SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

SHC Task 68 – Efficient solar district heating systems

Viktor Unterberger, Task Manager

National Research Day
Rapperswil, Switzerland, 01.06.2022

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

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

2011 2014 2016 2020

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

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

Objective

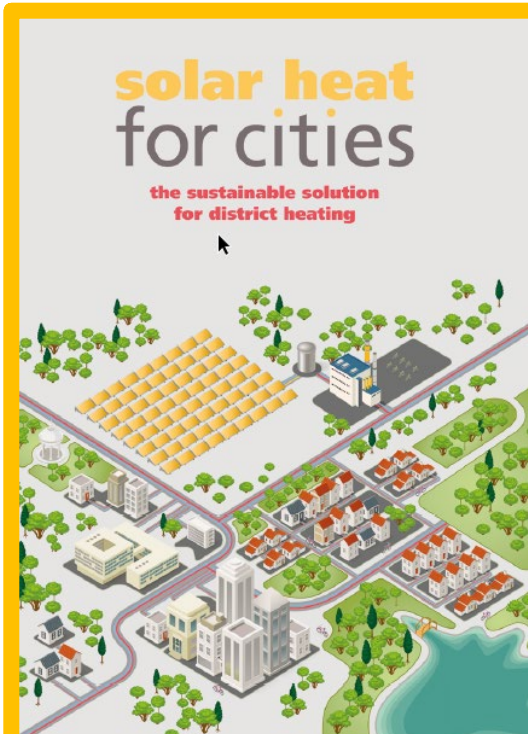
- Assist the integration of large scale SHC systems into DHC Networks

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



LINK: files.iea-shc.org/public/mrj/d-d2-investor-brochure.pdf

Joint scientific outputs

Applied Energy 270 (2020) 114997

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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 Tschopp[a], Zhiyong Tian[b,*], Magdalena Berberich[c], Jianhua Fan[d], Bengt Perers[d], Simon Furbo[d]

New plants

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

PHOTO: ARCON-SUNMARK

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"

2016 – 2020
Task 55
„Towards the integration of large SHC Systems into DHC Networks"

2022 – **2025**
Task 68
„Efficient solar district heating systems"

SHC
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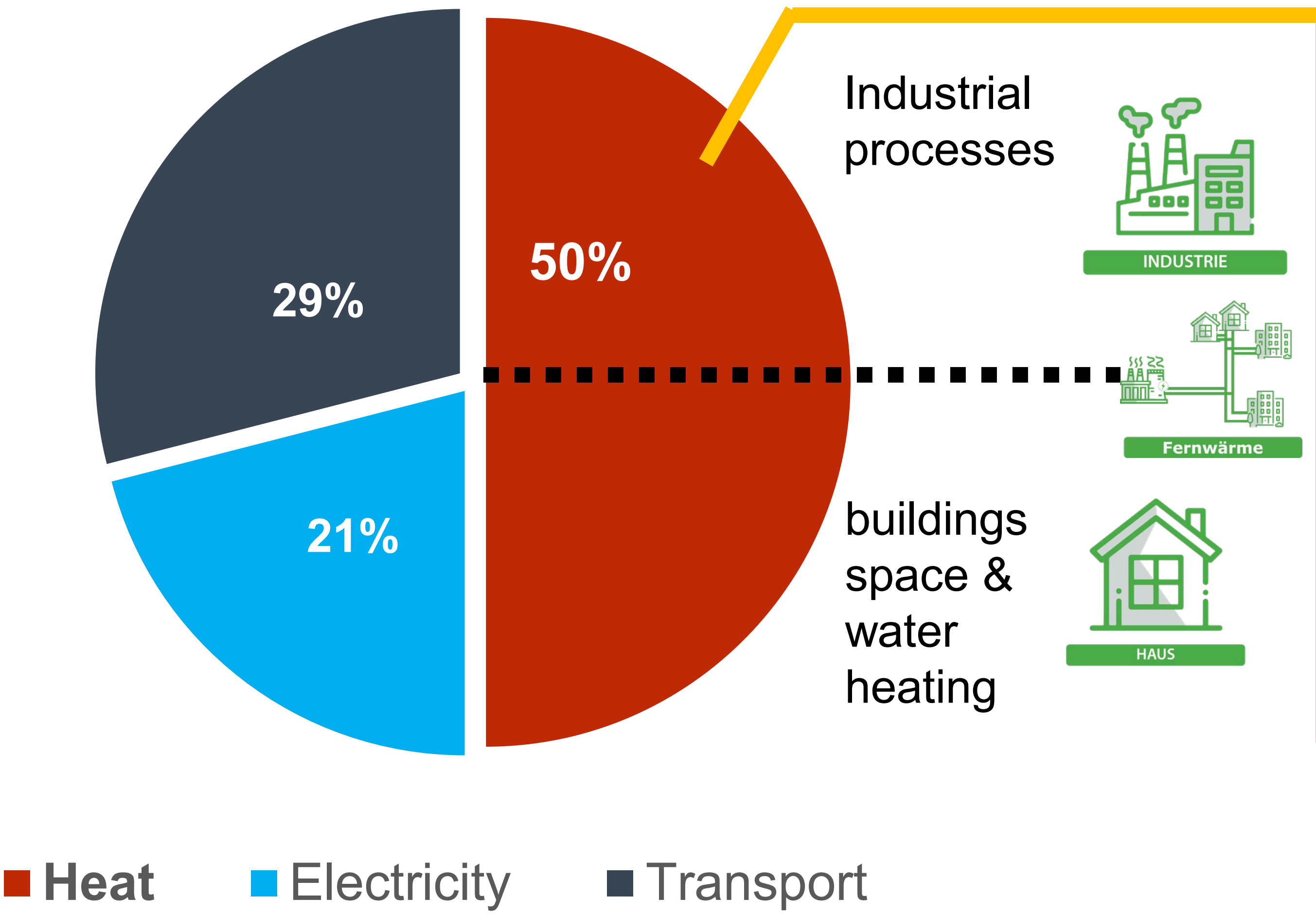
Need for energy independence in the EU drastically increased …

