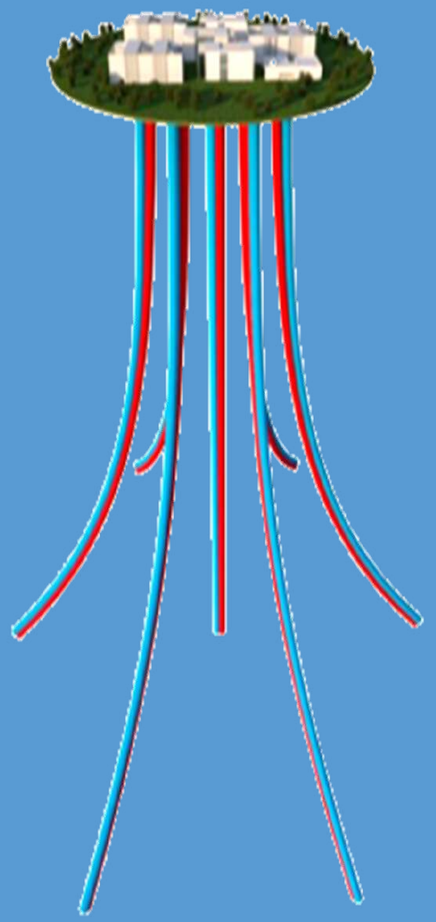
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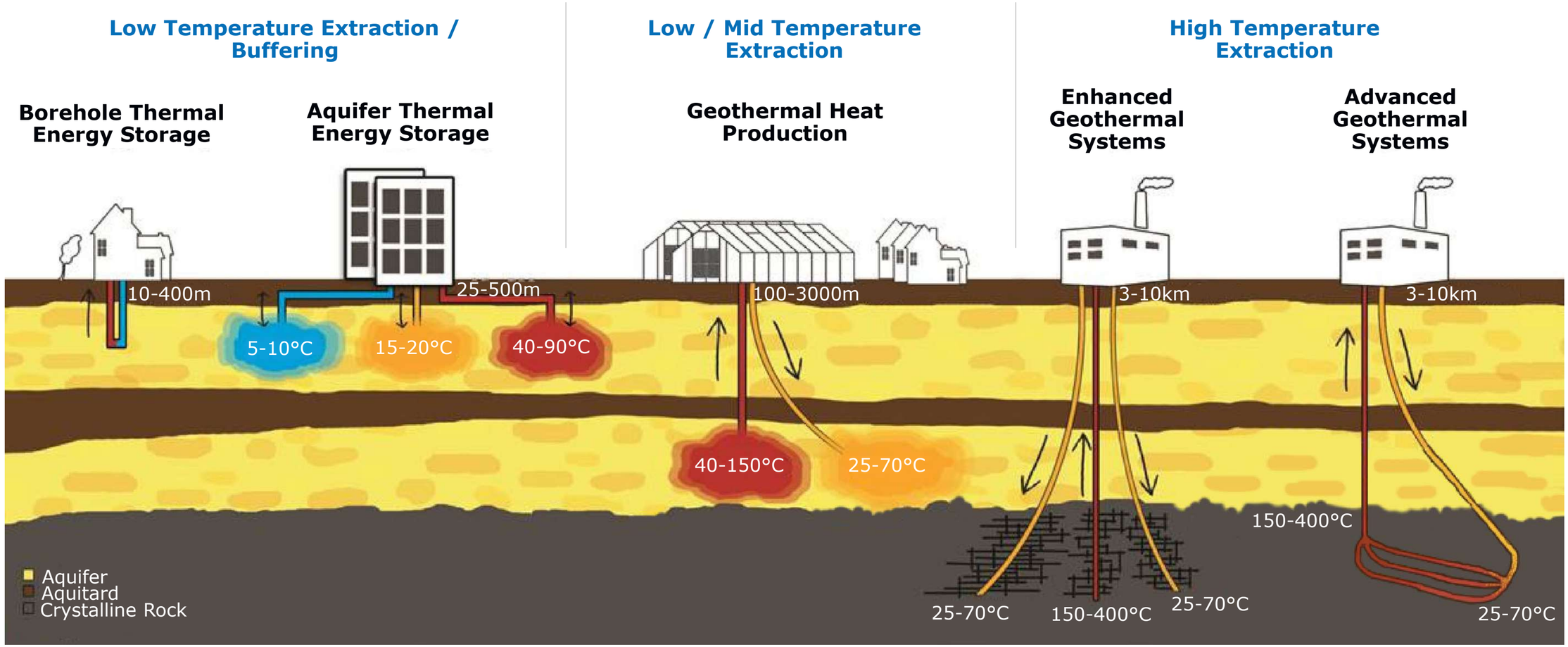
The DEPLOI story: From field pilot to first impact of steel shot drilling

