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# The COOLGEOHEAT project: Geothermal 5th generation district heating and cooling (Geo5GDHC/thermonet) in Denmark

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Nearly two thirds of all Danish (DK) households utilize 3rd and 4th generation (3G and 4G) district heating (DH) for space heating and hot water. Despite being the most mature district heating system in the world, projections show that the maximum extent of traditional DH in DK is limited to 65-70%. Currently, the remaining one-third of Danish households are left with no choice but to invest in individual heat supply systems, typically air-source heat pumps. As an alternative, the concept of geothermal 5th generation district heating and cooling (Geo5GDHC) has emerged recently. Geo5GDHC connects distributed prosumer heat pumps to a grid of uninsulated pipes that distribute energy at ambient temperatures from shallow geothermal drillings (open or closed), energy geostructures and sources of excess heat, to supply room heating and domestic hot water. This allows for combined heating and passive cooling with a single grid, capable of shifting thermal loads by seasonal energy storage. Geo5GDHC grids can be recharged and balanced by utilizing waste heat and by storing heat from passive cooling of the building mass during summer.

Currently, there are twelve commercial Geo5GDHC grids (thermonet) in Denmark using different energy sources and models for ownership and operation. However, in the case of Denmark, the maximum extent of Geo5GDHC is much larger. Geo5GDHC is complementary to 4th generation district heating and cooling (4GDHC) as it is less affected by economies of scale. Consequently, Geo5GDHC is often economically feasible when traditional DHC is not, typically in rural areas, and therefore serves as an extension of existing DHC technologies. As such, Geo5GDHC potentially ensures that the majority of Danish households are connected to a collective heating and cooling grid in the future when combined with 4GDHC. A similar potential for Geo5GDHC exists in Europe and the USA, however, despite its significant potential, the Geo5GDHC market is still very much in its infancy.

The Interreg ÖKS project COOLGEOHEAT addresses both technical and economic aspects of Geo5GDHC in a joint collaboration between stakeholders and research institutions in Sweden and Denmark. We present results from the ongoing project including the development of design

models in the Modelica simulation platform, that serve to estimate the thermal performance of the grid and the associated upfront investment and costs of operation, to support decision-makers. The project further explores business models for ownership and operation and the possibilities for financing grids with green investments of pension funds.