Nord Stream 2 gas pipline, Germany

Climate crisis is no remote thread anymore ...

Global final energy consumption …

#heatishalf

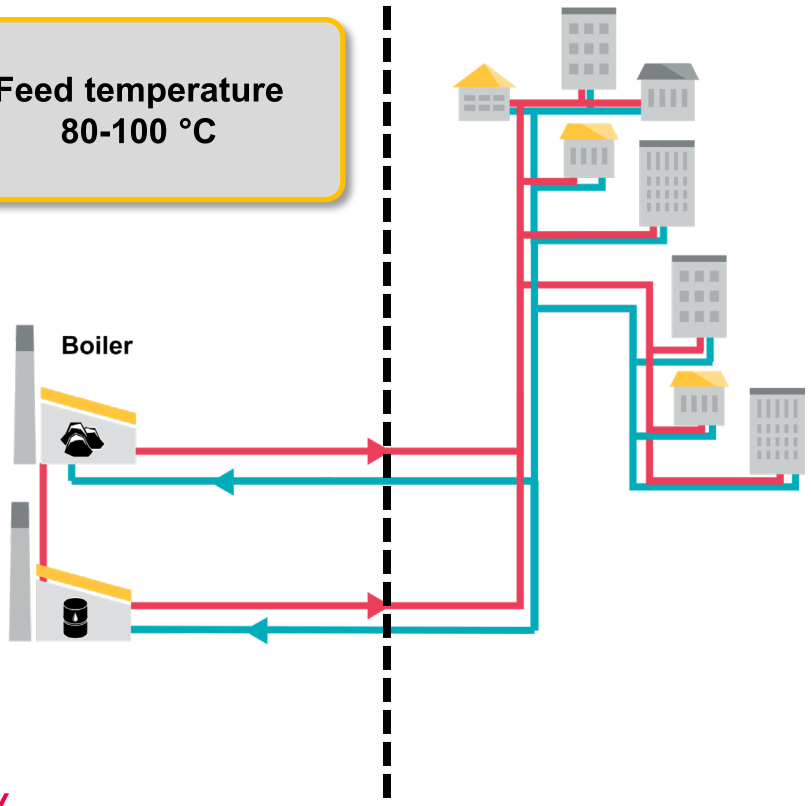


Heat contributes <u>40% of global CO_2 emissions</u>

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]

