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Recovery Potential and Emissions of Excess Heat in Denmark

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Large amounts of excess heat are continuously emitted into the environment as waste, in particular from industrial processes and power plants. The recuperation of this excess heat could considerably reduce the amount of primary energy used by society and thus decrease greenhouse gas emissions associated with a fossil energy supply. Several challenges occur for the utilization of these heat sources, as they may have a low temperature or be difficult to access.

The identification and quantification of the available heat sources is a first step to allow the development of methods and technologies for their utilization. Using exergy, as a thermodynamic measure for the maximum useful work obtainable from a stream, the potential of excess heat in Denmark is shown for the industry and utility sector. Considering the thermal processes of the most energy intense industrial sectors, the exergy loss was 3,800 TJ in 2012. An additional 1,100 TJ of exergy losses occur indirectly for the supply of electricity and district heat for industrial thermal processes, as shown in Figure 1. From the utility sector, the total found exergy loss was approximately 50,000 TJ of which 35,000 TJ originated from large-scale combined heat and power plants.

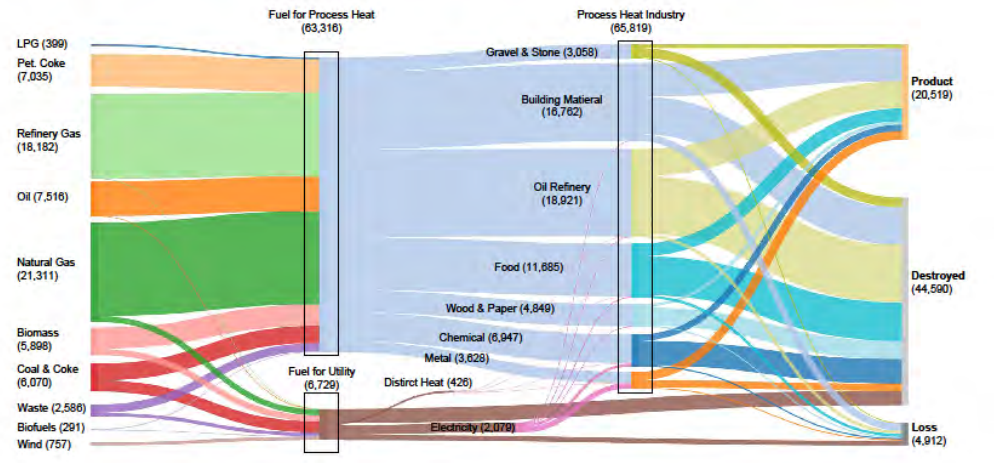

Figure 1: Exergy analysis of industrial process heating in the most energy intense industries in Denmark [TJ].

The focus of the current research is to find applicable methods for the assessment of efficiency improvements focusing on industrial energy systems and, depending on the type of the waste heat source, the recovery of losses with technologies such as organic Rankine cycles or heat pumps. In addition, the emission of greenhouse gases, dependent on fuel type and industrial process, are investigated and thus an indication of the avoidable emissions is given.