4-7 NOVEMBER 2024
ROTTERDAM, THE NETHERLANDS

GET2024

GEOTHERMAL ENERGY CONFERENCE

EXPERIENCE WITH APPLIED RESEARCH AND INNOVATION FOR GEOTHERMAL ENERGY IN THE NETHERLANDS GEO4ALL-PROGRAM

Radboud Vorage and Kris Hopstaken

SHORT INTRODUCTION

Geo4all
innovatieprogramma

Radboud Vorage
Board member Geothermie Nederland
Director of geothermal project Koekoekspolder
Chairman SC of Geo4all

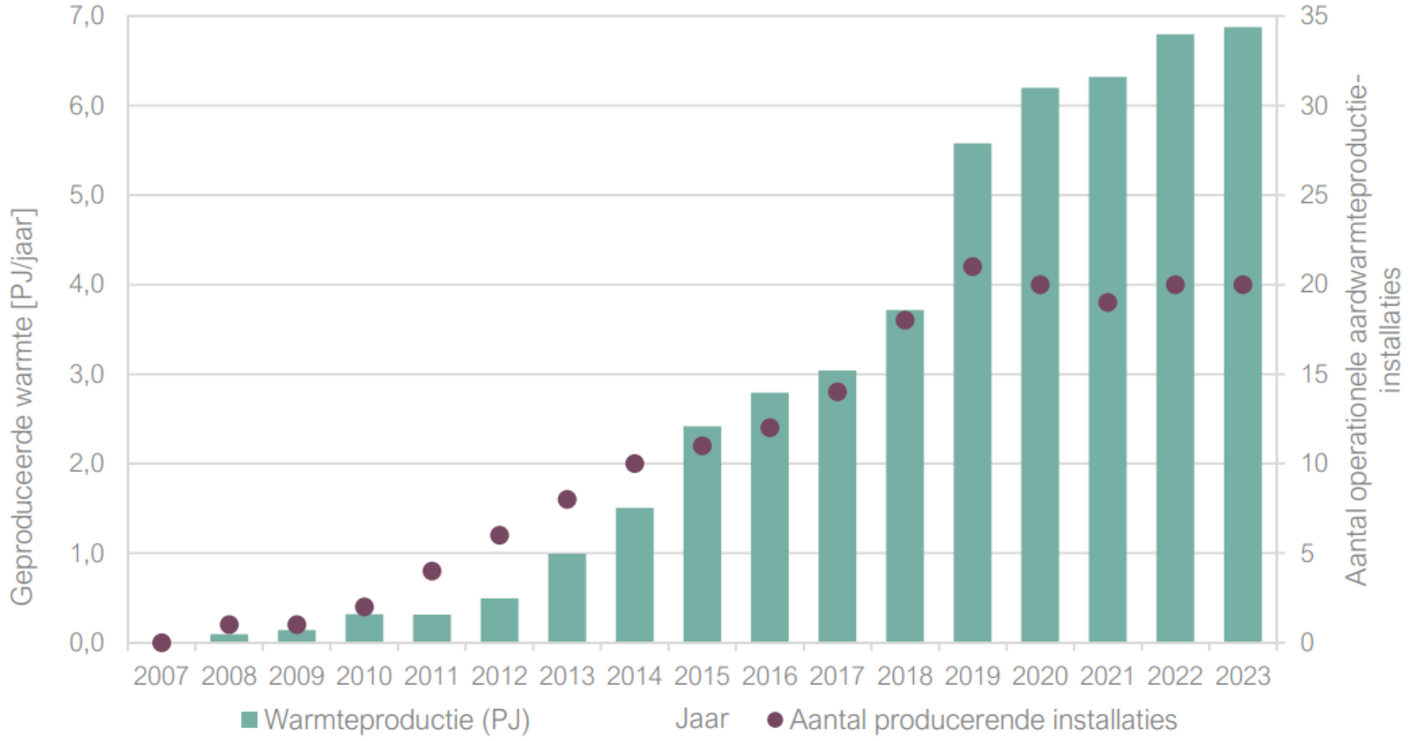
geothermie nederland

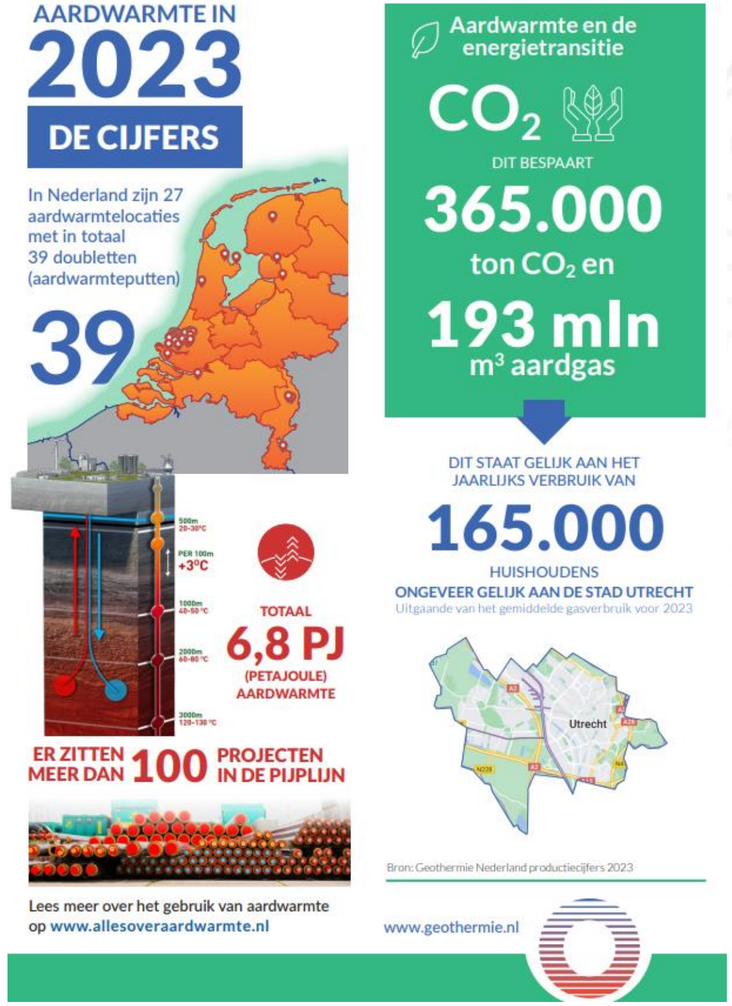
Kris Hopstaken
Senior Business Developer Geo Energy
Ambassador Geo4all program

TNO innovation for life

HISTORY OF GEOTHERMAL ENERGY IN NL

Start in 2007 and steady growth in heat production





MASTERPLAN GEOTHERMAL ENERGY 2018

Recommendations on innovation

Topics

- Safe design of systems and interaction with the reservoir (reducing seismic risks)
- Increasing the value of geothermal heat (build environment, cascading, heat networks, etc.)
- Reducing the cost of geothermel heat and increased livespan of geothermal installations

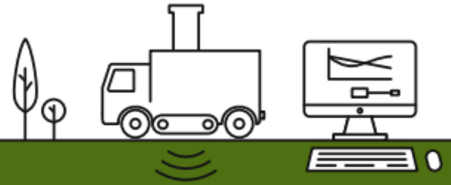
Methods

- Knowledge transfer (from gas/oil industry and other countries)