Jan Jette Blangé & Andreas Reinicke

Canopus Drilling Solutions



Geothermal solutions for storage, heat, and power delivery



Source: Prof. David Bruhn, TU Delft (modified)

Shared challenge for all Geothermal solutions

- Improve hole making efficiency (ROP, bit life)
- Improve reservoir contact at low cost (directional, bore hole length)

Project DEPLOI: Directional Steel Shot Drilling for Deep Geothermal

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Directional Steel Shot Drilling (DSSD) unifies erosion drilling, PDC technology and a novel directional control method

AT SURFACE



Steel Shot Injection & Retrieval System (SIU)

- Inject and retrieve all steel shot particles from the well



DSSD Advisory System

- Real-time monitoring system for drilling, hydraulics and formation response
- Optimizes drill rig operation

BELOW SURFACE (*DOWNHOLE*)

Downhole Directional Control

- Directional steel shot erosion
- Reduces steering tool cost and complexity



Hybrid Hole Making

- Combines mechanical PDC cutting with controlled particle erosion
- Improves drilling efficiency and bit life





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DSSD drilling performance: Effective in all formations & no depth dependence



Steel shot erosion works in all soil & rock





DSSD bits drill further >2x faster in hard rock

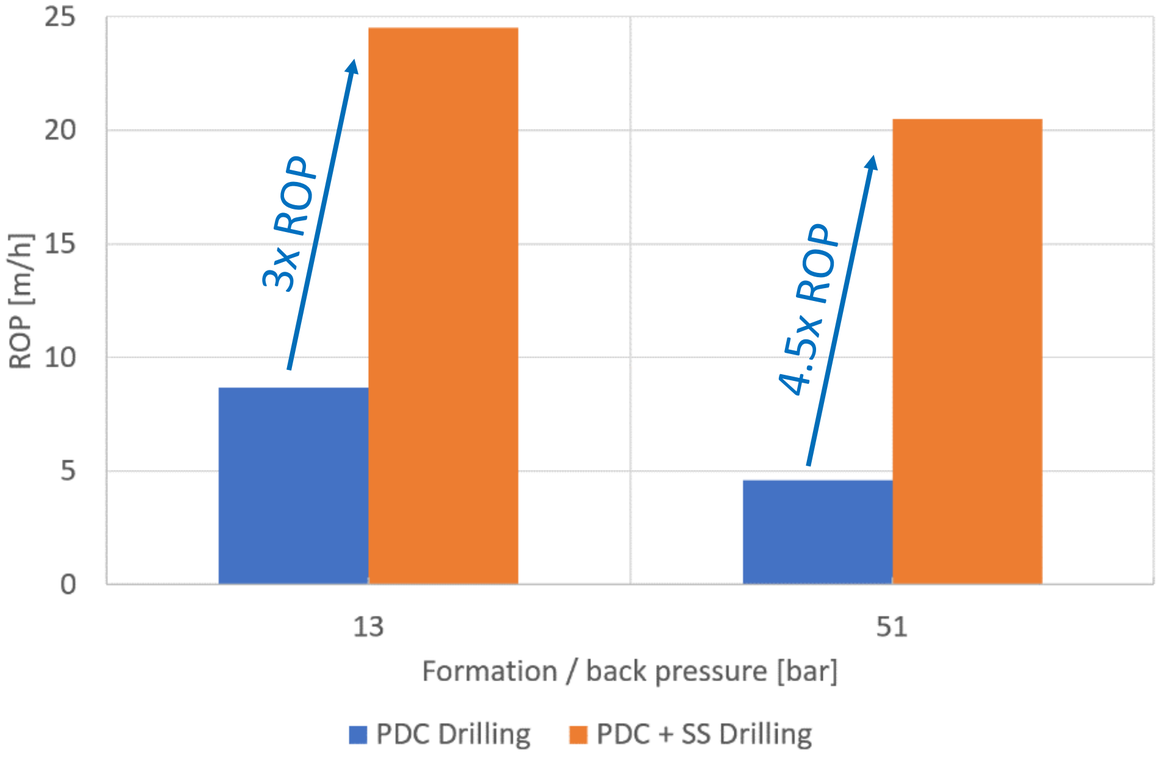
Steering sub directs erosion enabling agile directional drilling for high productivity at low cost