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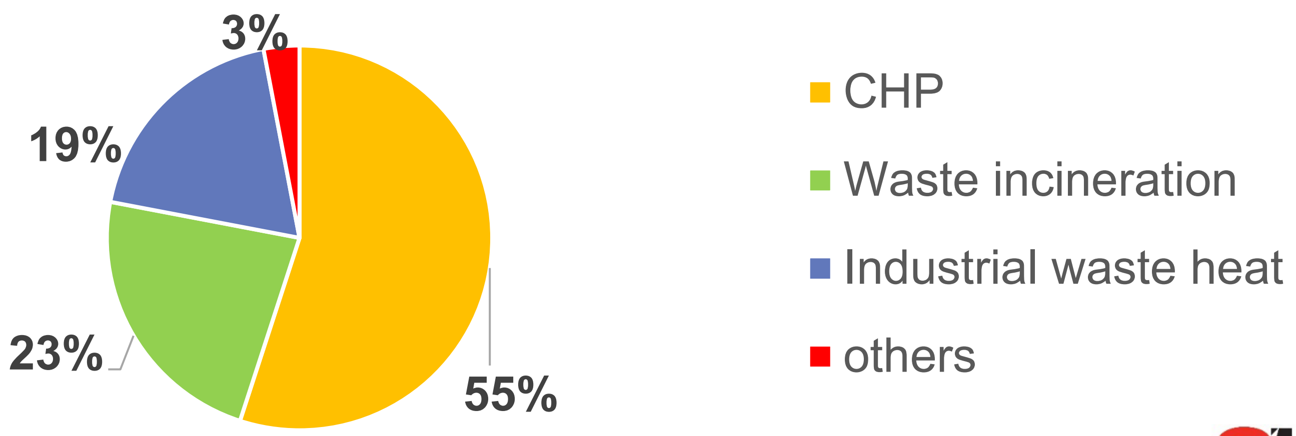
Examplarily district heating system for Vienna

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

Heat production in 2019

WIEN ENERGIE



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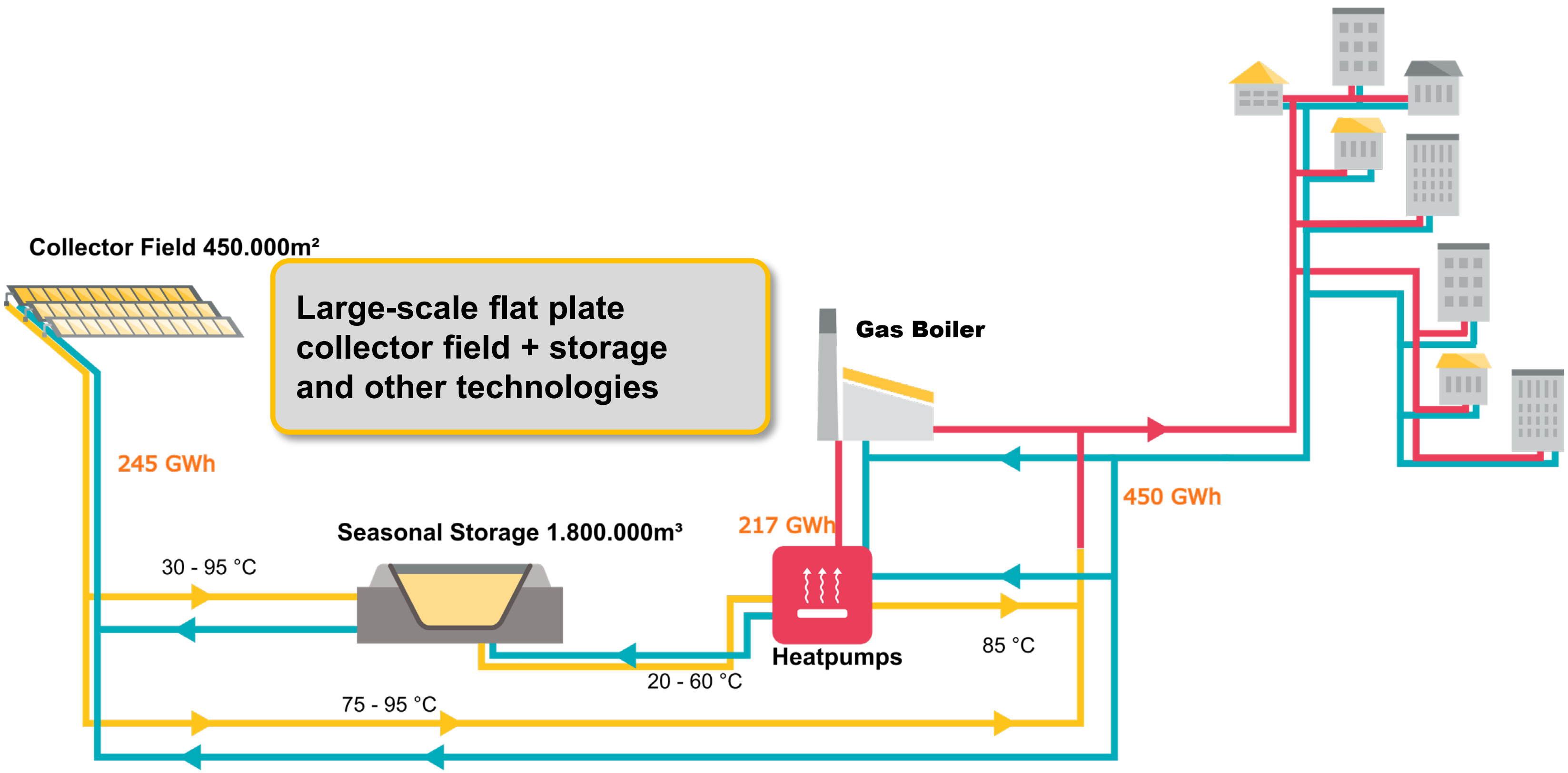
Large-scale Solar District Heating (SDH) – Concept

