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Modelling of a retrofitting methodology to revive abandoned oil reservoirs for geothermal exploitation

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Geothermal energy is considered as one of the renewable energy resources to meet the world's growing low-carbon energy demand. There are increasing number of oil wells to be abandoned and these wells could be potentially retrofitted to geothermal wells for sustainable purpose. There have been some studies and practices on retrofitting oil wells, but most of the existing retrofitting methods suffer from either low efficiency or high cost. In this study, we designed and modelled a novel retrofitting pattern to a single well featured with enhanced reservoir system (ERS). We established numerical models of ERS in abandoned oil reservoirs configured with a vertical well. We simulated the effects of reservoir initial oil saturation, thickness, permeability and different ERS designs on the production temperature and output power after 50 years. We found these effects have positive feedback on the production temperature and output power. In addition, we also modeled the temperature effect on oil-gas-water relative permeability as it would highly affect the oil viscosity and mobility in the oil reservoir. Moreover, through sensitive analyses of this retrofitted single well and the traditional doublet geothermal well, we found the retrofitted single well in our study could be as high as that from doublet geothermal well, implying that one single abandoned oil well could work either for direct use or power generation with economic yield but little retrofitting investment. Lessons learned in this study might also be applied to other geothermal scenarios, such as enhanced geothermal system.