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Evaluating Geothermal Potential in Germany by Numerical Reservoir Modeling of Engineered Geothermal Systems

Charitra Jain (1,2), Christian Vogt (1), and Christoph Clauser (1)

(1) RWTH Aachen University, Applied Geophysics and Geothermal Energy, EON Energy Research Center, Aachen, Germany, (2) ETH Zurich, Institute of Geophysics, Zurich, Switzerland

We model hypothetical Engineered Geothermal System (EGS) reservoirs by solving coupled partial differential equations governing fluid flow and heat transport. Building on EGS's strengths of inherent modularity and storage capability, it is possible to implement multiple wells in the reservoir to extend the rock volume accessible for circulating water in order to increase the heat yield. By varying parameters like flow rates and well-separations in the subsurface, this study looks at their long-term impacts on the reservoir development. This approach allows us to experiment with different placements of the engineered fractures and propose several EGS layouts for achieving optimized heat extraction. Considering the available crystalline area and accounting for the competing land uses, this study evaluates the overall EGS potential and compares it with those of other used renewables in Germany. There is enough area to support 13450 EGS plants, each with six reversed-triplets (18 wells) and an average electric power of 35.3MWe. When operated at full capacity, these systems can collectively supply 4155TWh of electric energy in one year which would be roughly six times the electric energy produced in Germany in the year 2011. Engineered Geothermal Systems make a compelling case for contributing towards national power production in a future powered by a sustainable, decentralized energy system.