Proceedings World Geothermal Congress 2026, Calgary, Canada, June 8—11, 2026

Sustainable and affordable URban Geothermal seismic Exploration Novel Technologies and workflows, the HEU URGENT project

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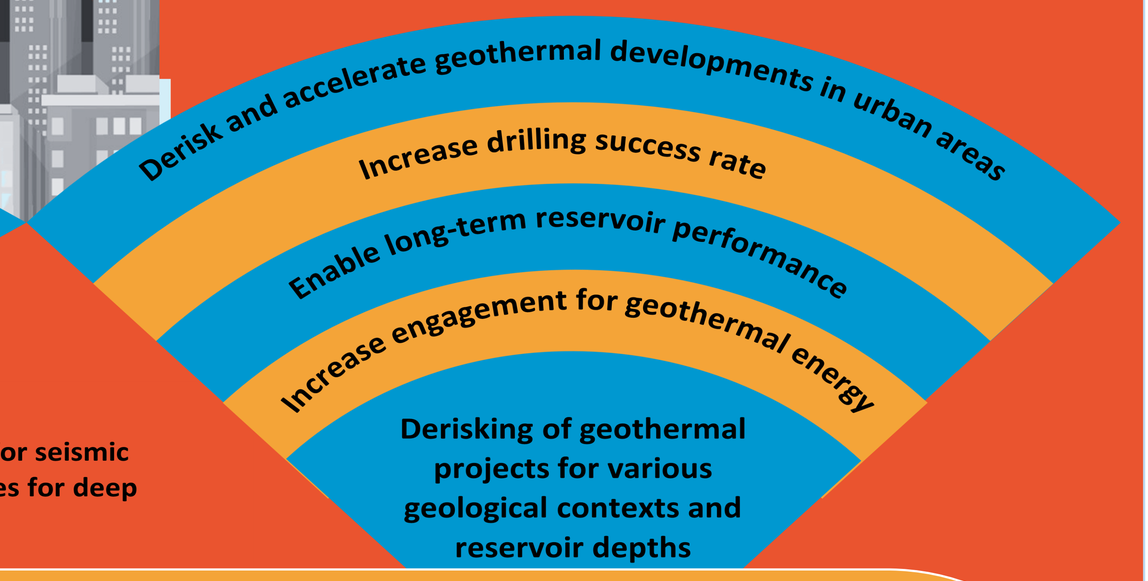
INTRODUCTION

The URGENT project aims to accelerate the decarbonization of Europe's heating sector by leveraging geothermal energy as a key alternative to fossil fuels in urban areas. Despite its potential, geothermal energy development is hindered by limited knowledge of subsurface resources and risks in complex urban environments, where conventional exploration methods fall short. The URGENT project addresses this gap by providing sustainable and affordable solutions for urban seismic exploration of geothermal resources. uptake strategies, and efforts to strengthen community acceptance.

2024 - 2027



URGENT Objectives



Main objective

DEVELOP innovative technologies for seismic exploration of geothermal resources for deep reservoirs in urban contexts.

RESULTS

The URGENT project aims to improve all the steps of geothermal urban seismic exploration including development of suitable, reliable and low impact technologies for acquisition, optimization of survey design and workflows for processing eVibe and 3C data, automation of interpretation of processed data to ease fault imaging and horizon picking. In addition, ML techniques adapted from the oil and gas sector are combined with thermo-hydro-mechanical (THM) reservoir modeling to optimize well placement and design. This integrated approach aims to maximize heat extraction, reduce seismic risks, extend plant lifetimes, and enhance profitability. Beyond its technical innovations, URGENT supports the wider adoption of urban geothermal projects through tailored exploration workflows, market uptake strategies, and efforts to strengthen community acceptance.