- Applied research (gathering data from existing projects)
- Demonstration/pilot projects
- Make a priority list for innovation

INNOVATION AGENDA 2021

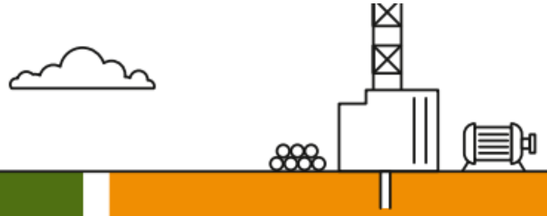
Innovatie Aardwarmte 2021

Inventarisatie van innovatiebehoeften
en huidige stand van zaken



Voorspellen en beoordelen van aardwarmtebronnen

A1	Ondergrond model voor betere voorspelling van aardwarmteproductie over tijd
A2	Meervoudig veldontwikkelingsplan voor doelmatig gebruik van de ondergrond
A3	Andere methode voor gebiedsbepaling winningsvergunning ontwikkelen
A4	Nieuwe concepten voor de winning aardwarmte
A5	Hergebruik van aardwarmtebronnen
A6	Data-acquisitie putten optimaliseren



Ontwikkeling van aardwarmtebronnen
(boren, putafwerking, materialen en apparatuur)

B1	Methoden om het boorproces te versnellen
B2	Verhogen productiviteit door putconcepten
B3	Verhogen productiviteit door reservoirstimulatie
B4	Impact van testwater verkleinen
B5	Optimaliseren putontwerp en putintegriteit
B6	Verbetering productiepompen
B7	Optimaliseren bovengrondse systeem en levensduur van apparatuur en componenten optimaliseren

