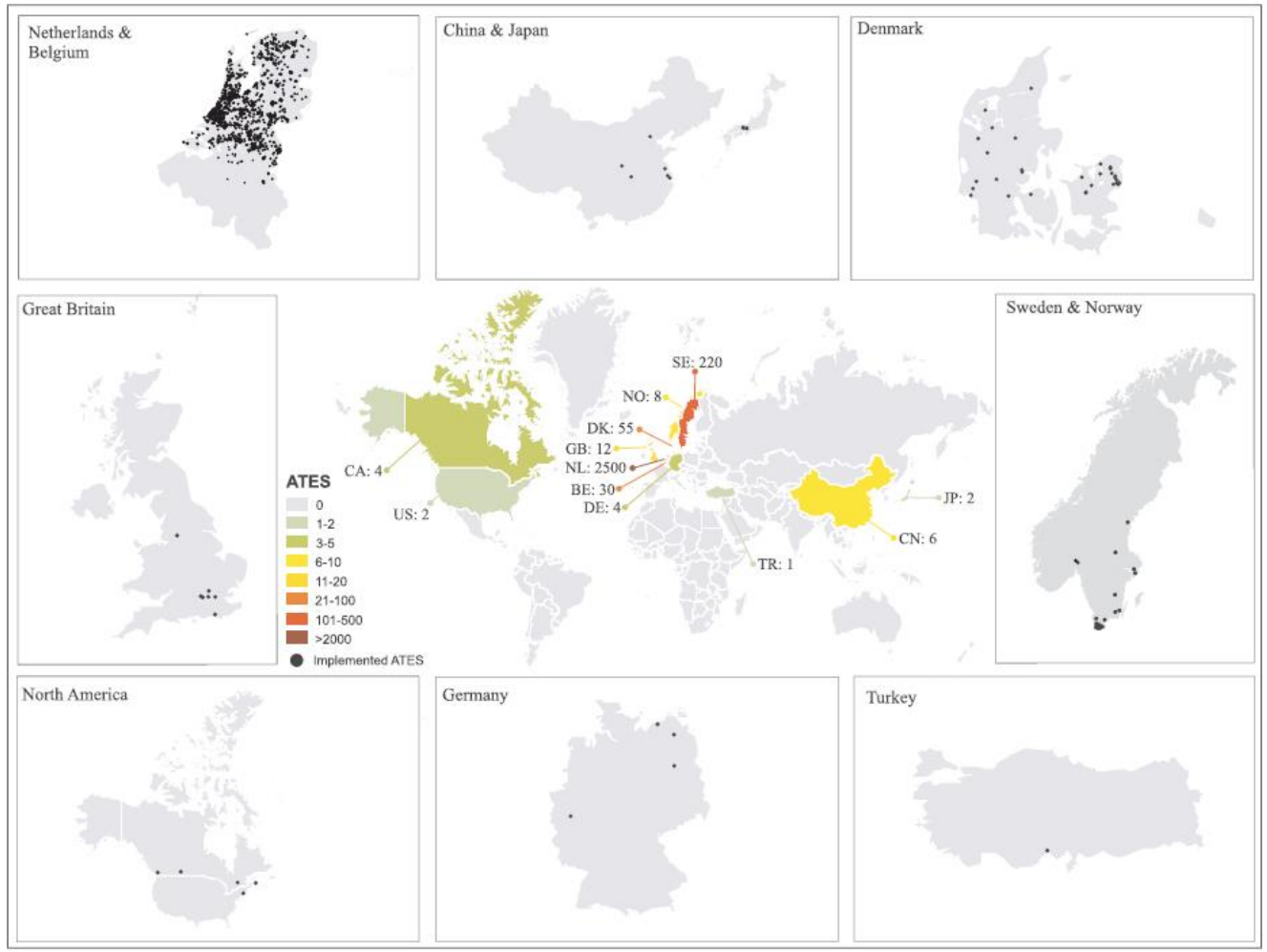


Fig. 5. Global spatial distribution of ATES.

Fleuchaus et al. (2018)

Worldwide, there are currently more than 2800 ATES (aquifer thermal energy storage) systems in operation, abstracting more than 2.5 TWh of heating and cooling per year.

99% are low-temperature systems (LT-ATES) with storage temperatures of< 25 °C.

85% of all systems are located in the Netherlands, and a further 10% are found in Sweden, Denmark, and Belgium.

Safe sealing of wells during or after production

➢ Example project: experimentally validated numerical studies

Contents lists available at ScienceDirect

Geomechanics for Energy and the Environment

journal homepage: www.elsevier.com/locate/gete

A study on the hydraulic aperture of microannuli at the casing–cement interface using a large-scale laboratory setup

