Ref. Ares(2025)1627345 - 28/02/2025

DELIVERABLE D5.2

DeepU drilling scalability and possible future on-site application

Lead Beneficiary: RED

Authors: N. Mutinelli[1], M. Chinello[1], L. Pockelé[1], K. Mallin[2], R. Pasquali[2]

Authors affiliations: [1]RED, [2]GEOSERV

Date: 17/02/2025

Dissemination Level

PU	Public, fully open	
SEN	Sensitive - limited under the conditions of the Grant Agreement	X
CI	EU classified - RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444	

This research is funded by the European Union (G.A. 101046937). The views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or EISMEA. Neither the European Union nor the granting authority can be held responsible for them.

Document History

Version	Date	Authors	Description
1	17/02/2025	N. Mutinelli, M. Chinello	First draft
2	22/02/025	R. Pasquali	Review 1
3	22/02/2025	K. Mallin	Review 2
4	25/02/2025	N. Mutinelli	Review 3
5	28/02/2025	L. Pockelé	Final Review

Disclaimer

This publication was completed with the support of the European Innovation Council and SMEs Executive Agency (EISMEA) under the HORIZON-EIC-2021-PATHFINDEROPEN-01 programme. This research is funded by the European Union (G.A. 101046937). However, the views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or EISMEA. Neither the European Union nor the granting authority can be held responsible for them.

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF EQUATIONS

TABLE OF TABLES

ABBREVIATIONS AND GLOSSARY OF ACRONYMS

Acronym	Extended definition
API	American Petroleum Institute
BHA	Bottom Hole Assembly
BOP	Blowout Preventer
$Dh_{end,SCN"X"}$	Ending depth of section “X”, [m]
$Dh_{strt,SCN"X"}$	Starting depth of section “X”, [m]
DSP	Drillable Straddle Packer
DTRC	Dual-Tube Reverse Circulation
EGS	Enhanced Geothermal System
$Eff\_d\_t_{SCN"X"}$	Effective drilling time for section “X”, [h]
GHI	Grit Hot-pressed Inserts
GTO	Geothermal Technologies Office
LCM	Lost Circulation Materials
LN	Liquid Nitrogen
$L_{SCN"X"}$	Length of section “X”, [m]
LWD	Logging While Drilling
m	metres
MWD	Measurement While Drilling
$m_{LN,SCN"X"}$	Liquid nitrogen mass consumption for section “X”, [kg]
$\dot{m}_{LN}$	Liquid nitrogen mass flow rate, [kg/s]
MT	Milled tooth
NDT	Non-Destructive Test
ORC	Organic Rankine Cycle
PDC	Project Coordinator
PPI	Production Price Index
POOH	Pull-Out-Of-Hole
ROP	Rate Of Penetration, [m/h]
SoA	State of Art
SP	Spontaneous Potential
TCI	Tungsten Carbide Inserts
TIH	Trip-In-Hole
UCS	Uniaxial Compressive Strength
MT	Milled Tooth
WOB	Weight On Bit

PUBLISHABLE SUMMARY

The DeepU project represents a groundbreaking advancement in geothermal energy, offering the opportunity to overcome some of the limitations of current mechanical drilling technologies. Conventional geothermal drilling is constrained by high operational costs, slow penetration rates, and geological challenges that restrict its replicability, its capability to reach very large depths economically. . DeepU introduces an innovative approach that leverages high-power laser technology in combination with cryogenic gas injection. This revolutionary technique enables the creation of deep (>4 km) geothermal systems, offering a more efficient, cost-effective, and sustainable means of harnessing geothermal energy.

This deliverable provides an in-depth evaluation of the scalability of the DeepU drilling system, particularly its feasibility for large-scale, on-site deployment. The study focuses on key factors influencing drilling efficiency, including rate of penetration, energy consumption, cost structure, and environmental impact. Through rigorous computational simulations and comparative analyses with state-of-the-art (SoA) drilling methods, the report highlights the potential advantages of DeepU technology. These include significantly reduced well construction costs, enhanced precision, and the ability to operate effectively in diverse geological formations.

The findings suggest that DeepU's novel methodology has the potential to transform the geothermal energy sector by making it a more economically viable and a competitive alternative to fossil fuel-based energy sources. DeepU technology could accelerate the adoption of geothermal energy on a global scale by drastically reducing drilling costs and improving energy output. Additionally, its reduced environmental footprint aligns with international efforts to transition toward more sustainable energy solutions.

Future research and development efforts will focus on optimizing system components, improving operational efficiencies, and conducting real-world field demonstrations to validate performance. Industry partnerships, technological refinements, and continued innovation will be critical in driving the successful commercialization and adoption of DeepU drilling technology.