Bedrijfsvoering, productie en (slimme) integratie in het energiesysteem

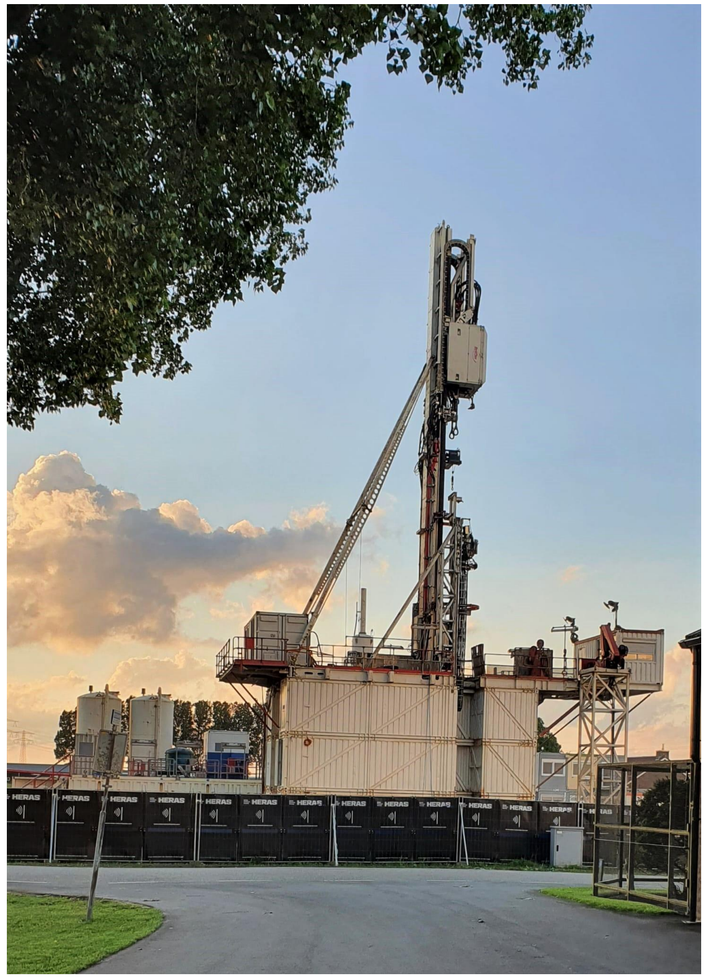
C1	Behoud van operationele kwaliteit
C2	Winning van minerale producten uit het geothermische water
C3	Warmte systeemintegratie
C4	Flexibele warmtelevering uit aardwarmtebron vergroten

Doorsnijdende -innovatie onderwerpen, inclusief niet-technische innovaties en aan innnovatie gerelateerde randvoorwaarden

D1 Heldere wet- en regelgeving	**D4** Gebundelde duurzame warmtevraag ontwikkelen	**D6** Overeenstemming acceptabele grens seismisch risico
D2 Kennis- en datadeling	**D5** Automatiseren, digitaliseren en Artificial Intelligence (AI) toepassen waar mogelijk	**D7** Langdurig en milieuvriendelijk benutten van de bron
D3 Betrekken van de omgeving bij aardwarmteprojecten		**D8** Organiseren van boorcampagnes

