“Comparison of Life Cycle Assessments of Deep Geothermal Power Production”

Bachelor’s Thesis

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Abstract

Deep Geothermal Power provides a solution to cope with the rising electricity demand. Life Cycle Assessments (LCA) suggest that the environmental impacts are low compared to other electricity sources. The goal of this thesis is to achieve a comprehensive comparison of the environmental performance of different geothermal power plant technologies and set the results into context with other electricity sources.

Existing LCAs of a dry steam, two single flash steam, a double flash steam and a binary power plant are harmonised. To accomplish this, the Life Cycle Inventory (LCI) is adapted and extended based on assumptions. The Life Cycle Impact Assessment (LCIA) quantifies the impacts with the help of ReCiPe 2008 Midpoint Indicators.

In terms of the Climate Change, the Dry Steam plant has the highest impact (215 g CO_2 eq/kWh). It is followed by the Binary Plant (46.4 g CO_2 eq/kWh), which exploits an Enhanced Geothermal System (EGS). The first single flash steam plant shows a value of 37.8 g CO_2 eq/kWh. The second single flash plant performs even better with a value of 26.9, which decreases to 24 g CO_2 eq/kWh with a second flashing unit.

The direct emissions of gases during the operation of a geothermal power plant are the critical processes of the environmental performance. The highest releases stem from dry steam and flash steam plants. With binary power plants, this pattern is avoided thanks to the closed-loop system and full reinjection of the geofluid. The higher value for the Climate Change Indicator is attributable to the significant drilling and stimulation needs of the EGS. Therefore, binary power plants yield the best results from a purely technological perspective.

Regardless of the technology used, geothermal power performs better in terms of environmental impacts than conventional fossil fuels. A major advantage, as a contrast to other renewable electricity sources, is the base-load characteristic of the power generation. This also counts for nuclear power, but problems with radioactivity are avoided.