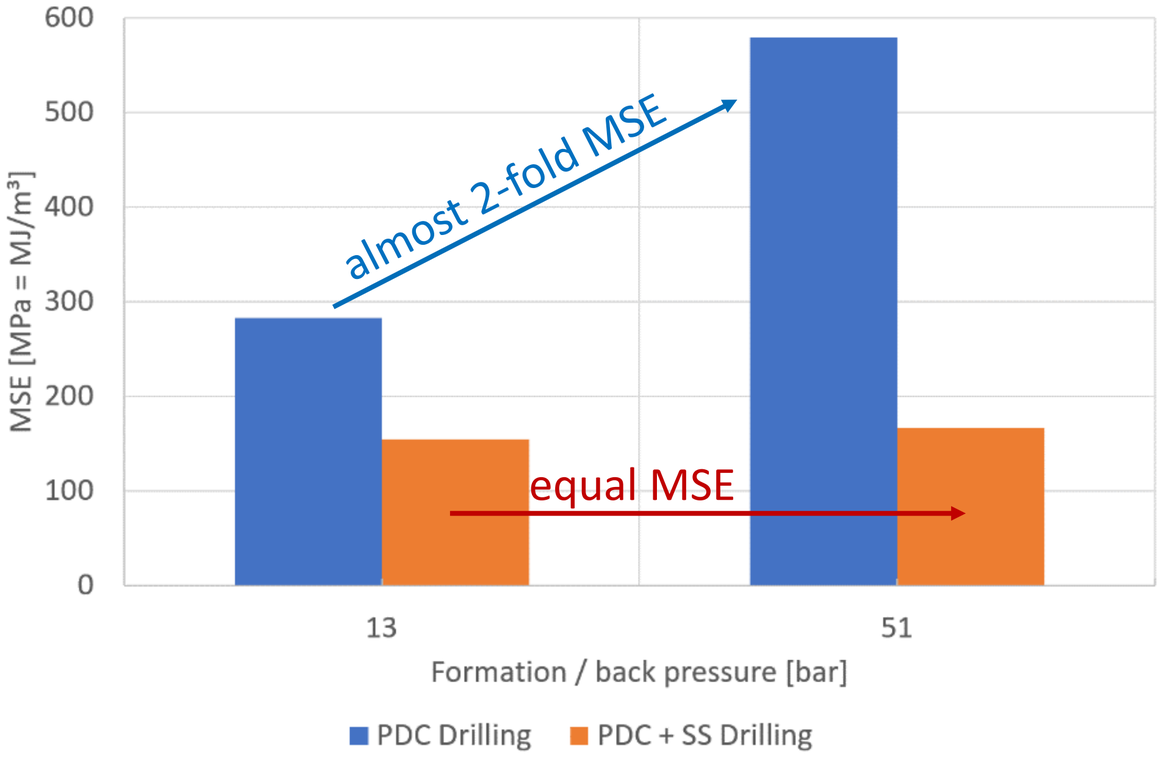
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DSSD drilling performance: Optimization of the rock removal process

