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Optimising access to deep geothermal resources with new state-of-the-art drilling technologies to unleash clean, abundant energy from the Earth

A new dawn is opening up for drilling deep U-tube heat exchangers, combining laser and cryogenic gas

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In 2022, the University of Padua announced the launch of the DeepU project aimed at developing an innovative drilling technology to overcome many geothermal energy production limits.

The project's name reflects the DeepU primary goal of drilling more efficiently with reduced Non-Productive Time, resulting in deep (>4 km) U-shaped closed-loop geothermal heat exchangers. The new technology proposed in DeepU will revolutionise the geothermal energy sector, increasing the accessibility of deep geothermal resources for low-carbon heating and power generation.

The unique technology developed and tested involves a laser propulsion drilling method with cryogenic gaseous flushing for cooling the laser drill head. In case a glazed layer is formed on the borehole walls, the obtained systems are physically isolated from the surrounding rocks and ready to be developed immediately after drilling. The increased drilling speed and the lack of casing and production liner in the reservoir section will substantially reduce well drilling costs.

So, let's recap the results of the first year of activities.

The most suitable cryogenic gas has been selected based on the required qualities: availability, low price, and thermodynamic properties that allow the gas to remain in a liquid state over long distances to reach the base of the well during drilling.

New concepts for drill string and drilling platform design are in development. The novel drill string guides the laser beam down inside the inner drill string while transporting the liquid cryogenic gas downward to the drill head. The drilling tower and platform house the laser and the rotary drilling systems, the liquid cryogenic gas tank and the ash extraction plant with the gas separator and recycling system.

A press container has been set to perform the first laboratory tests with the novel lightweight laser and gas processing drill head and was equipped with monitoring devices. In a preliminary drilling test, a 3D-printed titanium laser processing head created precise and symmetrical holes in granite, limestone and sandstone samples. In addition, constant rates of penetration upwards of 20m/hr have been achieved, with relatively low energy inputs and no component wear that would be associated with mechanical engaging drilling methods.

Health and Safety aspects related to site development, drilling operations and completion, as well as environmental and economic aspects of the DeepU technology uptake are under analysis to achieve regulator acceptance and commercialisation.

DeepU has been funded under the EIC Pathfinder programme (G.A. 101046937) by the European Commission as part of Horizon Europe. Dr Eloisa Di Sipio coordinates the project from the University of Padua in collaboration with partners - Prevent, Fraunhofer IAPT, GeoServ, Red, and CNR-IGG – from 3 different countries. It will run until February 2025.

For further information, check the official website www.deepu.eu and don't hesitate to get in touch with the DeepU team at info@deepu.eu