This research is funded by the European Union
(EIC, Path nder Programme, G.A. 101046937)

Deep U-tube heat exchenger breakthrough: combining laser and cryogenics gas for geothermal energy exploitation

Project start date: March 1 2022
Project duration: 36 months
Hop-on extension: July 1 2023

Coordinator Ing. **Luc Pockelé** (RED Srl)

RED Renewable Energy Development

Università degli Studi di Padova

Fraunhofer IAPT

Wrocław University of Science and Technology

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DeepU Project

Goals

- Developing new **laser drilling technology**
- Extracting energy from **deep (>4 km)** U-shaped or other closed-loops
- **Reducing the costs** of well drilling
- Making accessible **geothermal energy anywhere**

Key project figures

7
Partner organizations

4
Involved countries

36
Months duration
starting on March 1, 2022

Key project actions

- Drilling technology design and development
- Validation at the lab scale
- Compliance with legal and environmental aspects
- Closed-loop scenario definition
- Cost-effectiveness assessment

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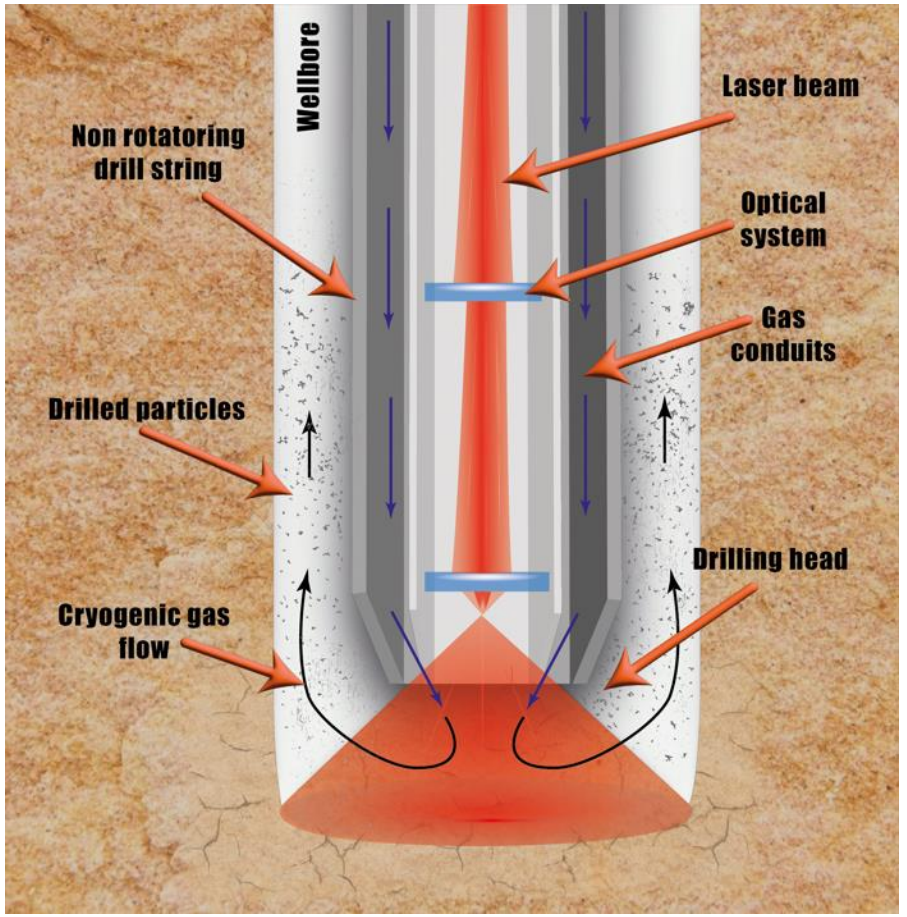
INNOVATIVE DRILLING TECHNOLOGY

A **laser** propulsion drilling method is combined with **cryogenic gaseous flushing** for cooling the laser drill head, borehole walls and bring the cuttings to the surface

Improved ROP
Reduced drilling time and cost

In case a glazed layer is formed on the borehole walls, the borehole is physically isolated from the surrounding formations without requiring further casing activities.