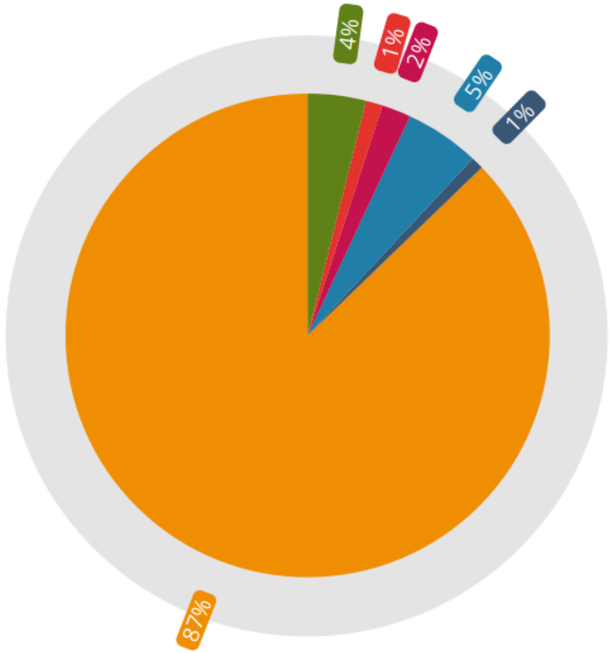
COST PRICE REDUCTION

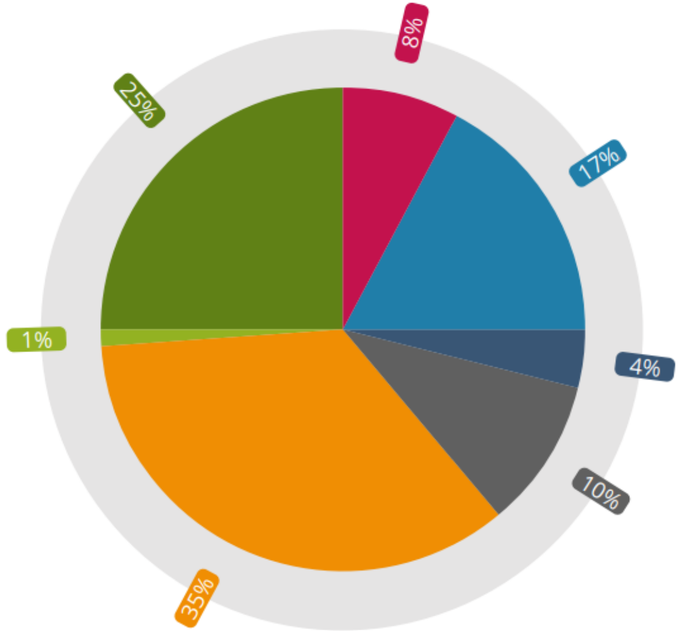
Where are the costs in geothermal energy