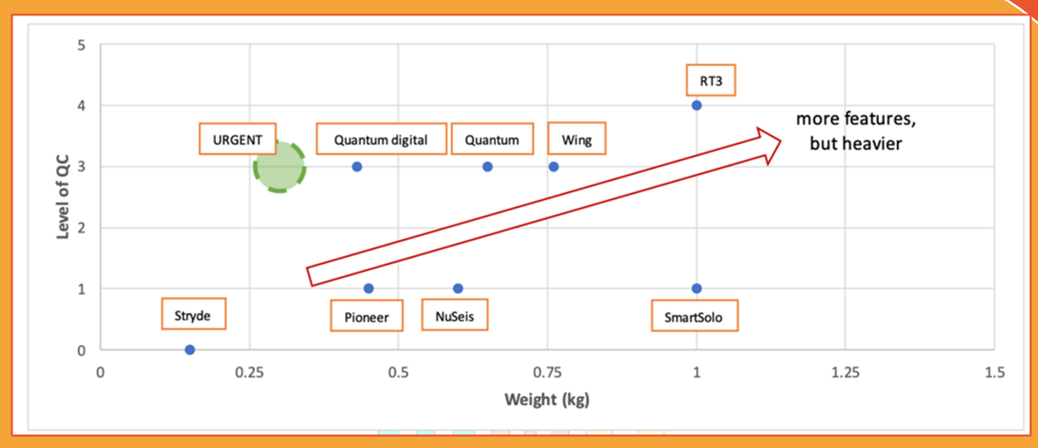


Figure 1. Positioning of URGENT nodes compared to existing commercial nodes

1. Prototype of the **eVibe seismic source** capable of imaging deep geothermal reservoirs

2. Prototypes of **miniaturised smart seismic receivers** capable of reaching deep geothermal reservoirs



Figure 2. Receiver prototype



Figure 3. eVibe prototype

3. **Optimised survey design** to reduce data acquisition costs and enhance geothermal resource derisking

4. Workflow for **processing eVibe, 3C data** acquired using **optimised survey design**

5. **AI/ML** driven workflows to **image fault** and **extract fault plane**

6. **Risk management toolbox** to assess induced seismicity risk and ML driven tools to optimise well location

7. Identification of critical **environmental, social and political factors affecting public acceptance** and definition of an **exploitation roadmap** to maximise URGENT impact

8. **Integrated workflows** designed to enhance geothermal resource derisking in a wide range of geological settings

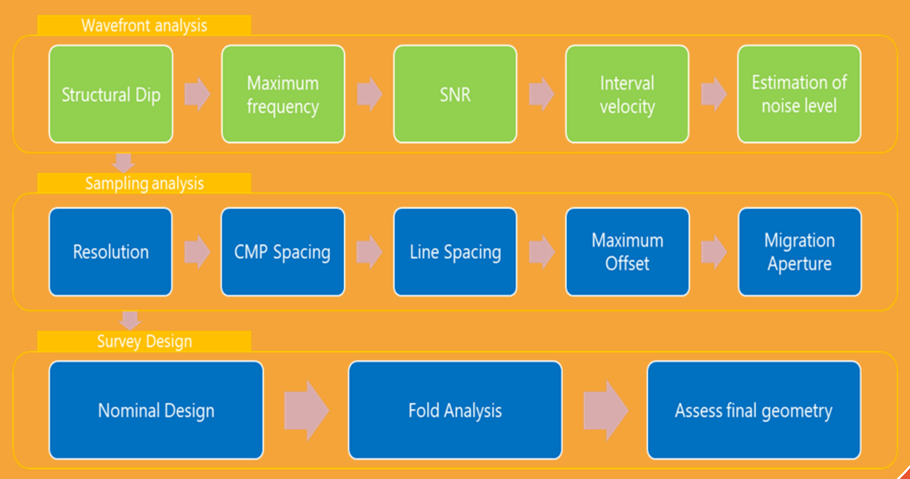


Figure 4. Innovative survey design workflows

Test sites

VITO site *urban context*

Challenges
Induced seismicity, complex fissured and fractured reservoir

URGENT Activities
Conduct a small-scale 3D seismic survey to test seismic acquisition technologies, methods, and data (post)processing techniques. Test AI/ML methods, training models to identify and represent faults in 3D.

Konin site *urban context*

Challenges
Injectivity, reservoir continuity detection and costs of exploration

URGENT Activities
Conduct 2D seismic survey to test seismic acquisition technologies, methods, and data (post-)processing techniques. Test AI/ML methods, training models to identify and represent faults in 2D.

Batta site *industrial and urban context*

Challenges
Seismic exploration in noisy industrial area

URGENT Activities
Conduct 2D seismic survey to test seismic acquisition technologies, methods, and data (post-) processing techniques.

CONCLUSIONS

Achievements June 2026

- 625 single-channel + 25 three-channels MEMs receivers +1 20kN eVibe prototype
- Innovative survey design algorithm tested for the 3 sites including compressive sensing
- One 2D survey conducted in Hungary Q1 2025
- Optimized processing workflows tested based on the acquired data
- A minimum value product of the Risk Management toolbox available
- Improved OpendTect software features for automatic fault detection
- Mapping of stakeholders in Poland and Belgium
- Societal engagement activities, with country specific action plans

To come

- Two more surveys planed Q3 2026, a 2D in Poland and a small scale 3D in Belgium
- LCA and Roadmap for market uptake of the URGENT technologies and solutions
- Full integration of the results to define seismic exploration workflows for geothermal energy

Acknowledgements

This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101147467.

URGENT project

urgent-project-heu.eu