Reduced time and casing cost for setting up the HE



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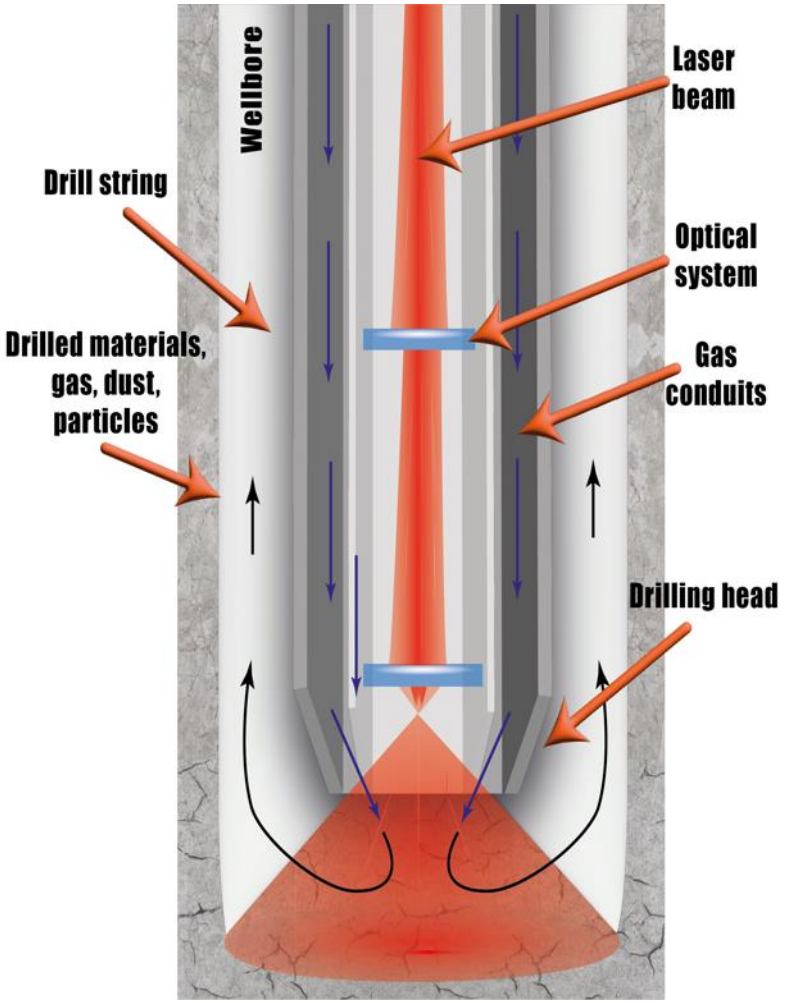
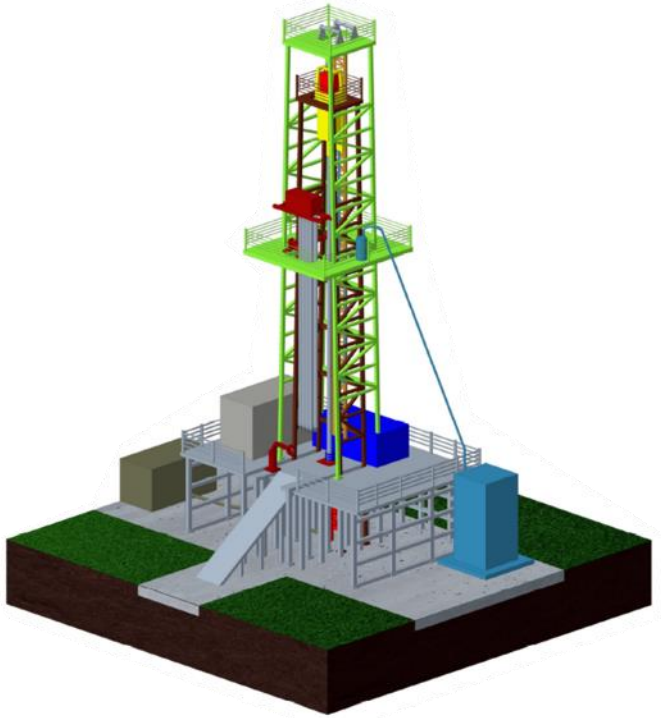
Cryogenic gas supported laser drilling technology