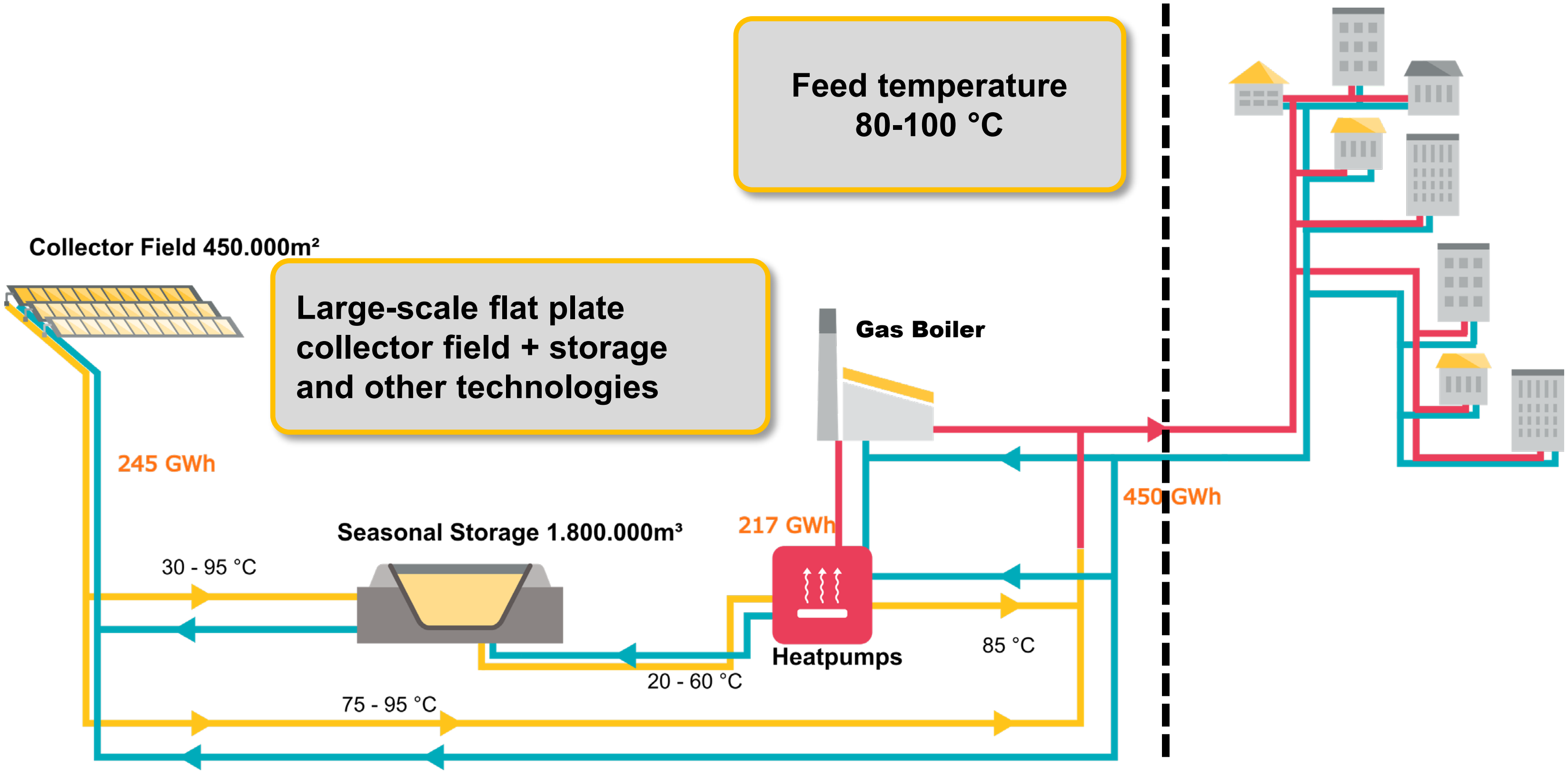


Solar District Heating in Europe

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

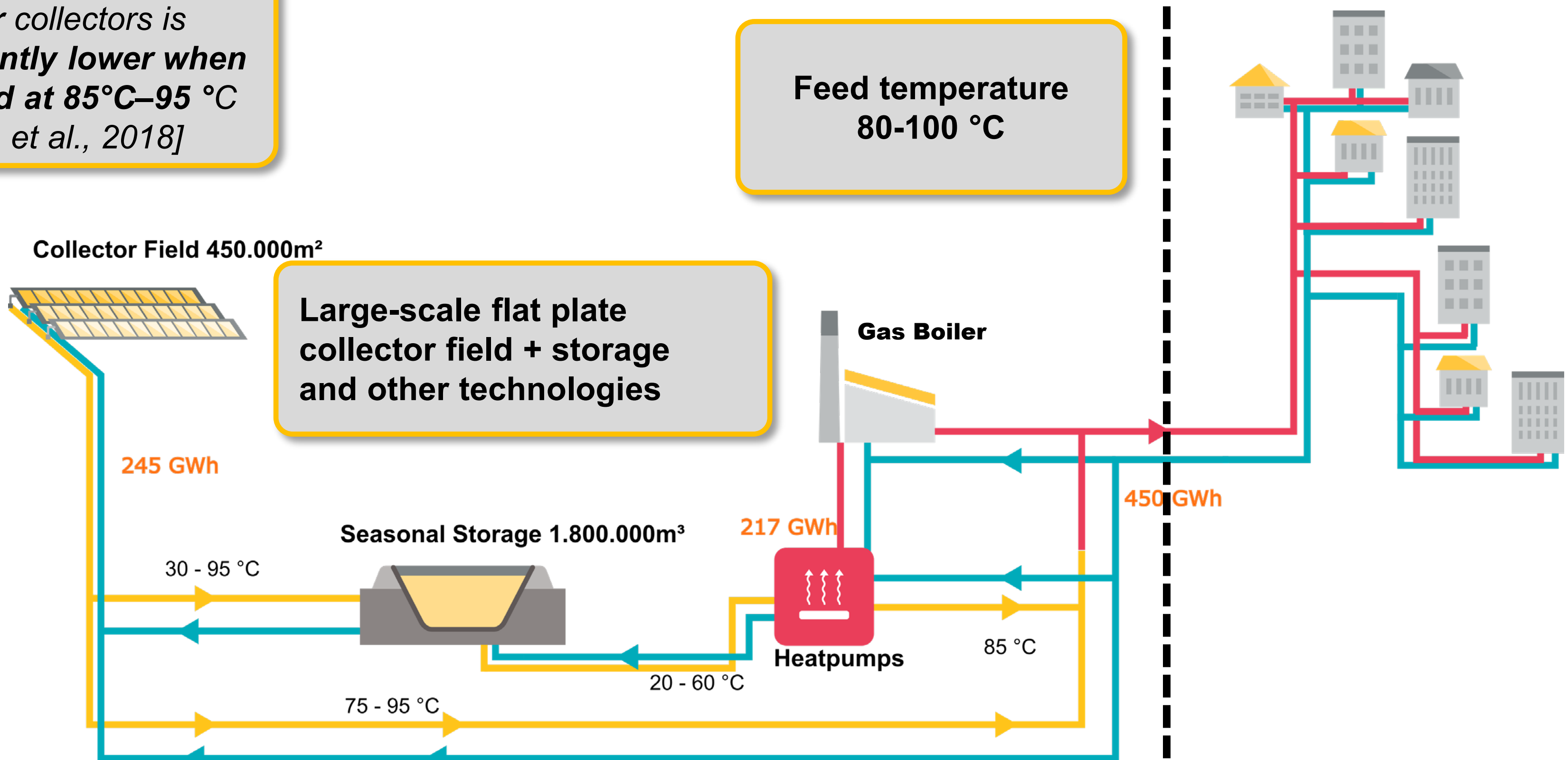


Large-scale Solar District Heating (SDH) – Concept