Effect of chip hold down can be reduced with hybrid drilling mode



MSE (energy to drill) remains constant with increasing back-pressure



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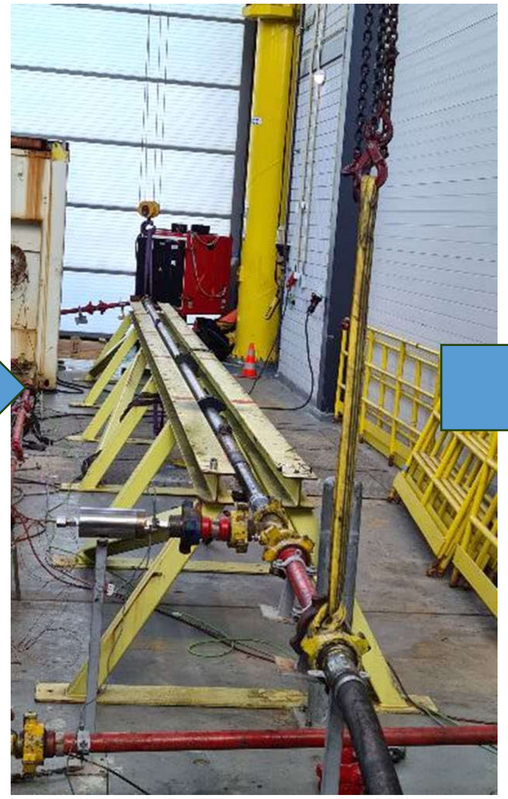
DSSD drilling performance: Technology maturation from lab to field

