

Simulation and Evaluation of an Inter-Municipal District Heating Network

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Introduction

Decarbonizing the heat sector is a key challenge for achieving European and Austrian climate targets. Within the real-world laboratory Reallabor WEIZplus (Weiz–Gleisdorf, Styria), the project FossilFree4Industry investigates fossil-free energy solutions for industrial and residential consumers. One model solution is the development of an inter-municipal district heating network (IMDHN), interconnecting five existing but currently stand-alone district heating (DH) systems. The aim is to establish a future-proof, integrated energy infrastructure for the region – decarbonizing the heat supply, unlocking renewable energy access for industrial consumers, and providing the capacity for a potential two- to threefold expansion of the supplied heat volume.

Methodology

The methodology follows a structured, multi-step approach combining spatial analysis, scenario development, and energy system modelling.

- **Status-quo analysis** of the five existing DH systems covering most relevant key performance indicators, see Fig. 1.
- **Spatial analysis** to identify potential areas (Areas of Interest) for future network expansion and densification.
- **Scenario development:** future heat demand up to 2040 defined for two pathways – all generation units including fossil backup (AE) and renewable-only operation (EE).
- **Energy system modelling** of individual and interconnected network configurations using *energyPRO*.

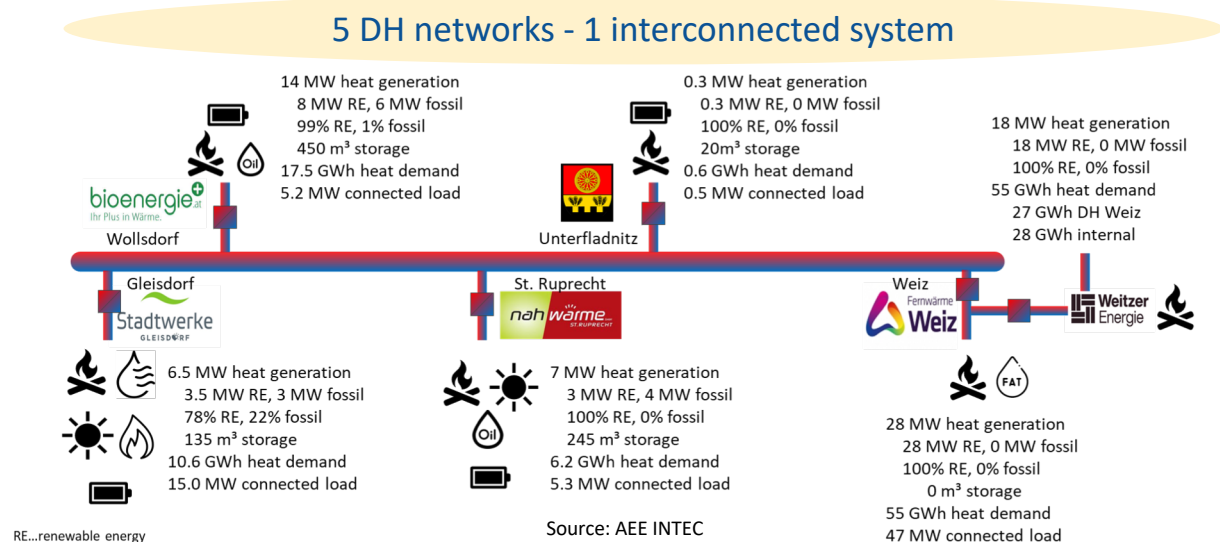


Figure 1: Overview of the district heating networks in the Weiz–Gleisdorf region and main KPI's (status 2023)

Results

Based on a current heat supply of 89 GWh/a, scenario development projects a demand of 200 GWh/a by 2040 – requiring a total heat production of 240 GWh/a. Fig. 2 shows the load curve for the AE 2040 scenario as a representative example: biomass covers the base load consistently, while fossil units are only needed during winter peak hours – confirming that interconnection allows existing renewable capacity to be used more effectively across the entire network.

