EXAMINATION OF THE SUITABILITY OF INDUSTRIES FOR THE INTEGRATION OF GEOTHERMAL ENERGY AND CASCADING UTILISATION OF HEAT USING THE EXAMPLE OF GMUNDEN

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Abstract: The energy demand of industry accounts in Austria for around 30 % of final energy demand, with process heat demand being the largest share of industrial energy consumption. In order to successfully decarbonise the industry, geothermal energy with its diverse possibilities such as heating, cooling, power generation and storage must also be integrated into industrial processes. As part of the CASCADE project, industrial plants in the Gmunden region are being analysed for their suitability for the potential supply for geothermal energy. The Gmunden dairy is the main focus of the investigations. Analyses of measurement data from the various processes will provide information on necessary temperature levels, energy quantities and changes in energy requirements over time. The work also focuses on the excess heat potential of industrial and trade companies. At the Gmunden dairy, all relevant excess heat flows are analysed in order to assess the potential for further cascading use in the district heating network or in other companies. For all other companies the top-down approach via specific key numbers is applied to determine the excess heat streams.

Keywords: Industry, excess heat, geothermal energy, cascading energy use

1 INTRODUCTION

The project CASCADE is part of the NEFI – New Energy for Industry model region which places the decarbonisation of industry in the centre of a long-term innovation process to foster technological development. The CASCADE project aims to assess deep and shallow geothermal resources in three areas in Upper Austria – Steyr, Gmunden, and St. Martin im Mühlkreis - in order to investigate the feasibility of providing heat for the involved partners, i.e. industrial partners – Gmundner dairy plant as well as the district heating grids of the two municipalities Steyr and Gmunden. Key element is the elaboration of a concept for cascaded heat use: high-temperature deep geothermal resources for industry and the district heating grids, followed by use of the middle- to low-temperature residual heat for housing and commercial purposes, thus creating regional synergies and at the same time significantly boosting the economic efficiency of the system.

Industrial energy use accounts for approx. 29 % of the final energy use in Austria [1]. Process heat demand is the largest fraction of industrial energy use. In accordance with the Paris agreement, this on-site demand need to be supplied by carbon neutral energy carriers. In order to achieve a successful long-term transformation of the energy supply structure in course of the energy transition, in particular the heat sectors must be included in addition to the current strong focus on the electricity sector: In Austria, the heat supply is responsible for more than half of the final energy demand (Fig. 1-1), low-temperature heat <100 °C for space heating and water heating takes a share of approx. 64 %, the rest is accounted for medium- and high-temperature heat used in the industry and service sectors [2].

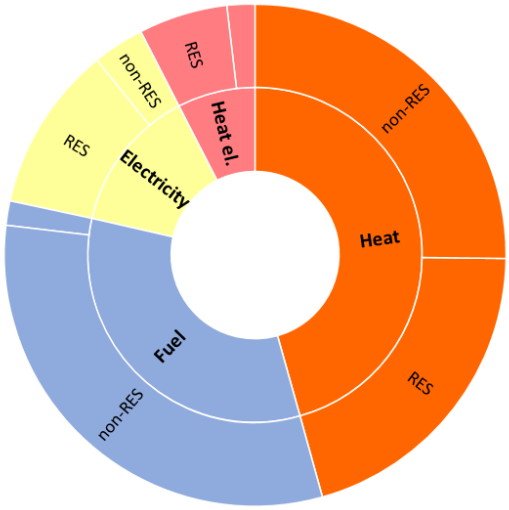

Figure 1-1: Final energy consumption in Austria 2022 and share of renewable energy divided between heat, electricity and fuels (own illustration, data from Statistics Austria [2])

In the supply of medium- and high-temperature process heat in industry and trade, excess heat is inevitably generated as a by-product either in process equipment (dryers, ovens, boilers etc.) or in the form of wastewater (washing, dyeing and cooling processes) for example. It describes the losses of a process and can be reduced by efficiency measures, but not completely avoided [3]. The reason why excess heat can often no longer be used directly in the process is that the quality or useful work potential of the excess heat (exergy) is already too low for the relevant processes in operation and can therefore no longer be used economically.

In terms of cascading energy use, however, this part of the excess heat can be used to cover heat requirements outside the plant to supply private buildings, other industrial plants or greenhouses for instance. Energy cascades also refer to a special form of connecting customers to DH networks enabling lower return temperatures and higher transport capacities. Here, suitable customers draw their heat demand from the return line of the main DH networks. [4]

Geothermal heat is available 24/7 and should be used as best as possible due to the high investment costs. However, existing studies on geothermal use in Austria were mostly limited to the geothermal heat supply of private and public buildings. Regarding the industrial use of geothermal energy, the examples might be fewer but show high potential.

2 METHODOLOGY

In addition to other objectives in the CASCADE project, the authors' first objective is to verify the suitability of the Gmunden dairy for the integration of geothermal energy for the supply of the processes (this applies also for other industries). The second objective is to determine the available excess heat potential (on all investigated temperature levels) from the plants for further cascade utilisation in the existing district heating network of the city of Gmunden as well as a possible supply to other companies, but perhaps for internal use. To analyse the energy flows in the plants, a distinction is made between bottom-up and top-down approaches. In the case of the Gmunden dairy, the bottom-up method is used to analyse all energy streams using time-resolved measurement data and thus identify energy consumption as well as possible excess heat streams. For the other companies the top-down approach is applied. In this case key figures from literature or derived from statistical data (e.g. energy consumption per employee) are used to determine the overall energy consumption of the companies. Key figures from the literature or from our own calculations of similar industrial sectors are used to determine excess heat. [5]

3 RESULTS AND DISCUSSION

The work on the energy situation of the plants has not yet been finalised. The analysis of the Gmunden dairy includes different parts of the plant. To date, the CIP system (cleaning in place), VTIS installation for continuous UHT treatment with direct steam injection, the two cheese dairies and the thickening of whey have been analysed. Other systems to be analysed are the steam generation, the air compressors, the refrigeration systems and the wastewater flows.

In addition to the dairy, further 10 industrial and trade companies with more than 20 employees were identified and analysed on the basis of the top-down approach. Energy demand and excess heat potentials are calculated using the top-down approach described above based on the available number of employees. The excess heat can also be categorised into temperature classes by comparing it with similar companies that have already been analysed.

4 REFERENCES

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