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A feasibility assessment of the implementation of a minewater heating system on the Durham University estate.

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Minewater heating is a form of shallow geothermal energy provision that exploits abandoned subsurface mines that have since flooded after mining activity ceased. Groundwater that occupies the void space left from material extraction is warmed to ambient temperatures by heat transfer exchanges with the surrounding rock.

By using ground source heat pumps, the temperatures of these waters can be lifted to those suitable for domestic heat use, with efficient electrical input.

An assessment to determine the feasibility of the implementation of a minewater heating system on the Durham University campus is currently in progress, with results due in March 2022. The system would use abandoned coal mines of the Durham Coalfield to heat several student accommodation buildings built above.

Assuming abstraction and reinjection of the minewater, we investigated the available heat resource using a numerical modelling tool developed at Durham University. This tool modelled the minewater flow through the void space of the mines and thermal interaction with the surrounding rock.

A new methodology was developed for the digitisation of historic mine plans provided by the UK's Coal Authority, which have then been modelled to provide 3D visualisation of technical factors critical to the success of such a project. Various configurations have been tested, and results indicate over 11 million kWh of heat in place resource available, at temperatures of 14°C. This heat in place figure is likely an underestimation of the resource as records indicate deeper seams were also mined at the locality.

We subsequently carried out an assessment of the economic feasibility. If a decentralised configuration were chosen for the design, it would be advisable to focus on three buildings with the most student rooms. Initial costs would be high, driven mainly by the associated costs of drilling injection and extraction wells. As the target seams are relatively shallow (145m for extraction and 70m for injection), smaller wells could be used, costing roughly £40,000 per well. If a centralised design were used, costs would be reduced by drilling fewer wells. However, retrofit

work to replace the original centralised gas infrastructure connections could induce significant cost and disruption. However, running costs would be low, and emissions savings from not using gas boilers would be significant; peak daily CO_2 emissions from gas were 17,992 kg in 2019.

Finally, to assess the internal policy structure of the university and the feasibility of permission to be granted for the project, a social acceptance study was undertaken with key members of the university's Board of Directors. Considering the project through the concept of risk, obstacles to implementation were identified, and potential policy solutions were developed.

This study provided insights into current institutional views on engaging with innovative energy technologies. Future work may benefit from understanding these to produce relevant solutions to mitigate them in their feasibility studies.