Fig. 3 illustrates how interconnection reduces fossil generation and increases the renewable share compared to individual network operation. Without IMDHN, fossil generation is higher, the renewable share remains at 88%, and a supply gap occurs. With IMDHN, fossil peak loads are significantly reduced, the supply gap becomes negligible, and the renewable share increases to 94% – underlining the benefits of interconnection for decarbonizing the regional heat supply.

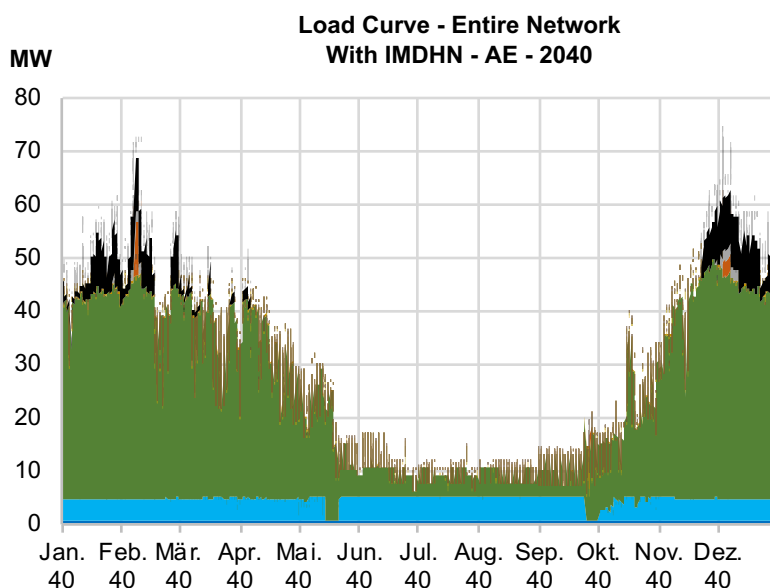


Figure 2: Load Curve – Entire Network with IMDHN – AE – 2040

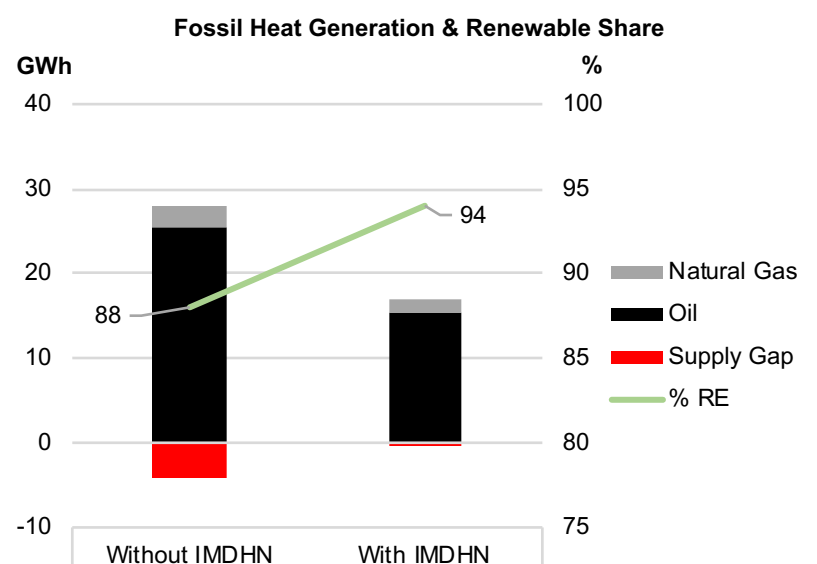


Figure 3: Fossil generation and renewable share – AE 2040 comparison

Conclusion & Outlook

The IMDHN is both technically feasible and strategically effective for decarbonizing the regional heat supply. Rather than each network seeking individual solutions, hydraulic interconnection enables the five systems to share generation capacity and balance loads across municipal boundaries – reducing the need for redundant investments at individual network level. Long-term full decarbonization will require diversification beyond biomass – utilizing low-temperature heat sources through large-scale heat pumps and expanding renewable generation through solar thermal and geothermal energy. The IMDHN provides the necessary system backbone to integrate these future energy sources at regional scale.

