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ROADMAP FOR THE DECARBONISATION OF THE HEATING SUPPLY AT AN INNER-CITY AUTOMOTIVE MANUFACTURING SITE

Summary

As part of the BMWE-funded urbanHeat project, a decarbonisation roadmap for the heat supply of the MAN Truck & Bus SE site in Nuremberg was developed. The initial situation was characterized by a largely lignite-based heat supply with high network temperatures and gas-fired redundancy. Through comprehensive data analysis, mobile measurements, and AI-based models, significant efficiency potentials were identified. A key achievement was the successful reduction of network temperatures by up to 20 K and the integration into the N-ERGIE district heating network. Overall, final energy demand for heating was reduced by 36%. Additional savings of over 30 GWh/a were identified, particularly through the use of heat pumps. A central measure is the implementation of a cooling water network enabling large-scale heat pump integration. With full implementation of the roadmap, energy demand could be reduced to approximately one-third of the baseline. The results also demonstrate high transferability to other industrial sites.

Keywords: industrial process heat, efficiency, steam substitution, waste heat, heat pumps, roadmap, decarbonisation

1. Introduction

As part of the urbanHeat research project funded by the BMWE, a roadmap for the decarbonisation of the heat supply at the MAN Truck & Bus SE site in Nuremberg was developed. At the start of the project, the heat supply for this historically developed, inner-city industrial site was largely based on a pulverised lignite boiler (70 GWh/a). Two natural gas boilers were available, primarily for redundancy purposes (10 GWh/a). Heat was distributed via a hot water network, which operated at a flow temperature of 90 °C and a return temperature of 80 to 85 °C, as well as a low-pressure steam network (0.5 bar). Even before the project began, an innovative three-pipe district heating connection was planned and commissioned to connect the site to the N-ERGIE AG district heating network despite the high return temperatures.

2. Approach

First, existing data on heat consumption at the generation, distribution and consumption levels was collated and, where necessary, supplemented by mobile measurements and AI models. A comprehensive analysis demonstrated that the network temperatures could be significantly reduced, which was successfully implemented as part of the project (see Fig. 1). A STANET simulation showed that the existing heating network requires only minor reinforcement to remain adequately dimensioned in the event of complete steam substitution.

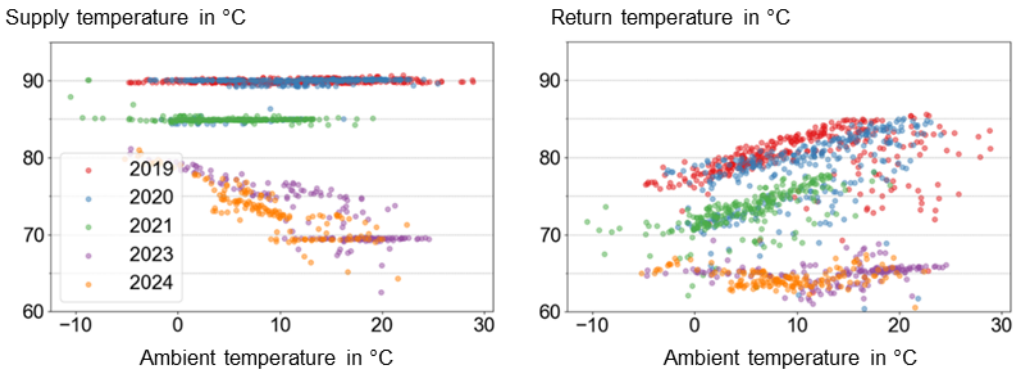

Fig. 1: Development of flow and return temperatures at the production site

3. Results

The roadmap for decarbonising the MAN site comprises a wide range of measures of varying complexity, some of which have already been implemented. Among other things, the following successes were achieved during the four-year project period:

- Reduction in final energy demand for heating applications by 29 GWh/a (-36 %)
- Connection of the MAN plant to the N-ERGIE district heating network
- Reduction in hot water network temperatures by up to 20 K
- Identification of further efficiency potential of more than 30 GWh/a, including more than 15 GWh/a of heat pump potential

In addition to reducing heat consumption through simple control measures, the establishment of a central cooling water network represents a key measure of the roadmap (Fig. 2). To date, recooling has been carried out by several decentralised evaporative cooling towers. By establishing a central cooling water network, a large-scale heat pump could be specifically integrated and, in an initial expansion phase, provide around 15 GWh/a of heat. Furthermore, water usage is significantly reduced.

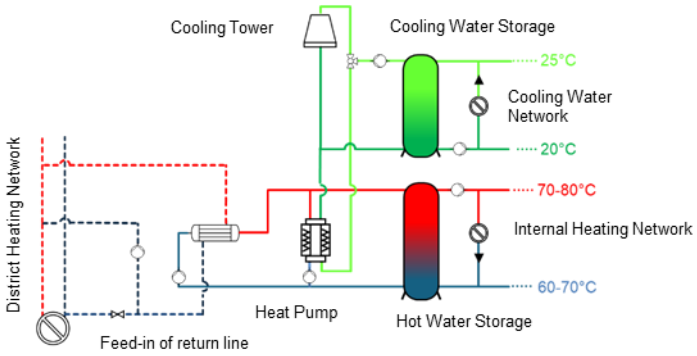

Fig. 2: Proposal for the central integration of a heat pump to simultaneously supply heat and chilled water

Overall, consistent implementation of the roadmap can reduce the MAN plant's final energy demand to just under one-third of consumption compared to the baseline scenario (Fig. 3). This paper examines the individual measures in detail. A comparison with a two-digit number of automotive production sites in the follow-up project HighSTEPS (FKZ: 03EN6040A) shows that many of the measures developed have high transferability potential for large industrial sites..

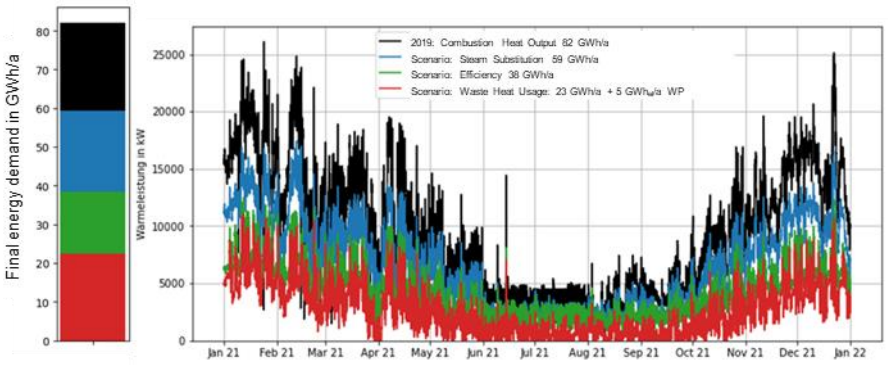

Fig. 3: Gradual reduction of final energy demand for heat supply through steam substitution, realising efficiency potential, and utilising waste heat with heat pump