



DeepU 39th M - Final Conference

06th - October 2025

Exploitation planning and IPR

44 month Final Conference meeting
06 October 2025
WP5 Exploitation planning and IPR
management



DEEPU DRILLING SCALABILITY AND POSSIBLE FUTURE ON-SITE APPLICATION

OBJECTIVES of the techno-economic analysis (T.E.A.):

- ✓ Compare DeepU drilling technology with conventional (SoA – State of Art) drilling technology:
 - Costs
 - Efficiency
- ✓ Assess the advantages offered by DeepU technology
- ✓ Identify next steps for technology advancement



Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation

INPUT DATA FOR T.E.A.: FROM SIMULATED OPEN & CLOSED-LOOP SYSTEMS IN 3 DIFFERENT SITES

Simulating different geothermal systems: identify the main parameters
of different well configurations for drilling cost calculation

Site	Well Conf.	Simul. by	Max Depth [m]	Vertical wells				Horizontal wells				Tot. Flow rate [kg/s]	T _{Out} [°C]	T _{In} [°C]	Gross El. Power [MW]	Net El. Power [MW]
				N. of w.	Single Length [m]	Tot. Length [m]	Ø of w. [mm]	N. of w.	Single Length [m]	Tot. Length [m]	Ø of w. [mm]					
Ferrara	3 doublet Open loop	CNR-IGG	2.000 vert.+ 4.500 dev. = <u>6.500</u>	3 inj.+ 3 prod.= <u>6</u>	6.500	3x6.5k+ 3x6.5k= <u>39k</u>	-> 0-2k m x330(13") -> 2-6.5k m x178(7")	/	/	/	/	500	135	65	25	22
Ferrara	Radiator Closed loop	CNR-IGG	<u>6.000</u>	1 inj.+ 1 prod.= <u>2</u>	6.000	1x6k+ 1x6k= <u>12k</u>	330 (13")	5+5 = <u>10</u>	<u>5.000</u>	5 x 5k+ 5 x 5k= <u>50k</u>	178 (7")	150	135	65	5.2	4.0
Ferrara	Single U Closed loop	UNIPD	<u>4.000</u>	1 inj.+ 1 prod.= <u>2</u>	4.000	1x4k+ 1x4k= <u>8k</u>	188 (7"-3/8)	1	5.000	<u>5k</u>	100 (4")	5	95	65	n/a	n/a
Ferrara	Coaxial Closed loop	UNIPD	<u>4.000</u>	1 inj. (+1prod. coax. pipe)	4.000	1x4k = <u>4k</u>	-> Outer 285 (11"-3/8) -> Inner 100 (4")	/	/	/	/	9	120	70	n/a	n/a



Deep U-tube heat exchanger breakthrough: combining laser and cryogenic gas for geothermal energy exploitation