Drilling Tower adaptions needed



Drilling head with gas flushing nozzles

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Laser drilling laboratory tests

Robotic arm

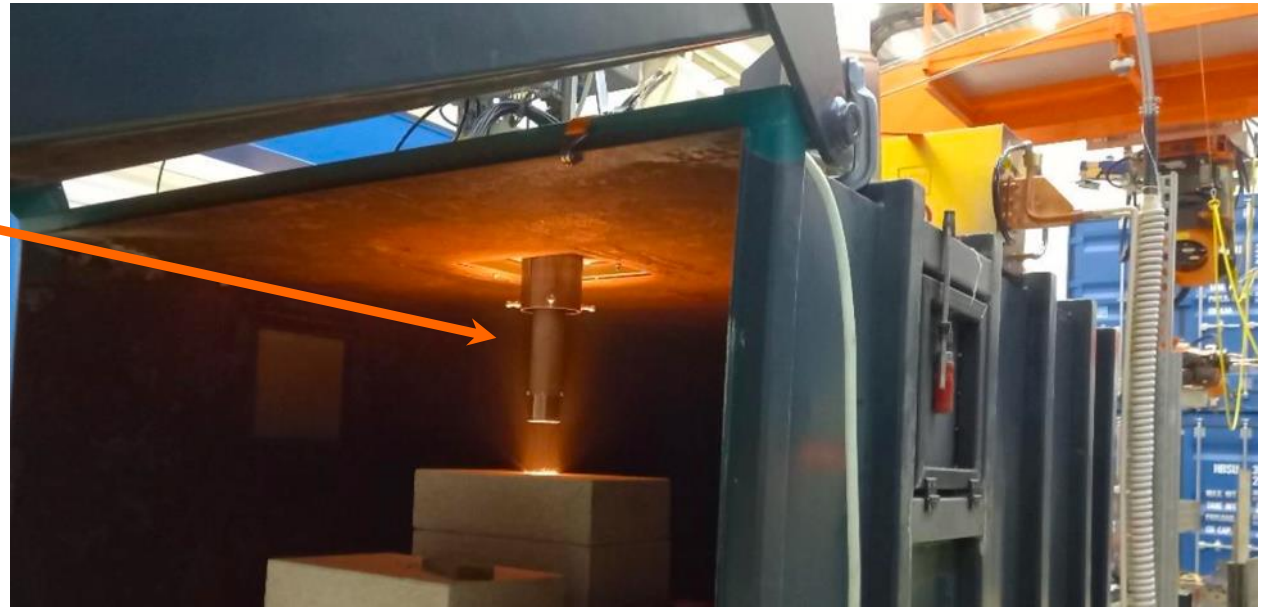
Optical system

Drilling string

Steel container

Rock slabs

150mm x 300 mm x 500 mm



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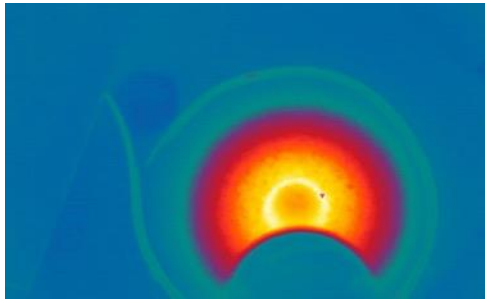
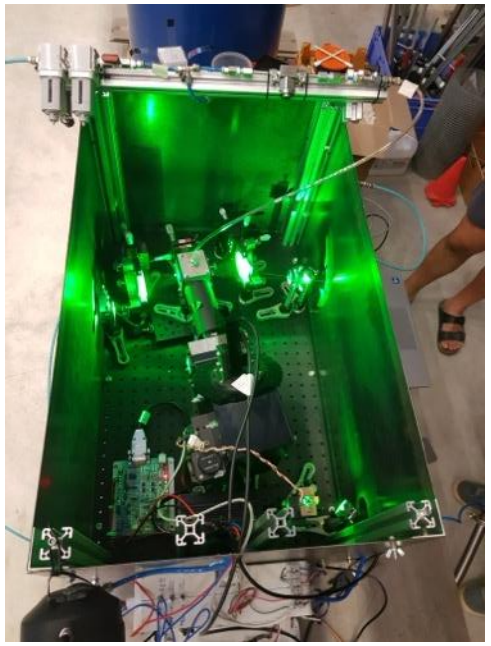
