Levelized cost of exergy – an exergy-based pricing method for CHPs

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In this paper, we propose a novel pricing method – based on exergy – and compare this approach with the convenient energy-based pricing. We present our findings for a low-temperature geothermally-fueled combined heat-and-power (CHP) plant, connected to a district heating (DH) system. A low-temperature (~130 °C) geothermal source is typical for the NW of Europe and two types of district heating systems are considered: one for the connection of houses with a conventional central heating system (90 °C/ 60 °C) and a lower-temperature DH system for the connection of houses with newer heating systems like floor heating and heat pumps (65 °C/ 40 °C). It is interesting to compare two types of DH systems due to the temperature-dependency of exergy. We have implemented a thermoeconomic optimization model for the optimization of the design and operating conditions of a parallel CHP plant. The objective is the Net Present Value (NPV) for the convenient pricing mechanism, considering a price for electricity and a price for heat. Alternatively, we propose the NPV based on exergy (NPVex) as a second objective, for which we consider the same price for electricity as for the exergy content of the heat which is delivered to the DH system. Besides the alternative calculation of the NPV, we propose an alternative for the Levelized Cost of Energy (LCOE) indicator, which is commonly used for power plants. For CHP plants, we propose the Levelized Cost of Exergy (LCOEx), which is the price for electricity and exergy delivered to the DH system (only one price), which results in break-even at the end of the plant lifetime. Finally, a discussion will be opened on the use of the different pricing methods. The two optimization objectives NPV and NPVex and the performance indicators LCOE and LCOEx will be compared for the CHP plant with the two types of DH systems as well as with a pure electrical power plant which is fueled by the same low-temperature energy source.