DRILLING COSTS ANALYSIS

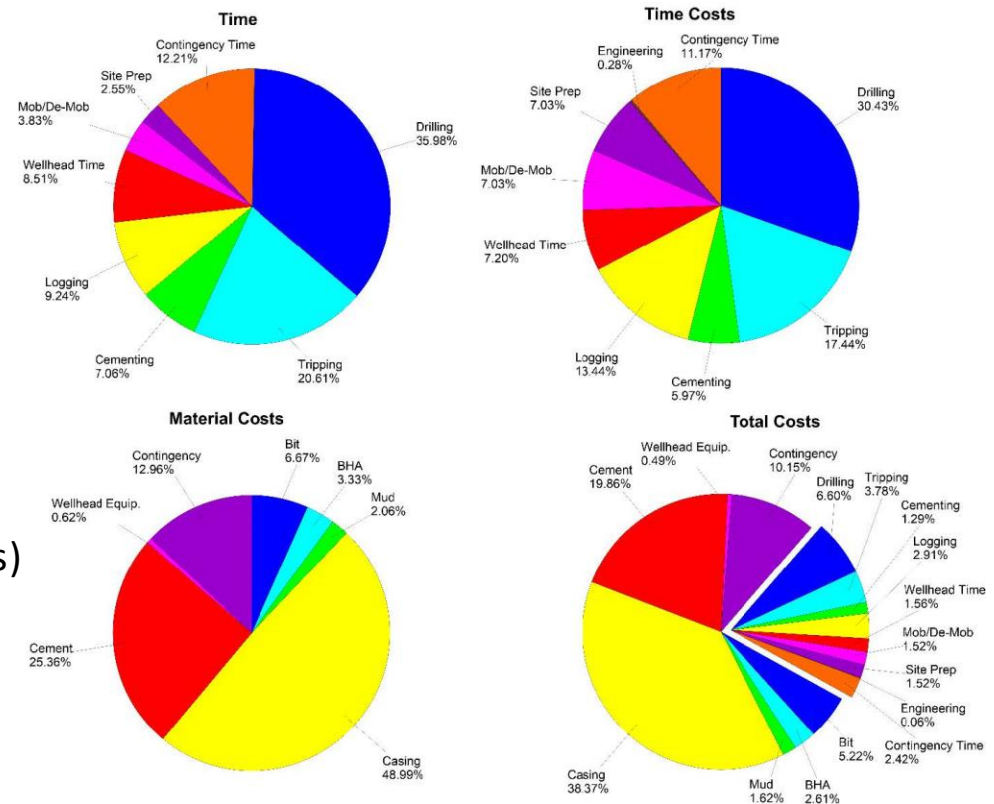
DRILLING COST IMPACT

- ✓ D.C. can account for over 50% of a geothermal energy project's total investment

DRILLING COST FACTORS

- ✓ D.C. influenced by many parameters:

- Well design
- General organization of activities
- Site and logistics
- Services
- Materials (consumables and resources)
- Daily operating activities
- Troubles during drilling
- Waste disposal
- Completion activities



[GeoVision analysis supporting task force report reservoir maintenance and development – Lowry et al., 2017]



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DRILLING COST ESTIMATOR

Spreadsheet based tool to compare DeepU drilling technology with SoA drilling:

- ✓ providing a detailed breakdown of drilling costs and their primary influencing factors
- ✓ evaluating penetration efficiency, material consumption, equipment costs, environmental sustainability

Drilling Cost Estimator: define and characterize relevant D.C. factors to identify & quantify potential cost savings

							State of the Art - Drilling Cost Estimate							DeepU - Drilling Cost Estimate						
ITEM	SECTION	PHASE	COST CATEGORY	COST TYPE	COST UNIT	TIME CATEGORY	Drilling technique	Description	RATE	Qty	UNIT	TOTAL	Comments	Drilling technique	Description	RATE	Qty	UNIT	TOTAL	Comments
PRE-SPUD		Pre-spud PH					SoA							DeepU						
PRE-SPUD Phase Sub-total		Pre-spud PH		Phase Sub-total			SoA					1,571,000.00 €		DeepU					1,571,000.00 €	
DRILLING		Drilling PH		Drilling Sub-total			SoA			Days	120			DeepU			Days	122		
DRILLING Phase Sub-total		Drilling PH		Phase Sub-total			SoA					76,845,737.97 €		DeepU					27,636,586.92 €	
SERVICES COSTS	(not time dependent)	Drilling PH																		
SERVICES COSTS Overall Sub-total	SOV	Drilling PH		Overall Sub-total								415,580.04 €							415,580.04 €	
DAILY OPERATING COSTS	(time dependent)	Drilling PH						DLY_OP_CST												
Ongoing daily costs Overall Sub-total	ONG	Drilling PH		Overall Sub-total	€/day			Ongoing daily costs				71,682.00 €			Ongoing daily costs				61,832.00 €	
Directional Drilling daily costs Overall Sub-total	DRS	Drilling PH		Overall Sub-total	€/day			Directional Drilling daily costs				75,000.00 €							75,000.00 €	
DRILLING		Drilling PH						DRI_OP_CST												
DRILLING OPERATIONS Overall Sub-total		Drilling PH		Overall Sub-total				12000 m	Vertical	2.00		28,208,378.22 €	2,350.70 €		Vertical	2.00		28,009,324.27 €	1,983.20 €	
DRILLING OPERATIONS Overall Sub-total		Drilling PH		Overall Sub-total				8 m	Directional	0.00		€	€		Directional	0.00		€	€	
DRILLING OPERATIONS Overall Sub-total		Drilling PH		Overall Sub-total				20000 m	Horizontal	0.00		48,221,779.71 €	954.66 €		Horizontal	0.00		48,221,779.71 €	954.66 €	



POWER PLANT COST CALCULATION

SURFACE PLANT COST:

- ✓ Assuming power plant costs based on literature
- ✓ Cost calculation for the simulated plants
- ✓ Same plant cost for DeepU & SoA technology

