International Energy Agency
Technology Collaboration Programme on
District Heating and Cooling including Combined Heat and Power

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Annex TS1 | Low Temperature District Heating for Future Energy Systems

Excerpt

FINAL REPORT

FUTURE LOW TEMPERATURE DISTRICT HEATING DESIGN GUIDEBOOK

Edited by Dietrich Schmidt and Anna Kallert

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FUTURE LOW TEMPERATURE DISTRICT HEATING DESIGN GUIDEBOOK

Final Report of IEA DHC Annex TS1
Low Temperature District Heating for Future Energy Systems

Edited by Dietrich Schmidt and Anna Kallert

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iea Energy Technology Network

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Further information about the IEA DHC programme may be obtained from

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EXECUTIVE SUMMARY

The building sector is responsible for more than one third of the end energy consumption of societies in industrialized countries and produces the largest amount of greenhouse gas emissions (GHG) of all sectors. District heating can contribute significantly to a more efficient use of energy resources as well as better integration of renewable energy into the heating sector (e.g. geothermal heat, solar heat, heat from biomass combustion or waste incineration), and surplus heat (e.g. industrial waste heat). The more efficient use of all energy resources and the use of renewable energy are measures which lead to a reduced utilization of fossil energy, and thereby a reduction of GHG emissions to fulfill the set climate goals. Low temperature district heating is a heat supply technology for efficient, environmental friendly and cost effective community supply. In comparison to conventional district heating, the network supply temperature is reduced down to approximately 50 °C or even less. Within this context, low temperature district heating offers prospects for both the demand side (community building structure) and the generation side (properties of the networks as well as energy sources). Especially in connection with buildings that require only low supply temperatures for space heating, low temperature district heating offers new possibilities for greater energy efficiency and utilization of renewable energy sources, which lead to reduced consumption of fossil fuel based energy.

The IEA DHC Annex TS1 is a three year international research project which aims to identify holistic and innovative approaches to communal low temperature heat supply by using district heating. It is a framework that promotes the discussion of future but also existing heating networks with an international group of experts. The goal is to obtain a common development direction for the wide application of low temperature district heating systems in the near future.

As part of the project promising technologies for low temperature district heating application have been collected and identified to meet the goals of future renewable based community energy systems. Background materials and cutting edge knowledge on district heating pipe systems, network designs, hygienic domestic hot water preparation in low temperature supply schemes, space heating controls and the integration of small scale decentralized heat sources is provided in the report for designers as well as decision makers in the building and district energy sector.

The analysis of the future heat demand showed that the district heating would still be needed for most of the buildings in 2050, inducing that the low temperature district heating is a promising heat supply for the future and for many buildings. Considering that there is enough available heat from renewables and waste heat sources at the low temperature level, the low temperature district heating will be of high relevance in the future. For future development of the district heating and a high reliability of the low temperature district heating, statistical data and knowledge on the heat losses and how operation or temperature levels may contribute to the distribution losses are highly necessary.

For the identification of integral and innovative approaches to low temperature heat supply at municipal level, an overview of a number of existing evaluation methods is provided. The planning tools are assessed in seven categories: analytical approach, target group of users, level of detail, model type, demand categories, final energy consumption and used variables within the assessment. The evaluation of the collected tools has shown some promising approaches for low temperature district heating. However, none has been found to be fully appropriate for the objective of a simplified, holistic tool for the evaluation of low temperature district heating. By evaluating the selected planning tools for district heating schemes, requirements have been derived for the development of a simplified planning tool.

The so-called Easy District Analysis tool has been developed, based on the identified requirements for a simplified district heating planning tool. The intended target groups of the tool are urban planners and planners in utility companies. The tool is intended to be used in the pre-planning phase of a district energy system. The focus of the tool is on the evaluation of the impact of different grid temperatures and of different operation modes of district heating schemes. The assessment is based on the parameters primary energy consumption, carbon emissions and heat production costs.

In the description of different case studies innovative demonstration concepts as examples of success stories for communities interested in developing low temperature district heating systems are displayed. Demonstrated cases include the use of advanced technologies and the interaction between different components within the systems. Based on these experiences, principles and lessons learned in designing these systems are given. Measurement data from community projects are also used in validation of the models and tools developed. There were a total of eight case studies from Germany, Denmark, Finland, Norway and Great Britain. The district heating systems were of very different sizes, from smaller building groups to city wide systems. Taking into account the size of the supply area, the network lengths vary from 165 m to 140,000 m. The connected buildings were residential buildings of different sizes, and mostly low energy or passive houses. Sources of heat were solar collectors, heat pumps, combined-heat-and-power-plants, excess heat from industry or the systems were connected to a larger network close by with heat exchangers. The temperature levels recorded were typical for low-temperature systems, varying from 40 to 60 °C in supply and 25 to 40 °C in return. Savings and increased efficiencies were observed in every case studied.

The material collected and summarized in the presented guidebook show that low temperature district heating is a key enabling technology to increase the integration of renewable and waste energy for heating and cooling. More research and development work is needed to assess the practical and wider implementation of low temperature district heating schemes for various cases and locations. Especially ways to overcome the hindering reasons need to be identified. This supports more discussions to get low temperature heating systems built and in operation.

Low temperature district heating is one of the most cost efficient technology solutions to achieve 100 % renewable and GHG emission-free energy systems on a community level.

THE LOW TEMPERATURE DISTRICT HEATING RESEARCH PROGRAM

The IEA DHC Annex TS1 aims to identify holistic and innovative approaches to communal low temperature heat supply by using district heating. It is a framework that promotes the discussion of future but also existing heating networks with an international group of experts.

The goal is to obtain a common development direction for the wide application of low temperature district heating systems in the near future. District cooling can also be integrated into the activities but is not the focus. The gathered research which is going to be collected within this Annex should contribute to establishing DH as a significant factor for the development of 100 % renewable energy based communal energy systems in practice.

By connecting the demand side (community/building stock) and the generation side (different energy sources which are suitable to be fed in the DH grids), this technology provides benefits and challenges at various levels.

The activities are strongly targeted at DH technologies and the economic boundary conditions of this field of technology.

MORE INFORMATION ABOUT THE PROGRAM:

Up to date information about the participants and the progress of the research program is available on the web page:

www.iea-dhc.org

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