ROP & SS
Injection Test



DEPLOI

Steering Sub
Test



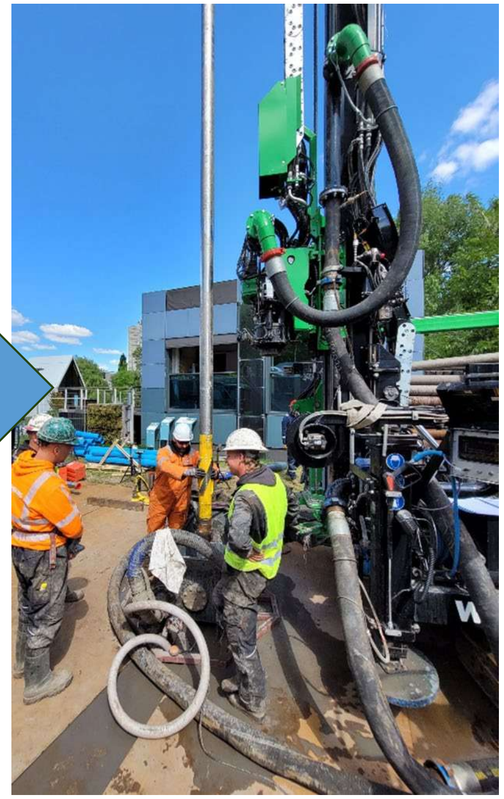
DEPLOI

Factory Acceptance
Test & Pilot VSH



DEPLOI

First set of Borehole
Heat Exchangers
Delft, 2026



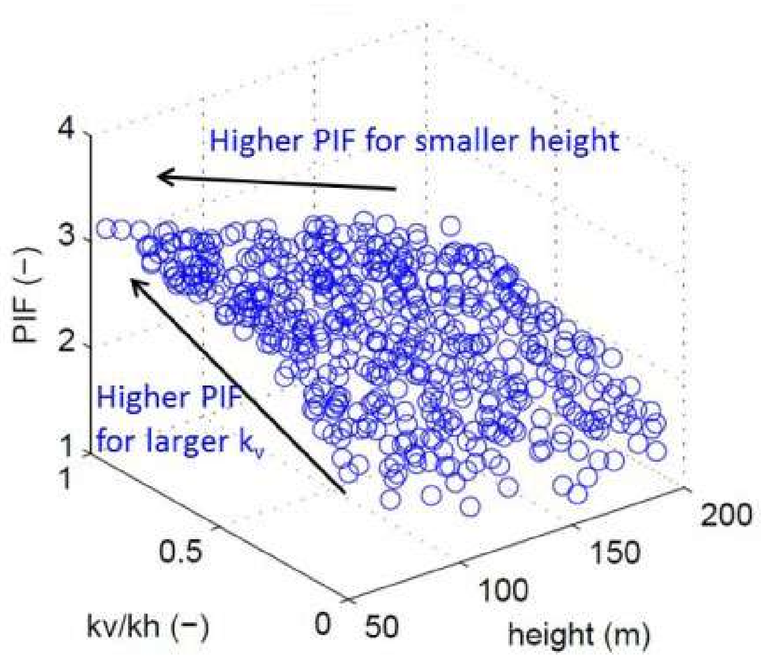
KVW, SES

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DEPLOI: Multi-lateral well construction for deep geothermal

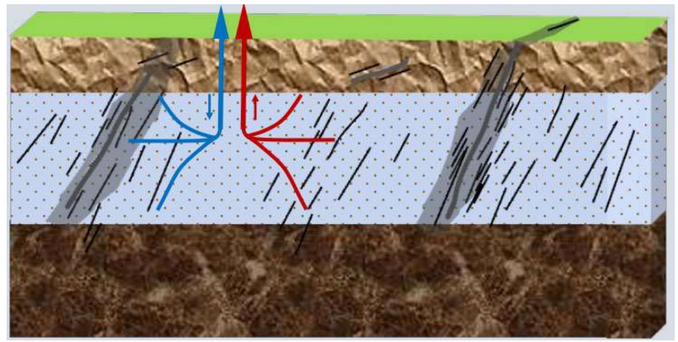
- Potential of multi-lateral well construction for geothermal projects has been demonstrated in many studies
- Cost-effective multi-laterals boost the well productivity (x3) and reduce the LCoE
- Increased POS to hit good reservoir

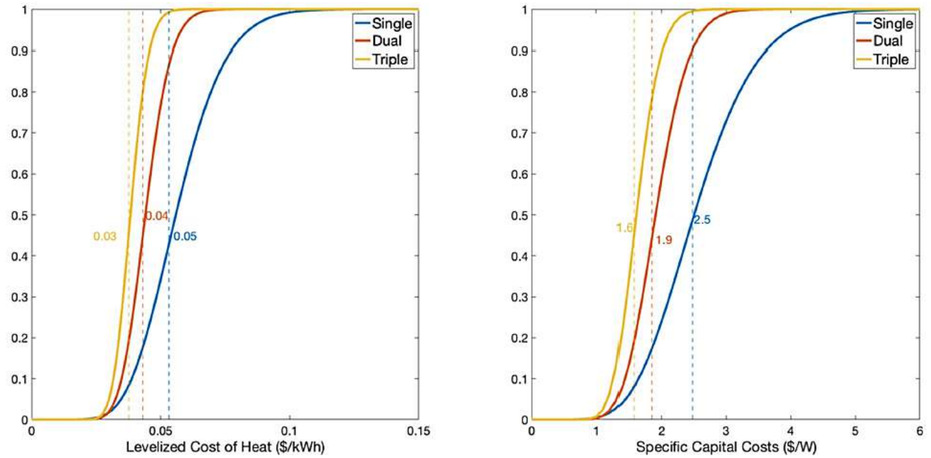
Matrix reservoir



Peters et al. (2015). *Radial drilling for Dutch geothermal Applications.* TNO 2015 R10799