Integraal Kostprijsreductie Programma Aardwarmte

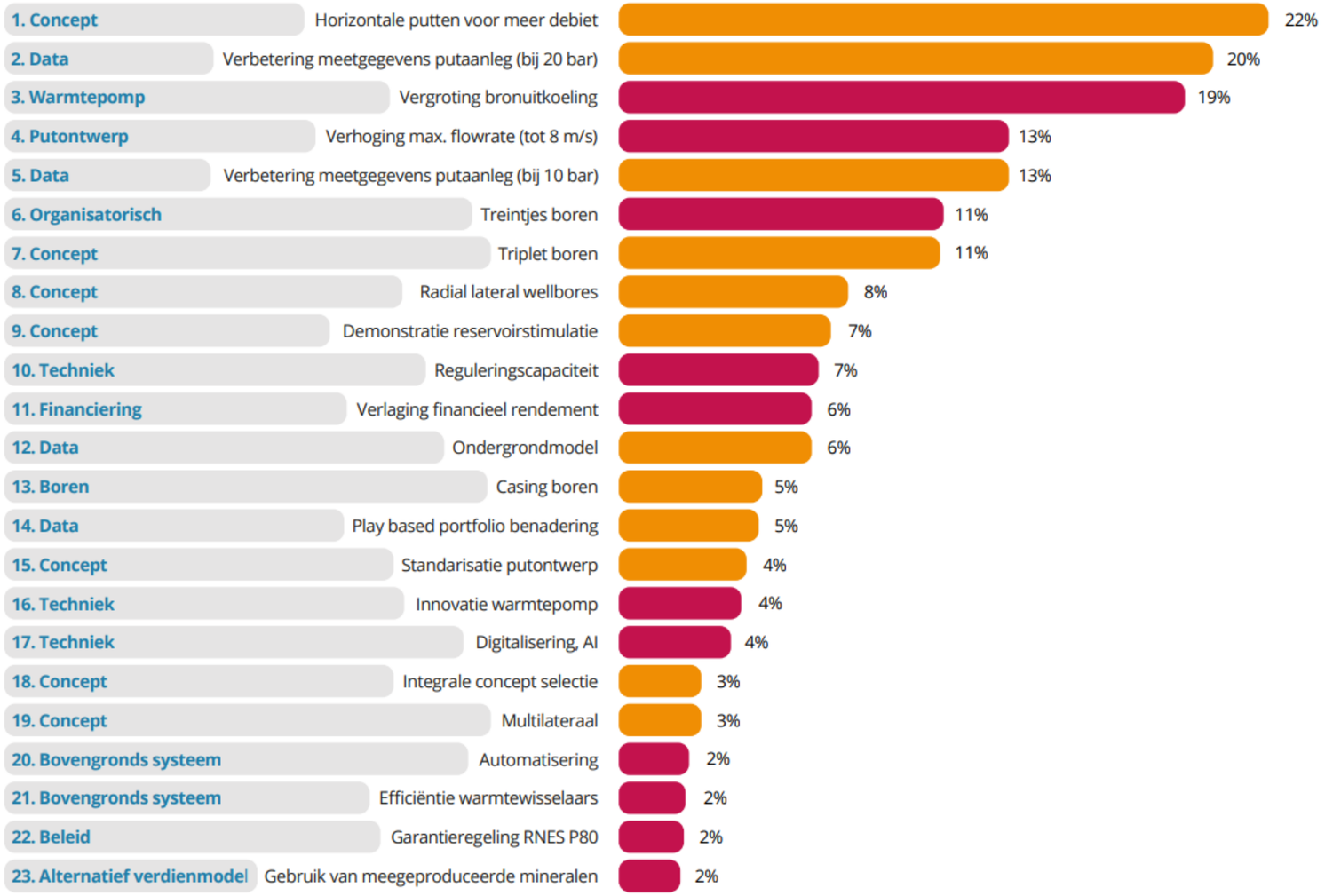
Whitepaper status december 2021





COST PRICE REDUCTION

Where are the opportunities to reduce costs



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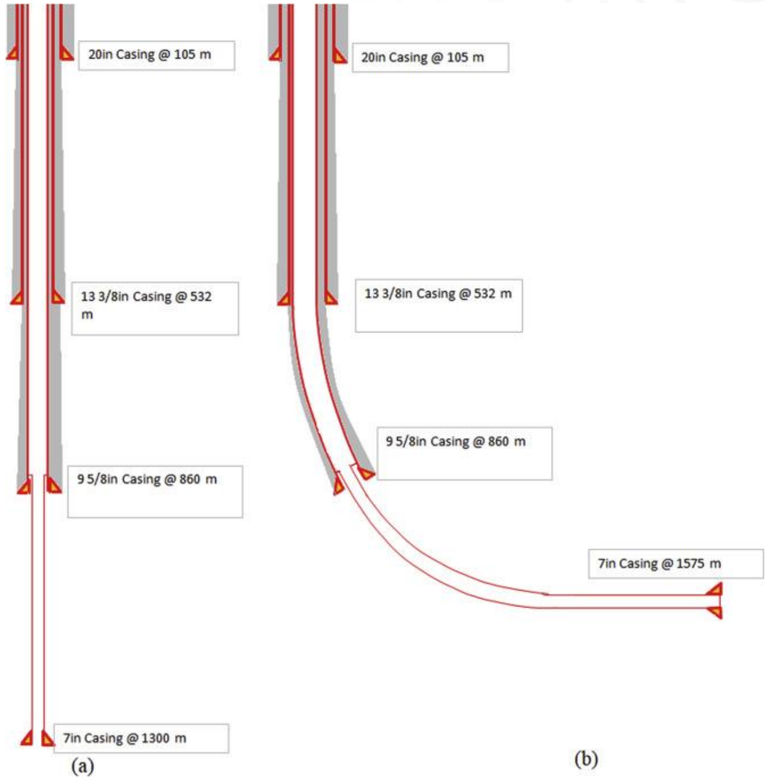


BUILDING INNOVATION AND KNOWLEDGE NETWORKS

Geothermie Nederland and its partners

THE GEO4ALL INNOVATION PROGRAM

Hand-over to Kris Hopstaken

Geo4all

innovatieprogramma

GEO4ALL

Innovation

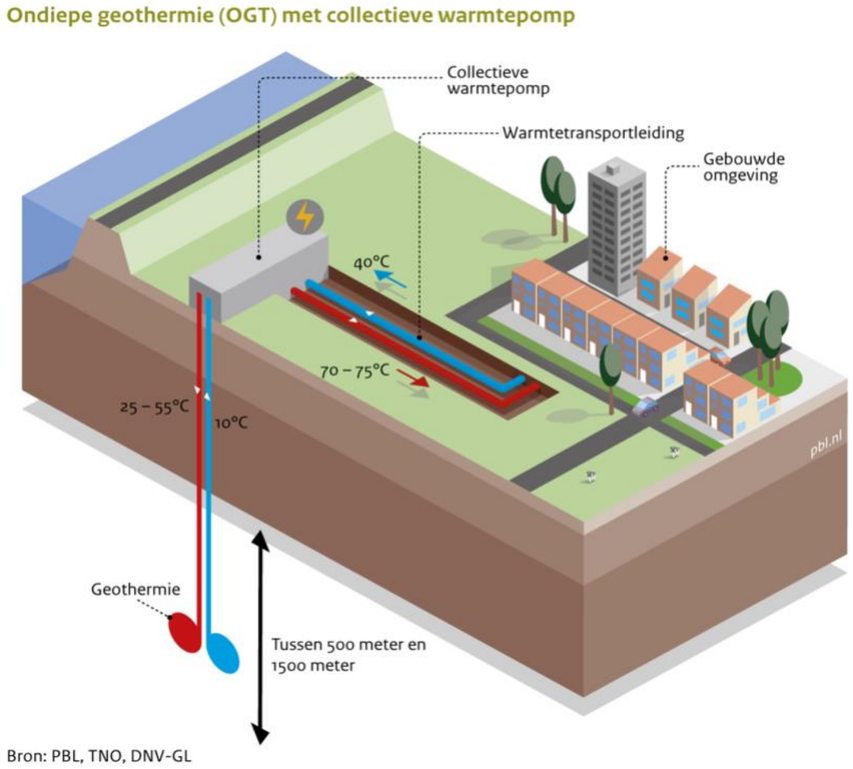
4-year innovation program set-up for Geothermal Sector in the Netherlands started in September 2024

