Energy, economy and exergy evaluations of the solutions for supplying domestic hot water from low-temperature district heating in Denmark

District heating in Denmark is going through the transition from 3rd generation (80/40 °C) to 4th generation (50-55 °C/25 °C) systems in preparation for district heating based completely on renewable fuels by 2035. However, concern about Legionella growth and reduced comfort with low-temperature domestic hot water supply may be discouraging the implementation of low-temperature district heating. Aimed at providing possible solutions, this study modelled various proposals for district heating systems with supply temperatures of 65 °C, 50 °C and 35 °C and for two different building topologies. Evaluation models were built to investigate the energy, economy and exergy performances of the proposed domestic hot water systems in various configurations. The configurations of the devised domestic hot water substations were optimised to fit well with both low and ultra-low-temperature district heating and to reduce the return temperature to district heating. The benefits of lower return temperatures were also analysed compared with the current district heating situation. The evaluation results show that the decentralized substation system with instantaneous heat exchanger unit performed better under the 65 °C and 50 °C district heating scenarios, while the individual micro tank solution consumed less energy and cost less in the 35 °C district heating scenario.

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