SHC Task 68 – Efficient solar district heating systems

Viktor Unterberger, Task Manager
History of tasks in the context of solar district heating (SDH) systems

2011 2014

Task 45
„Large Systems: Large Solar Heating/Cooling Systems, Seasonal Storage, Heat Pumps”

Objective
• Assist strong and sustainable market development of large SDH systems.

Highlights (selection)
• Large-scale installations in Denmark
• Collector Loop ➔ improved international standard, performance guarantees
• Seasonal storages ➔ guidelines for materials & construction, best practice examples
• ESCo Models ➔ energy performance contracts
History of tasks in the context of solar district heating (SDH) systems

Objective
• Assist the integration of large scale SHC systems into DHC Networks

Highlights (selection)
• Large-scale installations aside Denmark in Europe (e.g. Germany, Austria, …) and China
• Key components ➔ in-situ collector tests
• Control systems ➔ modular energy management system
• Dissemination ➔ Webinars, workshop, information brochure
Highlights

Information material

solar heat for cities
the sustainable solution for district heating

New plants

First fully subsidised
SDH system in Tibet
Sun meets 90 % of space heating demand

Joint scientific outputs

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journal homepage: www.elsevier.com/locate/apenergy

Large-scale solar thermal systems in leading countries: A review and comparative study of Denmark, China, Germany and Austria
Daniel Tschoppb, Zhiyong Tianb, Magdalena Berberichc, Jianhua Fand, Bengt Perersd, Simon Furboa

History of tasks in the context of solar district heating (SDH) systems

Task 45

Task 55
„Towards the integration of large SHC Systems into DHC Networks“

Task 68
„Efficient solar district heating systems“
Need for **energy independence** in the EU drastically increased ...
Climate crisis is no remote threat anymore ...

Germany, Belgium 200 dead flooding following extreme rains
Global final energy consumption ...

#heatishalf

- **50%**: Industrial processes
- **29%**: buildings space & water heating
- **21%**: Heat

Heat contributes 40% of global CO₂ emissions
Current district heating systems

Feed temperature
80-100 °C

Caloric power plants, often driven by coal, oil, gas …

Renewables <10%
[https://www.iea.org/reports/district-heating]
Examplarily district heating system for Vienna

• ~2 mio. inhabitants
• Installed heat capacity: ~3100 MW
• Temperatures
  • Primary network 90 –150 °C
  • Secondary network 65 –95 °C

Heat production in 2019

- CHP: 55%
- Waste incineration: 19%
- Industrial waste heat: 23%
- Others: 3%
Large-scale Solar District Heating (SDH) – Concept

Collector Field 450,000m²

Large-scale flat plate collector field + storage and other technologies

245 GWh

30 - 95 °C

Seasonal Storage 1,800,000m³

75 - 95 °C

20 - 60 °C

217 GWh

85 °C

Gas Boiler

Heatpumps

450 GWh
Solar District Heating in Europe

Market figures EU:

~ 300 plants (> 350 kW\(_{th}\))
Capacity: 1,100 MW\(_{th}\)
Newly installed: +30 %/a
Production: 660 GWh/a
(Source: Solites, 2019)
Large-scale **Solar District Heating (SDH)** – Concept

Large-scale flat plate collector field + storage and other technologies

Feed temperature 80-100 °C

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Seasonal Storage 1,800,000 m³

Gas Boiler

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245 GWh

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75 - 95 °C

20 - 60 °C

85 °C

450 GWh
Large-scale Solar District Heating (SDH) – Concept

Efficiency of flat plate solar collectors is significantly lower when operated at 85°C–95 °C [Tian et al., 2018]

Feed temperature 80-100 °C

Provide necessary feed temperature directly by solar
Feed temperature indirectly by solar combination of technologies

Extend focus
How to eff. provide desired feed temperature by solar + others
→ Looking for the best (efficient) combinations
1st Main Objective

