

Does deep geothermal drilling need a revolution?

The Earth's depths may hold the key to a sustainable energy future. However, what are the ways to access them more quickly, deeply, and cost-effectively? This daring question forms the basis of the DeepU webinar held on April 4, 2025 – an event that highlights one of the key challenges in the energy transition: exploring new geothermal frontiers through innovative and unconventional drilling methods.

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Geothermal energy is known for its ability to produce significant amounts of renewable, carbon-free energy with continuity. To boost this contribution, it is crucial to access the underground at increasingly larger depths, but the costs associated with deep drilling present a considerable challenge to developing geothermal technologies and energy production.

The webinar titled “Does deep drilling need a revolution?” united experts and stakeholders to explore a new vision for the future of geothermal energy. Held online as part of the European Project DeepU (G.A. 101046937), the event examined the current state of deep drilling technologies while initiating a discussion on the breakthroughs necessary to access ultra-deep geothermal resources. Central to the conversation was the pioneering technology proposed by DeepU – its approach combines high-power lasers and cryogenic gas to penetrate the most challenging rock formations.

The project partners showcased cutting-edge, innovative drilling technologies while emphasizing the advantages of non-mechanical drilling. They shared significant findings from the DeepU project that demonstrate, on a laboratory level, the potential of laser drilling technology to address the limitations of conventional methods. The research investigates how lasers interact with rock, revealing that thermal spallation, melting, and vaporization occur simultaneously, albeit with varying intensities based on rock type, power density, and irradiation duration. Notably, thermal spallation is the most promising to produce usable diameter wells, with drilling rates ranging from 5 to 15 meters per hour. The team has selected supercritical nitrogen as the flushing medium for deep borehole drilling due to its thermodynamic properties and effectiveness in removing cuttings. They developed a numerical model to determine the necessary pressure and flow rates for different borehole depths, which is being validated through a dedicated test rig. The proposed system involves storing liquid nitrogen, compressing it to high pressures (up to 350 bars), and delivering it down the borehole through a specially designed channel with vacuum insulation. Among the challenges discussed regarding the technology is the need for integration with existing drilling equipment and practices. The presentations and the recording of the webinar are available on the project website <https://www.deepu.eu/index.php/events/>

Innovation in geothermal drilling may signal a shift in producing carbon-free and renewable energy, aiding the energy transition and utilizing local energy resources. Once the technological challenges are addressed, geothermal energy could transform the global energy landscape and become the most competitive alternative to fossil fuels.

DeepU has been funded by the European Commission under the EIC Pathfinder Programme (G.A. 101046937) as part of Horizon Europe. Eng. Luc Pockelé coordinates the project from the RED srl in collaboration with partners from four countries: the University of Padua (Italy), Prevent GmbH (Germany), Fraunhofer IAPT (Germany), GeoServ (Ireland), The Wroclaw University of Science and Technology (Poland), and the Consiglio Nazionale delle Ricerche IGG (Italy). The project will run until October 2025.

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