PPS → Public/Private partnership
Public: National subsidy body (TKI): 3,5M EUR
Public: Dutch Universities with Postdoc/PHD
Private: 20 companies in the geothermal sector, contributing 2,5M EUR

Innovation program driven by pro-actively approaching sector
→TNO is orchestrating innovation
→6 themes of innovations and technology development
→Special attention to knowledge dissemination and communication
→Cooperate with sector associations (Geothermie NL)

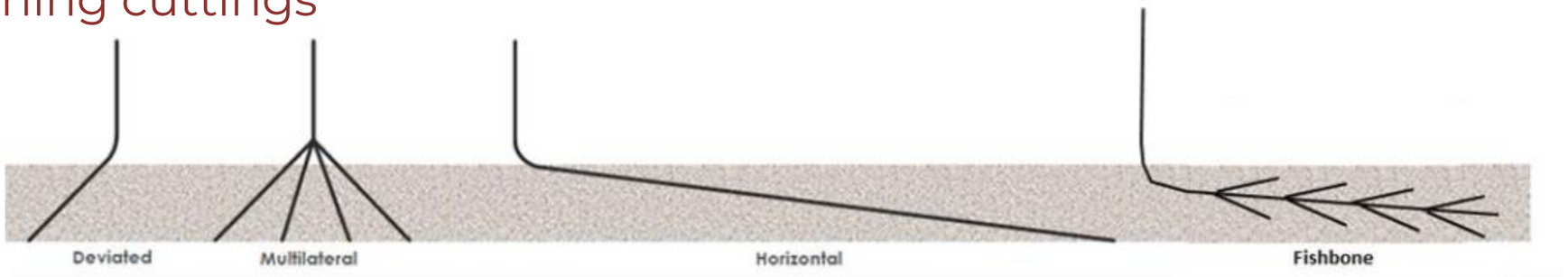
WP1 – Unlocking Shallow Geothermal Systems

- Goal
  - **Gather and make available the existing knowledge and experience**, from existing extractions (oil & gas, geothermal) in medium depth range (500-1500 m),
  - Outline key factors and parameters that require further attention for optimal exploitation and development of the shallow geothermal depth domain.
  - Determine which areas require **further knowledge development** and how this can be achieved.