Al Moghadam *, Koen Castelein, Jan ter Heege, Bogdan Orlic

TNO Energy Transition, The Netherlands

Experimental → Numerical

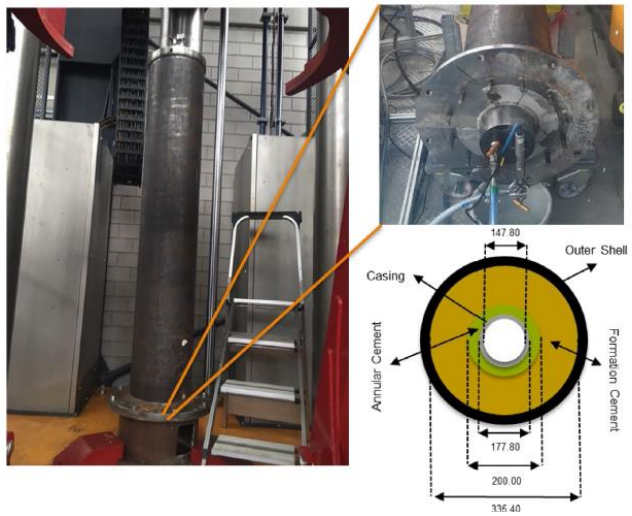


Fig. 1. A schematic of the samples in this study next to pictures of an actual sample. Green represents annular cement, and yellow indicates the formation analogue. The dimensions in the figure are in mm. The picture on the left shows the outer shell but presents the full length of the sample. The picture on the right shows the bottom face of the sample including the casing, annular cement, formation cement, and the outer shell.

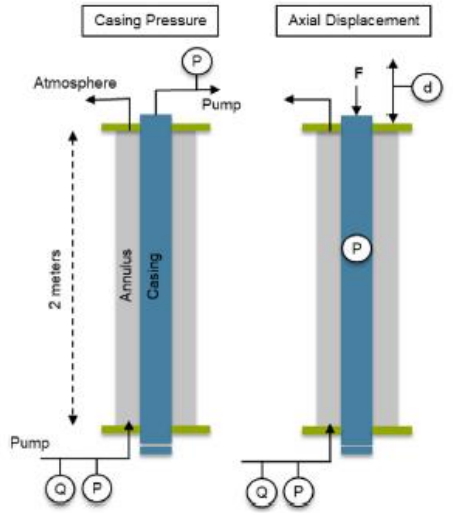


Fig. 2. A schematic of tests conducted in this work. "P" indicates pressure measurement, "Q" indicates flow rate, "F" indicates force, and "d" indicates displacement.

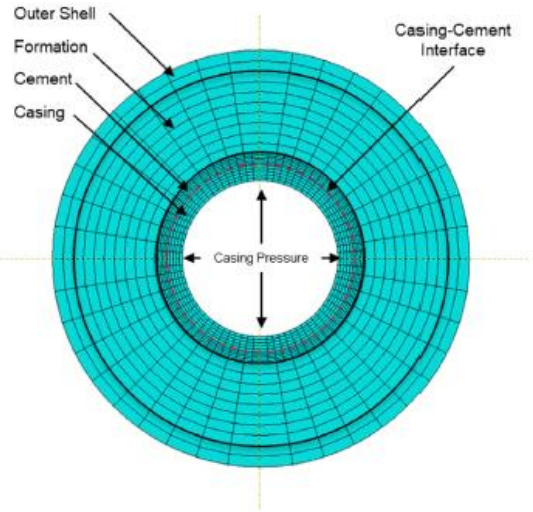
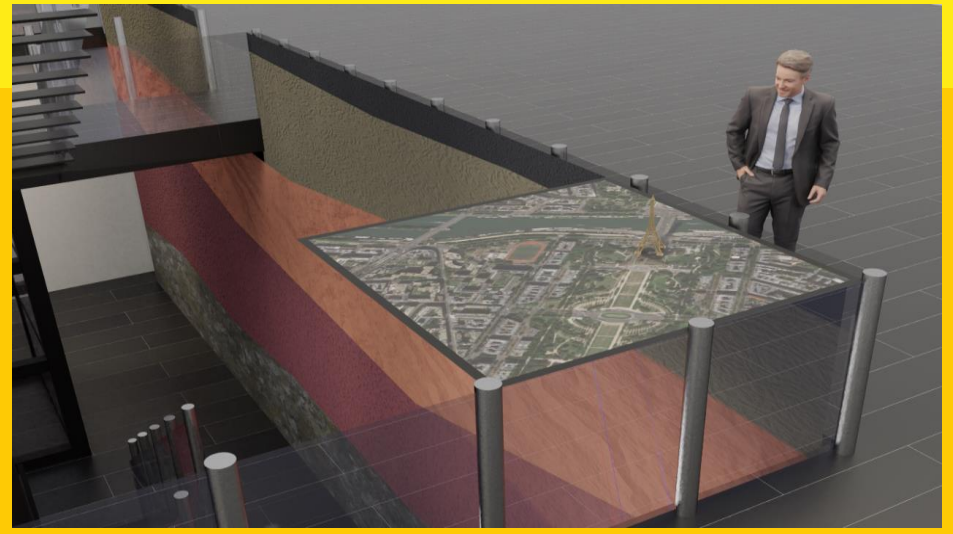


Fig. 3. The geometry of the finite element model.

Social acceptance

Education centre



Scale models, technology, interactive exhibits

Official website: rcsg.nl

Ministerie van Economische Zaken en Klimaat

provincie ZUID HOLLAND

ebn

Rijswijk

TNO innovation for life


THANK YOU FOR
YOUR TIME
TNO innovation for life