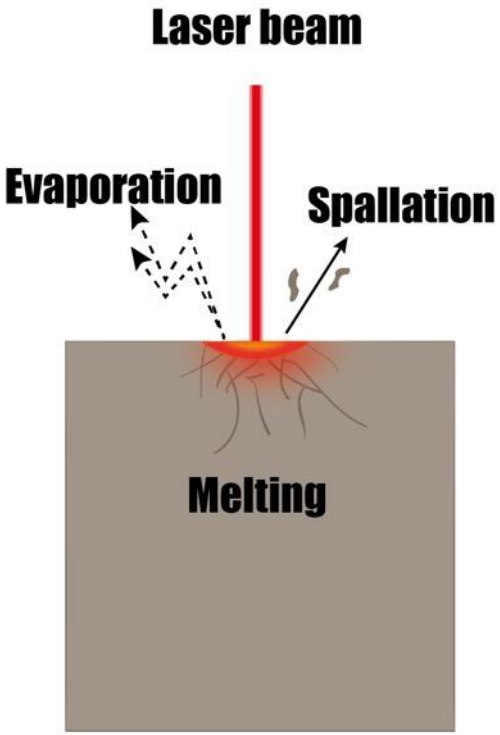
Experimental setup

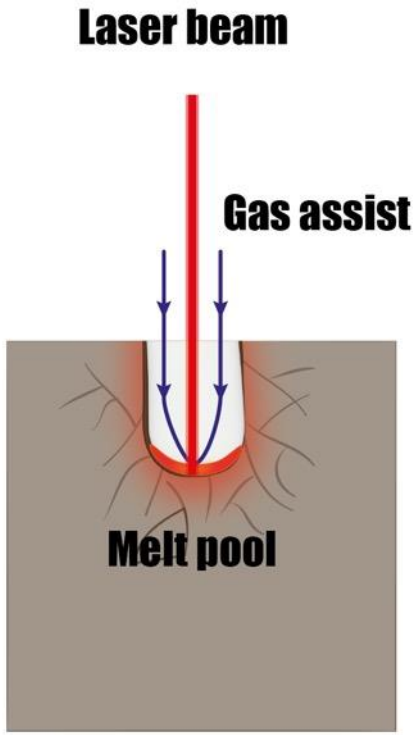
- Fixed position of robotic arm (working distance)
- Drill with and without assistance of room temperature N_2 flux
- Testing drilling heads
- Laser power: 6-30 kW
- Beam diameter: 5-20 cm
- Selected lithologies: granite, sandstone, limestone
- Video documentation
- IR video documentation (thermocamera)
- Gas spectrometry

