

<https://doi.org/10.7250/CONNECT.2024.007>

DESIGN AND PERFORMANCE ASSESSMENT OF DISTRICT HEATING SYSTEMS IN THE LATVIAN REGION

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Abstract – The energy consumed by buildings for air conditioning accounts for a large percentage of global energy consumption. To promote efficiency and sustainability, the scientific community is making great effort to develop renewable technologies. A well-known but unfortunately underestimated solution is the development of centralized heating and cooling systems that consistently reduce energy consumption. The work proposes a comparison between three heating configurations covering the demand of a settlement in the Latvian region: 1) centralized district heating (DH) system; 2) 5th generation district heating & cooling (5GDHC) system and 3) individual home heating (HH) systems. Thermal and electrical loads are evaluated by transient simulations of a residential area with 80 buildings for the Riga climate and compared with the same settlement in a Mediterranean region (Milan, IT). The energy plants are based on different technologies: combined heat and power (CHP) plants, gas-fired boilers, and domestic heat pumps. The analysis includes the option of power exchange with the national grid. A transient numerical model has been developed for each solution. Every component is modelled according to performance maps provided by the manufacturers, allowing an accurate simulation in both design and off-design operating conditions. The study covers energy, economic and environmental aspects. The result of the simulation highlights the large difference between the two locations, not only in terms of annual load but also in terms of load distribution. On an annual basis, the Latvian residential complex requires almost twice as much energy as the Italian one. The thermal losses in the district systems are 4.21 % in Milan solution and 5.65 % in Riga. The district heating system coupled with heat pump represents the best layout in terms of primary energy consumption in both locations, with energy savings of 50 % compared to other solutions. The use of 5GDHC is a good compromise that could increase the use of renewable energy. The adoption of cogeneration plant is a good choice in case of centralized district system that allows the installation of high efficiency genset. On the contrary, for small application as residential, the installation of cogeneration system results expensive and the conversion efficiency does not justify the installation.

Keywords – *District heating; energy efficiency; transient simulation*