How to provide the heat most efficiently at the desired temperature level (focusing on the system aspect), considering also medium-high temperatures.
Many data, how to **gather**? How to **benefit** from it?
To take a next step regarding digitalization measures for SDH, allowing a more efficient data preparation and efficient data utilization → increase the benefit from data
3rd Main Objective

Make solar district heating installations more competitive and business appealing → find ways to make SDH systems more cost-efficient and explore new business models
Gather results and operating experience to raise awareness for solar technologies and efficiently disseminate this knowledge.
Task Structure

Subtask A: Concepts
- Requirements | Planning | Configuration | Modelling

Subtask B: Data preparation & utilization
- Gathering/Storing data | Auto. Monitoring/Evaluation | Control

Subtask C: Business models
- Financing & Investment schemes | Risks & Barriers | Cost red.

Subtask D: Use Cases and Dissemination
- Demos | Awareness | Market overview | Best practice

Technologies / Components

Systems
- Medium to high temperature SDH – directly by solar
- Medium to high temperature SDH – indirectly by solar
  (e.g. solar + heatpump / biomass / waste heat …)
IEA SHC Task 68 – Overview

• April 2022 – March 2025

• 10 Participating countries
  • Austria / China / Denmark / Germany / Italy(?)
  • Netherlands / Spain / Sweden / Switzerland / Turkey(?) / UK

• Get in touch and join us …. 

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SHC Task 68 – Efficient solar district heating systems

Viktor Unterberger, Task Manager

National Research Day
Rapperswil, Switzerland, 01.06.2022
Subtask A
– Concepts

Subtask leader (not yet fixed!)
Magdalena Berberich, Solites, (Germany)

Planned activities of Subtask A:

A1: Comparison of different collector technologies for providing medium-high temperature heat with respect to technical and economic characteristics.

A2: Collection of requirements and concepts necessary to efficiently plan, design and scaling-up SDH systems, especially considering also medium-high temperature heat.

A3: Analysis of existing simulation tools for the simulation of efficient SDH systems, especially considering medium-high temperature heat.

A4: Define performance and efficiency measures for SDH systems on component and system level

16 interested institutions
Subtask B
– Data preparation & utilization

Subtask leader
Sabine Putz, SOLID, (Austria)

Planned activities

B1: Describe and propose efficient solutions to gather, store and distribute data from heterogenous devices on a single- but also multi-plant level.

B2: Develop guidelines for the validation of data from SDH systems.

B3: Collect, describe, develop and apply techniques for analysis, monitoring and fault detection of data.

B4: Comparison of state-of-the-art available control strategies on sub- (=component level) and superordinate level (=system level).

B5: Develop and define requirements and concepts for open data approaches

11 interested institutions
Subtask C
– Business models

Subtask leader
Luuk Beurskens, TNO, (Netherlands)

Planned activities

C1: Collect and provide an overview of financing and investment schemes worldwide for SDH systems.

C2: Evaluate, discuss and propose possible new business models for efficient SDH systems, with a special focus on medium-high temperature or/and digitalization aspects.

C3: Define a standard, certain criteria or a seal of approval for planners/designers of SDH systems

C4: Collect, list and compare measures and possibilities to reduce the costs of SDH systems.

6 interested institutions
Subtask D
– Use Cases and Dissemination

Subtask leader
Joakim Byström Absolicon, (Sweden)

Planned activities

D1: Collect and provide an overview of efficient SDH installations as well as their description and structure, especially providing medium-high temperatures.

D2: Provide valuable future scenarios as well as qualitative and quantitative targets for the solar sector and policy makers regarding SDH systems.

D3: Prepare and manage industry workshops.

D4: Prepare appealing documents for industry and public in order to increase the knowledge regarding efficient SDH systems, the benefits from data and ways to cut costs.

11 interested institutions

Icons partly taken from "https://www.flaticon.com/" title="Flaticon"