WP2 – Marginal reservoirs

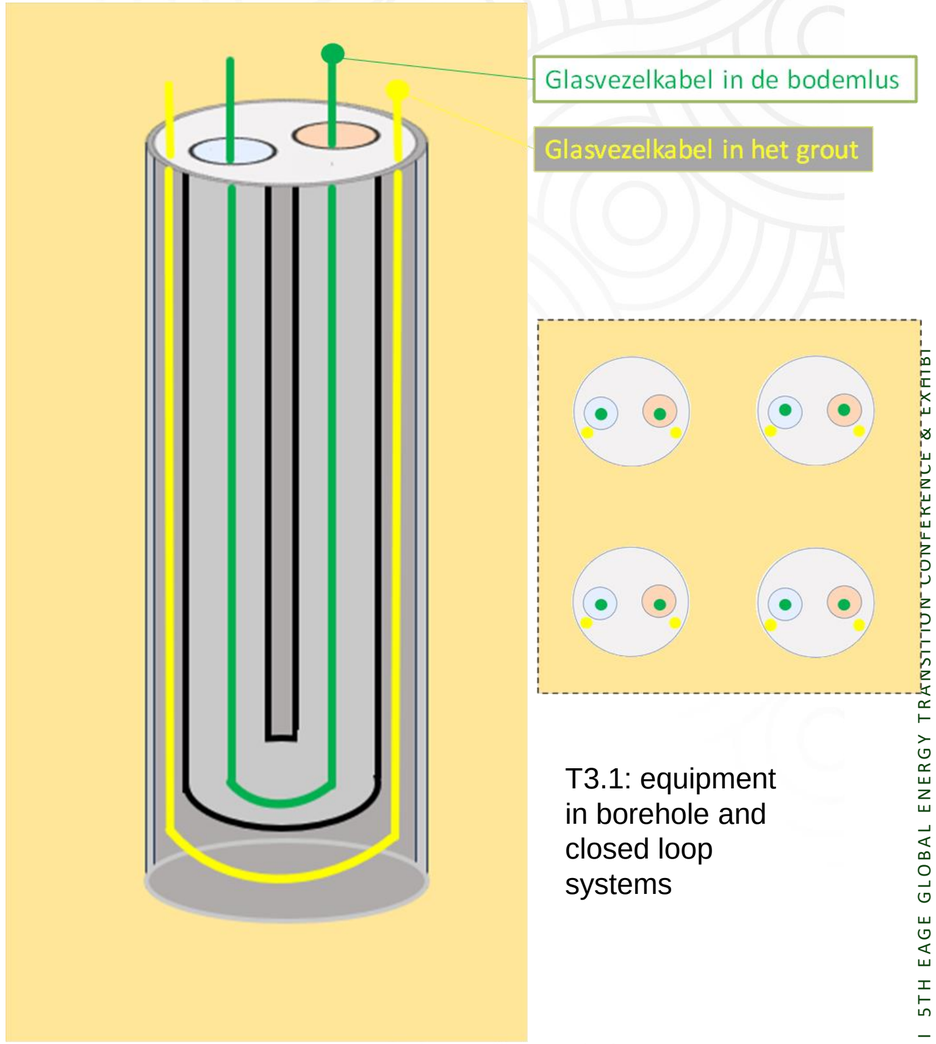
- Goal
  - Many areas in the Netherlands have less favourable geological characteristics at conventional depths (>1500m) that result in low expectation values for flow rates (typically less than 100 m3/h)
  - **Advanced well concepts** can significantly improve the business case by increasing flow rates by a factor of 3-4
  - **Improve the business case** for geothermal energy production in marginal reservoirs
  - Research on drilling mud (performance, flow and success in returning cuttings



Example of well geometries considered in concept select for the case studies

WP3 – Shallow closed-loop systems

- Goal
  - 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

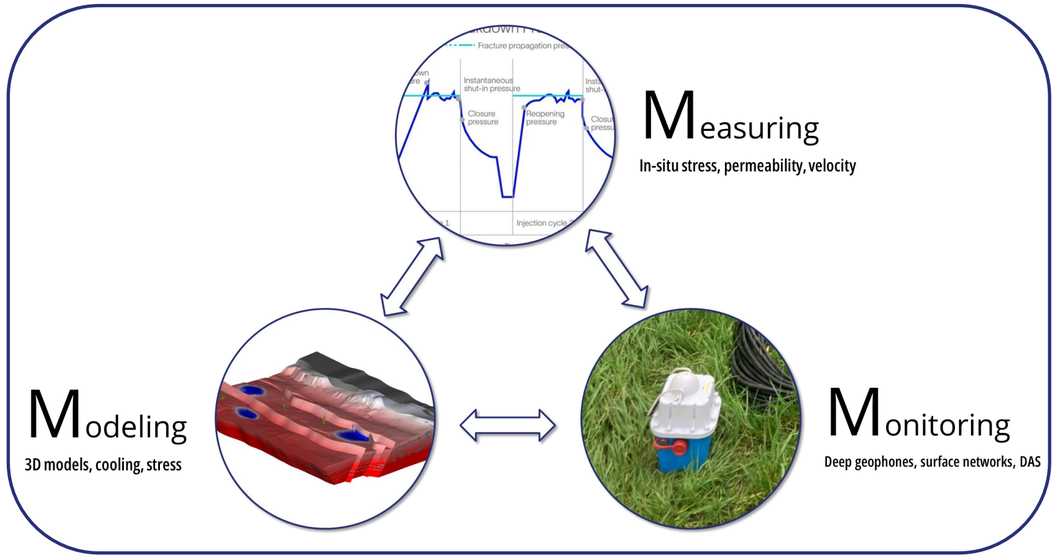


T3.1: equipment in borehole and closed loop systems

Mede mogelijk gemaakt door:

TNO innovation for life · ENCOR · TEON Energia dalla terra · Canopus · ebn · geothermie nederland bron van energie · itho daalderop Climate for life · XWELL SERVICES GROUP An excellence logging company

WP4 - 3M Coldfront & induced seismicity



Research questions

- How does cooling of the deep subsurface (the 'cold front') resulting from geothermal heat production behave in space and time?
- How do structures (e.g. faults) in the deep subsurface affect cooling, and vice versa?