Fractured reservoir



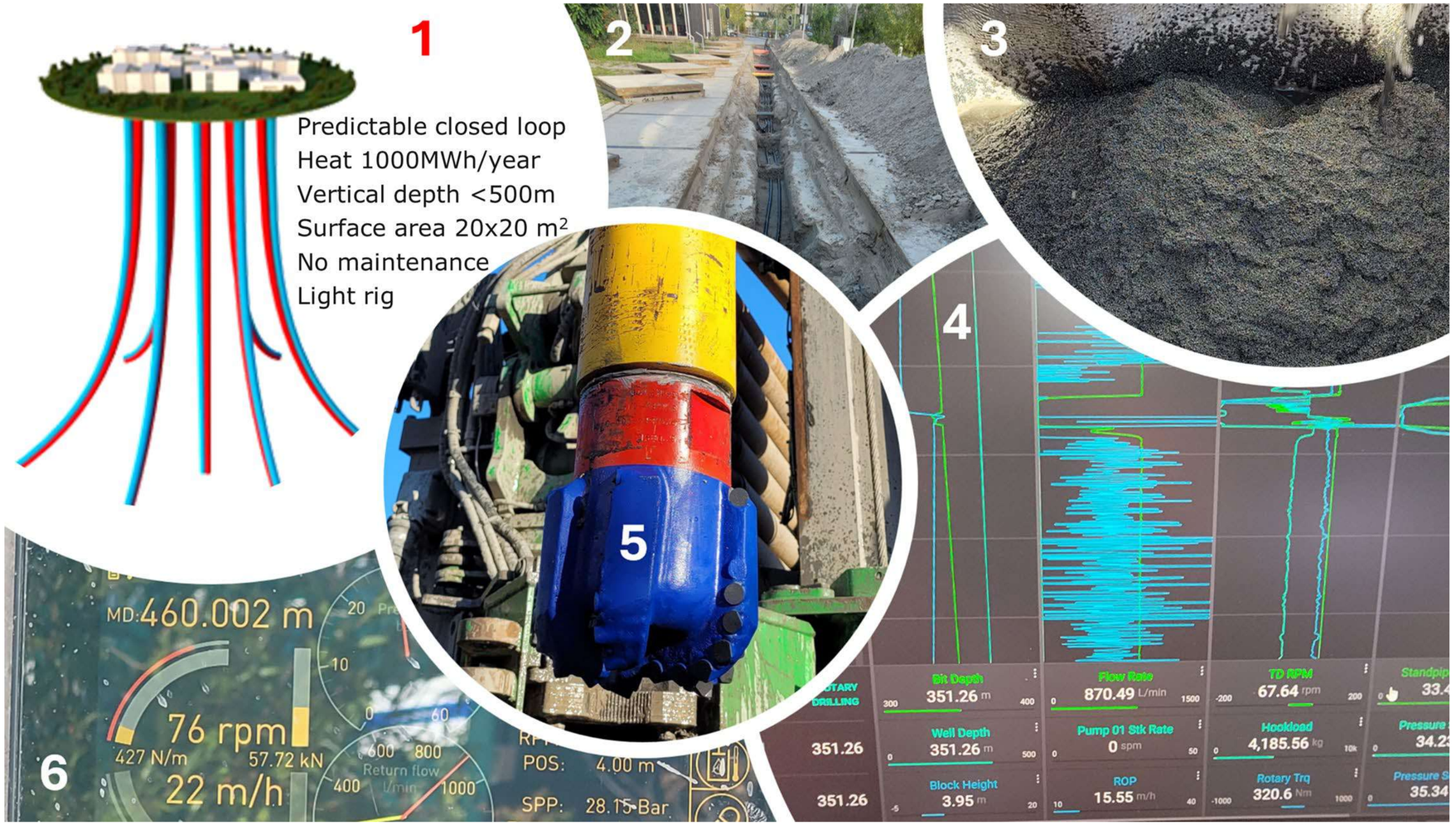


Deb et al. (2026). *Field demonstration and integrated productivity-economics assessment of multi-lateral geothermal wells enabled by directional steel shot drilling*