Site	Well Configuration
Ferrara	3 doublet - Open loop
Ferrara	Radiator - Closed loop
Larderello	3 doublet - Open loop
Larderello	Radiator - Closed loop
Leinster	1 doublet - Open loop
Leinster	Radiator - Closed loop



DRILLING COSTS + POWER PLANT FOR SOA & DEEPU TECHNOLOGIES

Calculating drilling costs & power plant cost:

calculate levelized cost of energy (Electric Power & Heat for Direct Use) for the 2 technologies

Site	Well Conf.	Vertical wells			Horizontal wells			Tot. Flow rate [kg/s]	T _{Out} [°C]	T _{Out} ORC [°C]	T _{In} [°C]	SoA Drill, El.+ El.Pl.cost [M€]	DeepU Drill, El.+ El.Pl.cost [M€]	O&M, E Costs (1.5% Pl.costs) [M€]	Net El. Energy per year [MWh]	SoA LCOE [€/MWh]	DeepU LCOE [€/MWh]
		N. of w.	Tot. Length [m]	Ø of w. [mm]	N. of w.	Tot. Length [m]	Ø of w. [mm]										
Ferrara	3 doublet Open loop	3 inj. + 3 prod. = 6	3x6.5k + 3x6.5k = 39k	-> 0-2k m x330(13") -> 2-6.5k m x178(7")	/	/	/	500	135	80	65	162	150	1.125	183084	54.68	51.15
Ferrara	Radiator Closed loop	1 inj. + 1 prod. = 2	1x6k + 1x6k = 12k	330 (13")	5+5 = 10	5 x 5k + 5 x 5k = 50k	178 (7")	150	135	80	65	88	80	0.234	33288	151.65	138.72
Larderello	3 doublet Open loop	3 inj. + 3 prod. = 6	6x3k = 18k	-> 0-500 m x 330(13") -> 500-2k m x 178(7") -> 2k-3k m no CSNG	/	/	/	27	320	80	65	95	82	0.450	64079	88.18	76.92
Larderello	Radiator Closed loop	1 inj. + 1 prod. = 2	2x3k = 6k	330 (13")	5+5 = 10	5 x 5k + 5 x 5k = 50k	178 (7")	36	250	80	65	96	93	0.279	46603	118.58	115.34



CONCLUSIONS AND FUTURE DEVELOPMENTS

The DeepU technology introduces a novel approach:

✓ Competitive advantages:

- **Lower daily costs** (~10% less vs. SoA)
- **Faster drilling** (~30% less time, no trip in/out)
- **Lower power demand** for rig and fluid systems
- **Simpler, lighter rig** – no-torque, crane-based system
- **Reduced wear** – longer drill string lifespan
- **Cleaner process** – less waste, potential reuse of solids
- **Lower casing needs** – partial vitrification of borehole

✓ Challenges ahead :

- **Cryogenic fluid optimization** for efficiency and cost
- **Field validation** in diverse geological settings
- **Instrumentation & controls** to drive the drilling process & maintain safety
- **Scalability** for large-scale geothermal projects
- **Investment & partnerships** needed for pilot deployment



IPR STRATEGY: BUILDING A PROTECTED INNOVATION

DeepU is not just a prototype — it's a protected technology platform:

- ✓ **German process patent:** held by *Prevent GmbH*
- ✓ **PCT patent application:** approved
- ✓ **International patent application:** USA – approved
- ✓ **Proprietary know-how developed in DeepU:** under evaluation within the consortium



PATHWAY TO EXPLOITATION

From concept to pilot – ready for industrial scale-up:

- ✓ **Short-term (TRL 4-6):** Field validation up to 400 m (EIC Transition funding, prepare scale up, interest investors)
- ✓ **Mid-term (TRL 6-8):** 4000 m prototype (EIC accelerator + Joined venture + innovation fund/private investors 20m - 40m drilling tower prototype)
- ✓ **Long-term (Market Entry):** Licensing, service contracts, or Joint Venture with rig operators



PARTNERSHIP & INVESTMENT OPPORTUNITIES FOR DEEPU TECHNOLOGY

- ✓ **Licensing options:** Laser drilling modules, control software, EHS protocols
- ✓ **Joint Ventures:** With rig manufacturers, utilities, or EPC contractors
- ✓ **Technology service contracts:** Site design, operation matrix, vitrification expertise
- ✓ **Target markets:** Deep geothermal, underground storage, mining, Carbon Capture and Storage



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Many thanks for your attention



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