

Final report

1.1 Project details

Project title	IEA-DHC Annex TS1: "Low Temperature District Heating for Future Energy System"
Project identification (program abbrev. and file)	64012-0217
Name of the programme which has funded the project	EUDP
Project managing company/institution (name and address)	Technical University of Denmark Anker Engelunds Vej 1. Building 101A 2800 Kgs. Lyngby
Project partners	Danfoss
CVR (central business register)	30060946
Date for submission	2017-04-04

1.2 Short description of project objective and results

Engelsk version

The main objective of the IEA DHC Annex TS1 is to demonstrate and validate the potential of low temperature district heating as one of the most cost efficient technology solutions to achieve 100% renewable and GHG emission-free energy systems on a community level. DTU is the subtask leader of subtask on Technologies.

One of the aims of the project is to formulate a guideline for innovative technologies and advanced concepts and solutions for district heating at low temperature levels including both generation, distribution, and utilization. In the project a number different concepts for low temperature district heating to new and existing buildings were investigated. Solutions for energy efficient district heating network, as well as secure domestic hot water supply were analyzed, together with the illustration of renewable heat generation technologies.

Dansk version

Hovedformålet med IEA DHC Annex TS1 er at demonstrere og underbygge potentialet for lavtemperaturfjernvarme som en af de mest effektive teknologier til opnåelse af et energisystem baseret 100% på vedvarende energi og drivhusgasfri energi. DTU er leder af en delopgave vedrørende teknologier.

Et af formålene med projektet er at formulere en vejledning til innovative teknologier og avancerede koncepter og løsninger til lavtemperaturfjernvarme omfattende både produktion, distribution og anvendelse. Der er blevet undersøgt et antal forskellige koncepter for lavtemperaturfjernvarme til både nye og eksisterende bygninger i projektet. Løsninger til energieffektive fjernvarmenet og sikre løsninger til varmt brugsvandsforsyning er blevet analyseret og teknologier til produktion af varme baseret på vedvarende energi er blevet beskrevet.

1.3 Executive summary

Today, the 4th generation DH (4GDH) is emerging as a new system to replace the existing 3rd generation DH system. 4GDH is also named as low-temperature DH (LTDH). It has benefits in both heat distribution and heat generation. In the heat distribution, it reduces the network heat loss, increases the heat transport capacity by increase of supply temperature with respect to a lower return temperature, and reduces thermal stress and risk of scalding. In the heat generation, improves quality match between heat supply and heat demand, lower network supply and return temperature helps improve CHP plant power to heat ratio and recover waste heat through flue gas condensation, achieves higher COP values for heat pumps, and enlarges the potential of utilizing low-temperature waste heat and renewable energy. LTDH has been developed as the next generation DH and is ready to replace the current medium temperature DH system.

LTDH based on biomass and other renewable energy can substantially reduce total greenhouse gas emissions and secure a stable energy supply for future development of society. It has the ability to supply low-temperature DH for space heating and domestic hot water (DHW) for various types of buildings, to distribute heat with low heat losses and ability to recycle heat from low-temperature waste heat and renewable energy sources. From various research and development of LTDH projects, it has been shown that it is both technically feasible and economically sound to change current high/medium temperature district heating system to LTDH for both new and existing building areas.

In the IEA DHC Annex TS1 project, the Subtask B has collected and identified promising technologies and ideas for LTDH application to meet the goals of future renewable based community energy systems. Innovative technologies and advanced system concepts in LTDH are reported for heat generation, distribution and end user utilization.

1.4 Project objectives

The project follows the time schedule. For more information on the implementation of project and the milestones see 1.5.

1.5 Project results and dissemination of results

The collection of project activities, results and dissemination are listed below:

In the period of 2013

During this period, a guideline structure was formulated with the aim for a comprehensive review of state-of-the-art technologies, concepts and system solutions for low-temperature supply. Studies to supply low temperature district heating to existing buildings and safety of domestic hot water supply prepared via LTDH were carried out.

