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Optimal Combined Heat-and-Power Plant for a Low-Temperature Geothermal Source

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Abstract

This work compares the performance of four combined heat-and-power (CHP) configurations for application in a binary geothermal plant connected to a low-temperature 65/40 and a high-temperature 90/60 district heating system. The investigated configurations are the series, the parallel, the preheat-parallel and the HB4 configurations. The geothermal source conditions have been defined based on existing geothermal plants in the northwest of Europe. Production temperatures in the range of 110-150°C and mass flow rates in the range of 100-200kg/s are considered. The goal is to identify the best-performing CHP configuration for every set of geothermal source conditions (temperature and flow rate) and for multiple values of the heat demand. The electrical power output is used as the optimization objective and the different CHP plants are compared based on the exergetic plant efficiency. The optimal CHP plant has always a higher exergetic plant efficiency than the pure electrical power plant; up to 22.8%-pts higher for the connection to a 65/40 DH system and up to 20.9%-pts higher for the connection to a 90/60 DH system. The highest increase of the exergetic plant efficiency over the pure electrical power plant is obtained for low values of the geothermal source temperature and flow rate.

Keywords: CHP, district heating, geothermal, ORC, thermodynamic optimization

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