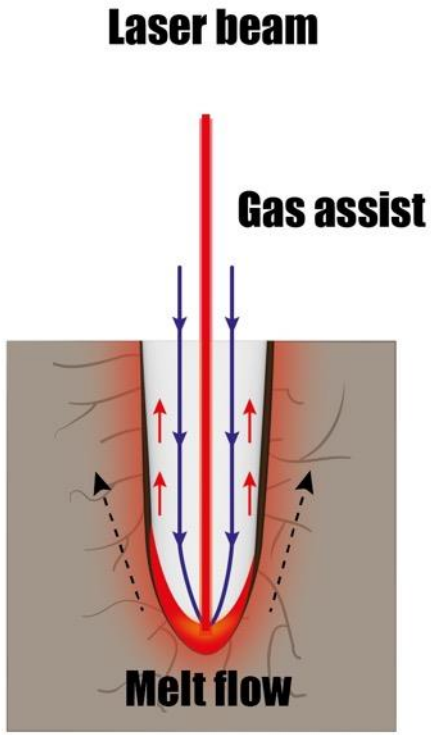




Laser-rock interactions







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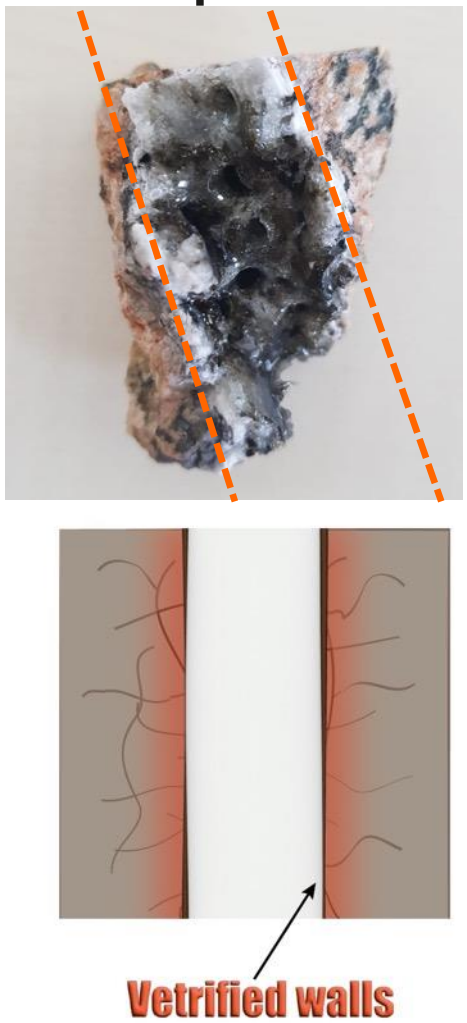

Based on Li et al. 2015

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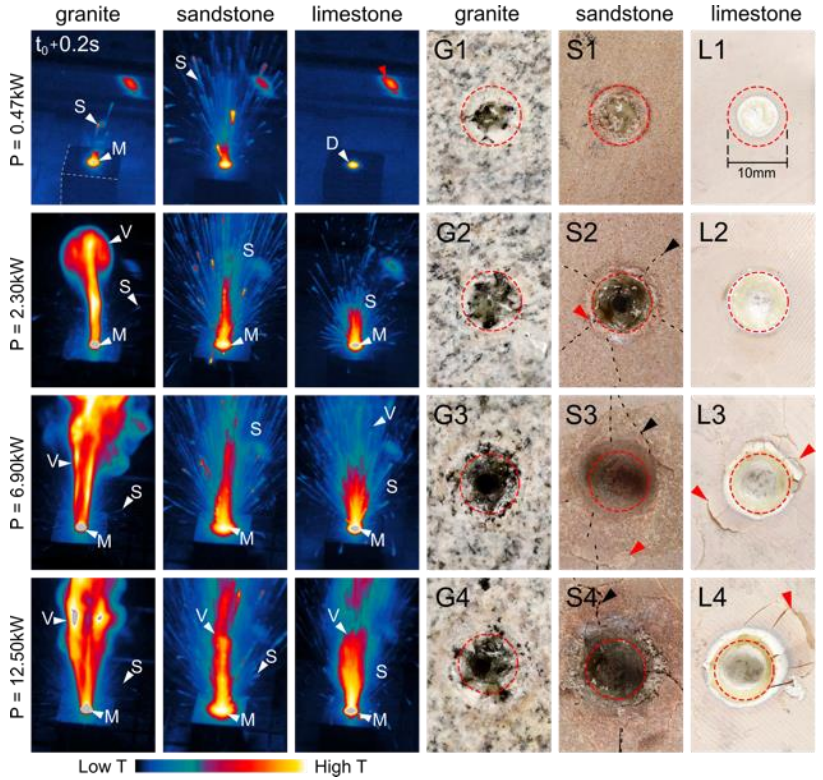
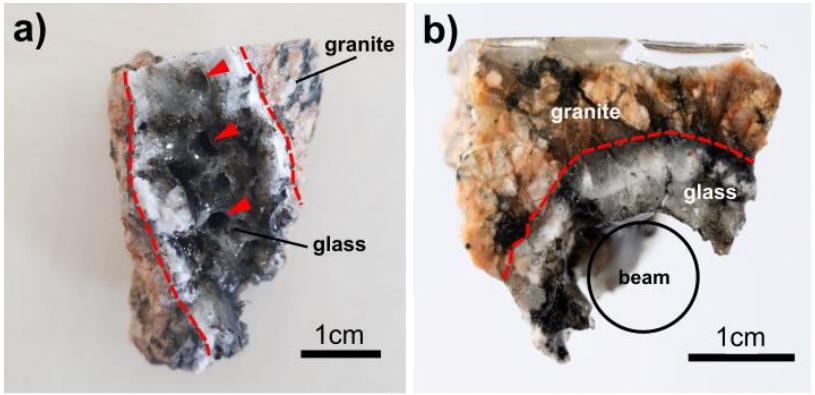
Results of the lab tests

