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Reutilising hydrocarbon wells as deep heat exchangers to decarbonise heating in the Northern Netherlands

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To meet the climate targets outlined in the Paris Agreement, European Green Deal, and the goal of reducing dependence on fossil fuel imports per the REPower EU Action, decarbonizing and reducing energy consumption in the heating and cooling sector is imperative. This sector, a major contributor to household energy use, plays a pivotal role in achieving sustainable energy goals.

Geothermal energy, particularly through geothermal doublets, stands out as an ideal solution for supplying energy for space heating and cooling. However, the inherent risks associated with fluid exchange with the subsurface make it scientifically or politically challenging in certain areas. Addressing this concern, deep borehole heat exchangers function as closed-loop systems, eliminating fluid exchange with the subsurface.

In this study, we explore the feasibility of repurposing existing oil and gas wells in the Northern Netherlands as deep coaxial borehole heat exchangers to provide heat to local communities. Utilizing analytical solutions, we calculate the thermal power output of 365 gas wells suitable for retrofitting. These wells exhibit bottom hole temperatures exceeding 80°C, capable of delivering temperatures above 60°C or thermal powers exceeding 800 kW, depending on flow rate and inflow temperature.

Our analysis includes assessing the proximity of well locations to high-density heat demand neighborhoods within a 6 km radius, facilitating the provision of supply temperatures for future local heat district networks. Notably, heat loss from well to neighborhood generally remains below 2°C, ensuring sufficient heating power supply to nearby residential areas. Several well clusters demonstrate significant heat over-supply, suggesting the potential for transporting excess heat to more distant locations. In cases where heat supply from wells is too low, in particular in neighbourhoods with very low building efficiency rating (<E), heat pumps can be utilised to supply the needed energy.

Our findings indicate that repurposing existing hydrocarbon wells as coaxial heat exchangers offers a viable option for providing low-carbon heating to numerous residential areas in the Northern Netherlands. However, the geographical distribution reveals that not all high heat demand neighbourhoods have well sites in proximity, underscoring the importance of implementing a diverse heat supply strategy.

