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Eavor-Loop™ Tilburg, Netherlands: A Closed-Loop Geothermal System for District Heating Use

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Summary

The Eavor-Loop is an advanced geothermal system where heat is extracted in from the deep subsurface through a closed loop multi-lateral geothermal system. Conventional geothermal doublet systems have been implemented in the Netherlands primarily in Southwest of the country and supply heat to greenhouse and utility scale district heating operations. To meet the heat demand offtake, a geothermal system requires a hot reservoir with sufficient permeability to maintain high injection and production rates for economic heat delivery.

The Eavor-Loop relies only on conductive heat transfer, rather than convection or reservoir fluid flow, and can be thought of as a large closed-loop subsurface radiator. The design removes the need for a hydrothermal source, has minimal water use, eliminates the complex resource characterization cost and time associated with geothermal reservoirs, and provides extremely predictable output. Finally, the Eavor-Loop™ has a small footprint on surface, and there is absolutely no fracking, no induced seismicity, negligible water use, and no emissions, making this system ideal for densely populated areas.

TKI Urban Energy in the Netherlands commissioned a joint feasibility study to evaluate the application of Eavor's 1.0 technology near Tilburg, Netherlands. The ELFO project (Eavor Loop Feasibility for Tilburg and Outlook for application in the Netherlands) is a collaborative research study between Eavor Technologies Inc., Huisman Geo B.V., Ennatuurlijk B.V. and TNO (Netherlands Organization for Applied Scientific Research). Van Wees (2023) documents the complete work of the ELFO project including detailed reports and findings of all five work packages.

This abstract will focus on the results from WP1 and WP3, which evaluated the subsurface feasibility and assessed the environmental and safety impacts of the Eavor-Loop™.

Results

The scope of the Eavor-Loop Tilburg Project is to drill and construct one Eavor-Loop which will generate thermal energy, to be used by Ennatuurlijk as a renewable heat source for the Amer Heat Network. The Eavor-Loop will consist of two vertical wells, each connected to 12 horizontal laterals of 2100 m in length at a depth of 3250 m.

Work Package 1 (WP1) was designed to characterize the subsurface through geological, geophysical, geomechanical and thermodynamic investigation. The resultant geological model identifies the Lower German Triassic as a suitable hot reservoir for Eavor-Loop placement given

a depth of 3,250m TVD, a geothermal gradient of 32.4°C/km, a thermal conductivity of 4.40 W/m·K (Dalby 2018) and robust mechanical strength properties as input to WP3.

A robust thermo-mechanical 3D simulation was carried out in WP3 by Van Wees (2023) to model the stress changes due to cooling during production of the Eavor-Loop™. Tensile failure is expected as the Volpriehausen and Detfurth are cooled during drilling and production, However, the magnitude of breakouts is very small, and only expected to be centimeters near wellbore. The simulation also addressed the potential reactivation of faults due to cooling and determined that induced seismic events are extremely unlikely even if a fault is directly intersected.

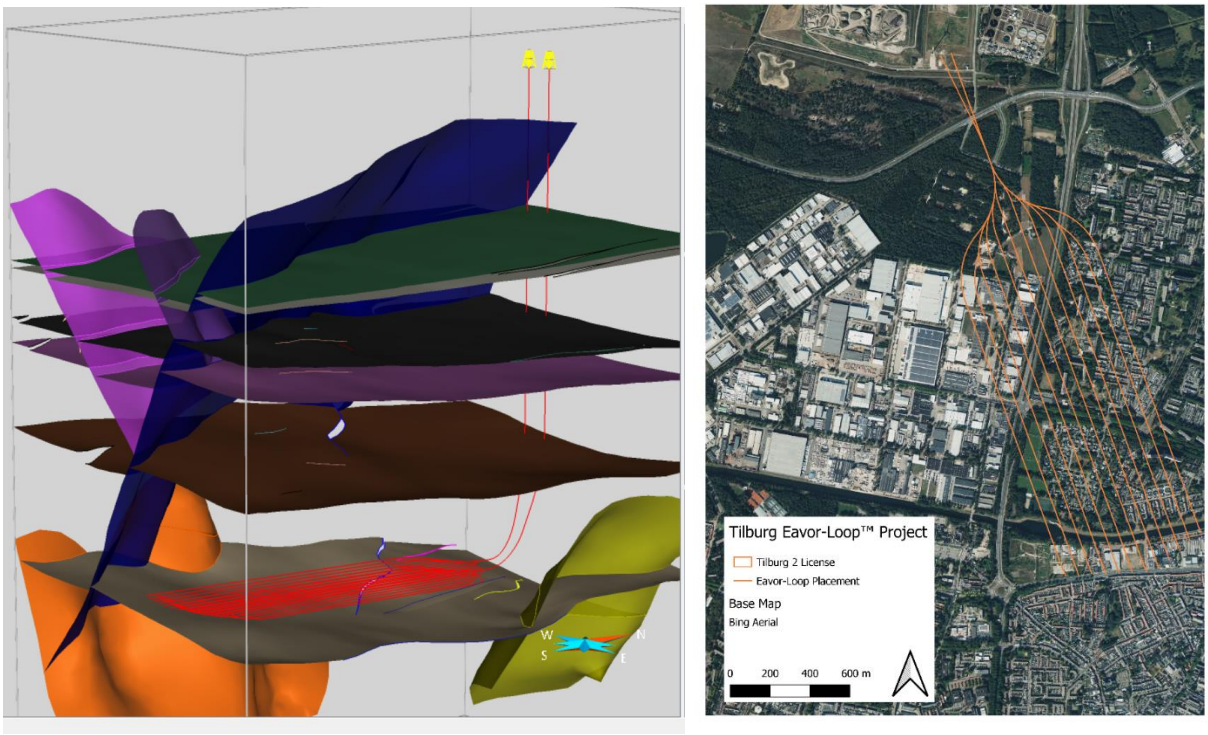

Figure 1: Eavor-Loop™ design and placement for Tilburg, Netherlands

Given the aforementioned subsurface conditions, the predicted energy yield for the project is 9.1 MW during the summer months and 7.1 MW during the winter months. Project development will follow the implementation of the Eavor-Loop in Geretsried, Germany, Longfield (2022).

Conclusions

The research in the ELFO Study Van Wees (2023) has produced a robust prediction of the subsurface conditions near the City of Tilburg. Given the low uncertainty on Heat in Place it is possible to predict energy yield with relatively high confidence. To be able to predict energy yield prior to construction is one of the many benefits to developing high potential geothermal resources with the Eavor-Loop closed system.

An Eavor-Loop can be deployed in the Lower German Triassic sandstone rich Volpriehausen, Detfurth and Hardegsen members. An expected energy yield of 9.1 MW in summer months and

7.1 MW in the winter months yielding an approximate annual production of 74,000 MWh of clean baseload heating into the Amer heating network.

Novel/Additive Information

TKI URBAN ENERGY
Topsector Energie

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