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Conclusive WorkPackage DEPLOI: Field pilot in Ede sandstone reservoir in 2027

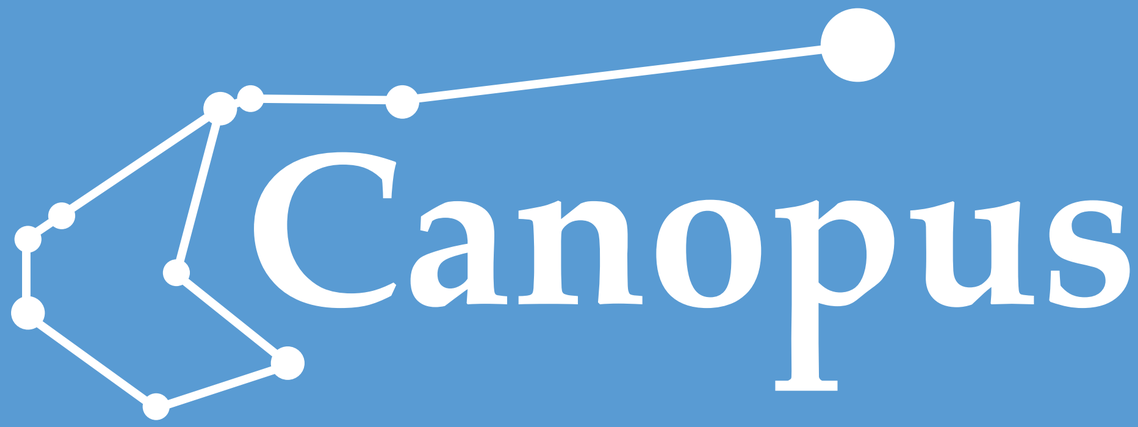
DSSD also for Shallow!!! Long & curved borehole heat exchangers for H&C. Set of 5 completed and connected to heat pump. Ready for commercial.



1. Canoctopus
2. 5 BHEs to >400m under 40m long road
3. All steel shot retrieved
4. Real-time monitoring of the light drill truck
5. Drilled chert layers at 400 to 460m depth

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Tour @ The Green Village on 13 Oct


Canopus

Deep conventional drilling technologies:
DSSD builds on and extends the capabilities of conventional PDC

	Critical system technologies proven	Operational disruption	Retrofit existing rigs	Impact on well hydraulics	Directional capability	Primary drilling fluid	Target application	High ROP & high lifetime
Best-in-class PDC Reference TRL9 technology	yes	none	yes	none	combined with RSS	mud	all - all	yes
Air Percussion Pressurized air driven hammer	yes	very limited	feasible	moderate only mid depth	no	air	shallow - hard rock	yes
Water/Mud Percussion Pressurized liquid driven hammer	for clean water only	very limited	yes	limited	no	clean water / mud	all - soft to medium	yes
High Pressure Jetting Clean water, high pressure jet cutting	for soft rock only	moderate	feasible	substantial for hard rock	no	clean water	all - permeable	not used for long sections
Particle Impact Drilling Larger steel shot drilling technology	yes	moderate	feasible	substantial	no	mud	all - ECD limited	expected
Canopus DSSD True hybrid steel shot drilling	yes	none	yes	negligible	outperforms PDC-RSS*	mud	all - all	Step change vs PDC*

* Physical model. Proven in lab. Confirmed in shallow pilots. To be field-demonstrated and quantified at depth in 2027

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