Expected results

- Three (semi-)permanent monitoring facilities providing continuous recordings of the subsurface.
- Public data for knowledge building and further analysis.
- Models of the different geothermal projects, calibrated against the field measurements and monitoring data.

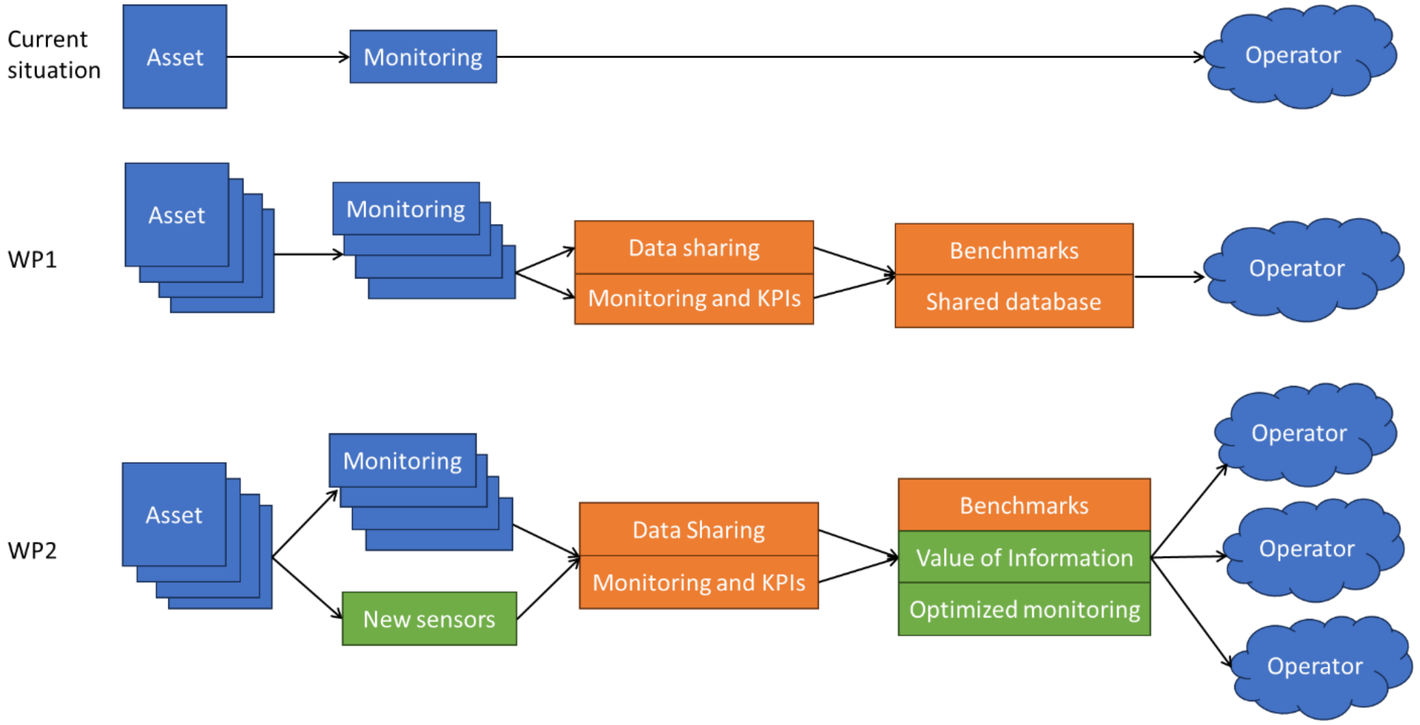
Geo4all innovatieprogramma

Mede mogelijk gemaakt door: TKI NIEUW GAS Topsector Energie

5TH EAGE GLOBAL ENERGY TRANSITION CONFERENCE & EXHIBI ION

WP5 – Value of geothermal production data

- Goal
  - Earlier detection of clogging or loss of materials in critical components, earlier detection of failures in production and injection pumps, minimizing number of interventions and logging which can lead to a significant saving in OPEX during the lifetime of a geothermal asset.
  - Improve operation and design of geothermal installations by better utilisation of available data and by improved data acquisition.



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THANK YOU FOR YOUR ATTENTION

Let us move to our speakers!