IMPROVED COGENERATION AND HEAT UTILIZATION IN DH NETWORKS

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ABSTRACT

A cogeneration plant supplying a single building or connected to a small DH network is usually heavily dependent on the heat demand. Long-term heat storing can make it possible to produce more electricity in the cogenerationplant, to use biofuels or other renewable fuels instead of fossil fuels and to connect new areas to the network. The investigation of these issues requires knowledge on the heat load profiles of the network and the electricity production of the cogeneration plant. In addition to thermal storage, the cogeneration can be improved by using CHP process configurations which have high power production effiencies at partial heat loads.

OBJECTIVES/GOALS

The objective of this project is to evaluate and develop approaches that will inprove the economic feasiblity and the thermal efficiency of cogeneration through better utilization of the produced heat and higher power generation in the CHP plant. The results can be applied both in cogeneration plants producing electricity, heat and cooling for a single building and in a district heating network system situated in or near areas with low heat densities. The economic feasibility of cogeneration in small DH networks is currently low and should be increased for future expansion of district heating.

In this project, a general load model will be constructed for esimating demand profiles for simultaneous DH and power loads. The model will be needed for both considering the suitability of CHP and long-term thermal storages (storage period longer than a few days) for the total system and for finding the best conditions for thermal storage use in the system. Long-term thermal storages and their usability for supplying heat or cooling in low heat density areas e.g. to new housing or industrial areas situated at longer distances from the existing main network will be investigated. Also possibilities for the combined use of cogeneration plants and long-term storages either connected to a single building or a small DH network will be considered. The power production of the cogeneration plants will be improved by searching the most efficient way to utilise the thermal storages with one or several CHP plants and by selecting those modules to the CHP process which have the economically feasible electrical efficiencies also during part load operation.

The goal of the project is to provide new possibilities to increase economical feasibility and thermal efficiency of cogeneration plants with efficient utilization of the produced heat with long-term thermal storage. This enables more efficient electricity production even in lower heat loads and gives possibilities to expand the district heating production to low heat density areas. Also the possibilities to increase the power porduction in the cogeneration pocesses are investigated. A model for heat and power loads is developed as well as an optimisation method for the most efficient thermal storage integration to the cogeneration plant and to the network.

TARGET AUDIENCE AND BENEFITS

The results are useful for district heating companies looking for possibilities to expand their networks to new and possibly remote residential or industrial areas. Also the manufacturers of smaller cogeneration units benefit from the improved heat utilization possibilities. Manufacturers of steam cycle CHP plants can utilize the results for improved electrical efficiency of the process and for optimal integration of plants with a thermal storage.

The results are assumed to benefit all participating countries, e.g. Sweden, which have a low share of CHP and rural areajs with small DH networks. Countries like Finland with small heating plants, that would need a profitable way to include electricity production in these processes would benefit from the project, as well as countries like Denmark that are actively developing small-scale CHP and DH systems to serve small communities. The more credible heat and elec-

tricity demand profiles benefit many countries, e.g. Norway, when the profitability of cogeneration use in a new site is evaluated. Countries, like UK or Canada, which have relatively low shares of DH connected with CHP can use the results when they are looking for new ways to increase the efficiency and the market share of cogeneration. Countries like Netherlands, which are aiming to maximize the environmental benefits of their small-scale CHP plants connected to DH networks, will benefit from the results.

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[1] http://www.iea-dhc.org/