In the period of 2014

Activities:

- The working report structure was formulated with emphasis on the state-of-the-art renewable and waste energy utilization, secure supply of domestic hot water and energy efficient district heating network.
- Solutions to use a micro electrical tank to replace thermal bypass to improve the network efficiency was theoretically analyzed. The energy efficient district heating network, concept of mass flow control and ring network design was reported.

Disseminations:

- Annex TS1 working phase meeting was held during May 13-14th, 2014 at BRE, UK, to exchange information and update the status of the project.

- An IEA Annex TS1 special session was held on the 14th DHC Symposium on Sep 7-9th, 2014, Stockholm, Sweden. DTU group contributed with four papers for the special session of 'Low-temperature district heating for future energy system.

In the period of 2015

Activities:

- A guideline report regarding low-temperature district heating technologies for future energy system was written and distributed to the working group.
- Concepts for energy efficient district heating network to avoid summer bypass heat losses were developed.
- Contributions to the Subtask A group the report on description and evaluation of planning tools for district heating
- Contributions to the Subtask C group the report on DHC interfaces
- Contributions to the Subtask D group report on low-temperature district heating case studies and demonstrations.

Disseminations:

- On 20-22.05.2015, the 5th working phase meeting was held at NTNU, Trondheim, Norway. This meeting was made jointly with the International Legionella Workshop.
- On 23-25.09.2015, the 6th working phase meeting was held at Danfoss, Denmark.

In the period of 2016

Activities:

- Final report for Subtask B of IEA Technologies was made.
- Contributions to the final guideline report for IEA Annex TS1 was made.

Disseminations:

- Annex TS1 7th working phase meeting was held during Apr 21st – 22nd , 2016 at Frankfurt, Germany to exchange information and update the status of the project.
- Organized a technical session on 'Low temperature district heating for future energy systems' at the 22nd International Trade Fair and Congress for Heating, Cooling and CHP, Apr 21st, 2016 at Frankfurt , Germany.
- A special session of IEA Annex TS1 was organized during the Clima2016 conference at Aalborg, 5 papers were presented during the special session.
- A special session of IEA Annex TS1 was organized during the 15th International Symposium on District Heating and Cooling which was held on Sep 4-7th, 2016 at Seoul Korea. Final IEA report was presented.

1.6 Utilization of project results

In IEA DHC Annex TS1 a comprehensive work on describing and evaluating new technologies as well as planning tools and interface problems for LTDH has been made and documented. The results represents a very useful step in the general development of the LTDH. The results have been used in the IEA Annex XI: Transformation Roadmap from High to Low Temperature District Heating Systems.

Danfoss will actively use the report to promote the concept of LTDH as well as use it as a proof that LTDH can be applied in an economically sound way. Being a contributing partner in the project also underlines that Danfoss is and has the ambitious to lead the district heating industry to a more energy efficient future.

The main value of the project result from Danfoss point of view is to show that the concept of district heating is continuously evolving to become a more efficient and an important player in the future smart energy system. Having an international body like IEA behind the publications adds additional credibility and potentially wider penetration of the concept.

1.7 Project conclusion and perspective

The conclusion of the project is that Low Temperature District Heating can be developed by use of new technologies and planning tools. By use of new solutions for improved control of space heating and domestic hot water heating in existing and new buildings lower return

temperatures as a first step and lower supply temperatures as the second step may be made possible. By improving the control of the operation of district heating networks they may be able deliver a low return temperature back to the heat production plant and deliver sufficient heat to the users with a lower inlet temperature from the production plant. In this way, heat production based on use of low temperature waste heat and renewable heat may be used.

The perspective is that the LTDH may be realized if the technical solutions are combined with non-technical solutions to implement new improved control in buildings and in district heating networks. The realization of LTDH will make it possible to replace fossil fuels with waste heat and renewable energy for heat supply to buildings in an optimal way.

The hardware technology and the software knowledge of the future Low Temperature District Heating Systems may pave the way for a large commercial growth for companies in the area of district heating.

Annex

See drafts of final reports from IEA DHC Annex TS1 on: <http://www.iea-dhc.org/home.html>