- Description of petro-physico-mechanical phenomena; **spallation, melting, evaporation**
- **Formation of glass layer** (1-5 mm)
- **Successful drills** of selected lithologies
- ROP up to **25 m/h**

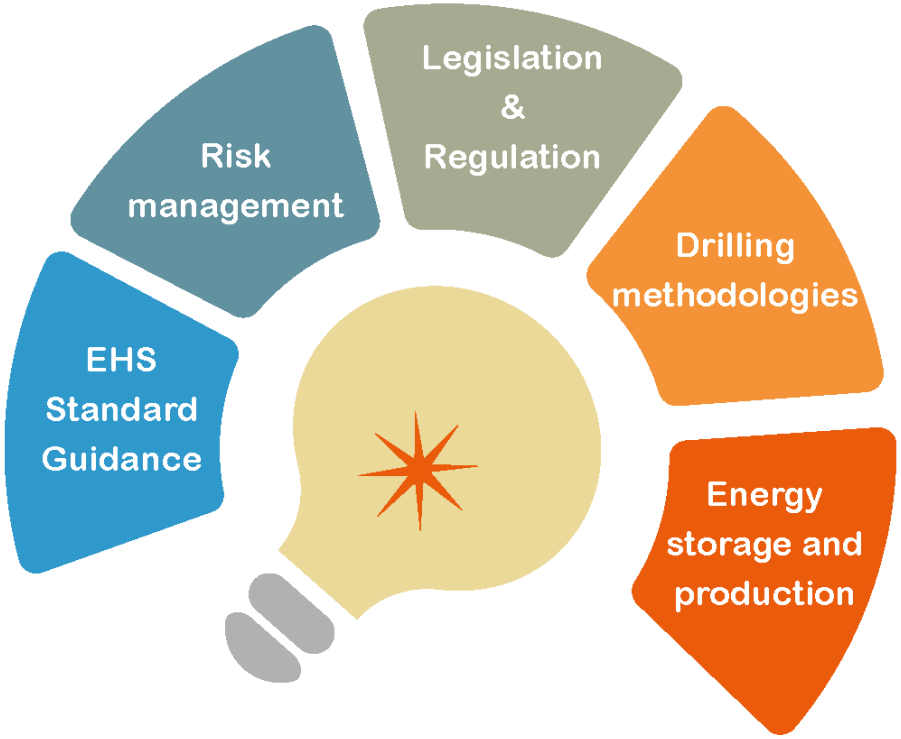


IR images and pictures of crater from drill head tests



Thermally spalled borehole

Preliminary analysis for a sustainable deployment



The project will analyze and assess:

- The **exploitation potential**
- The economics of the developed **drilling technology**
- The **legislative** aspects and **environmental**
- Health and safety (**EHS**) standards related to the proposed solution.
- The **risks assessment** comparing DeepU technology to conventional deep drilling

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Thank You for Your Attention

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