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

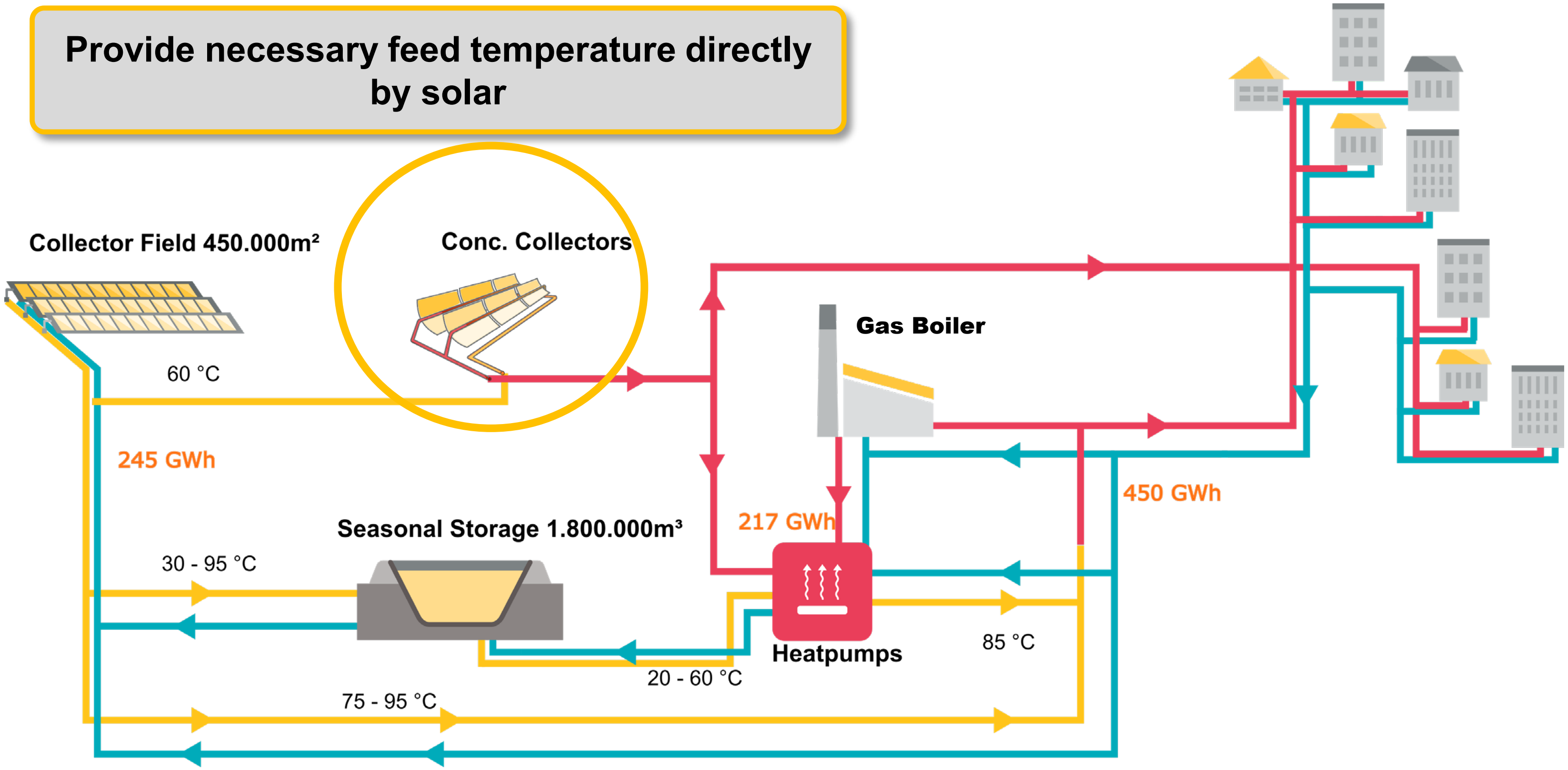
Feed temperature 80-100 °C

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



[Tian et al., 2018]: Z. Tian, B. Perers, S. Furbo and J. Fan, “Analysis and validation of a quasi-dynamic model for a solar collector field with flat plate collectors and parabolic trough collectors in series for district heating,” Energy, vol. 142, pp. 130-138, 2018.

Feed temperature directly by solar

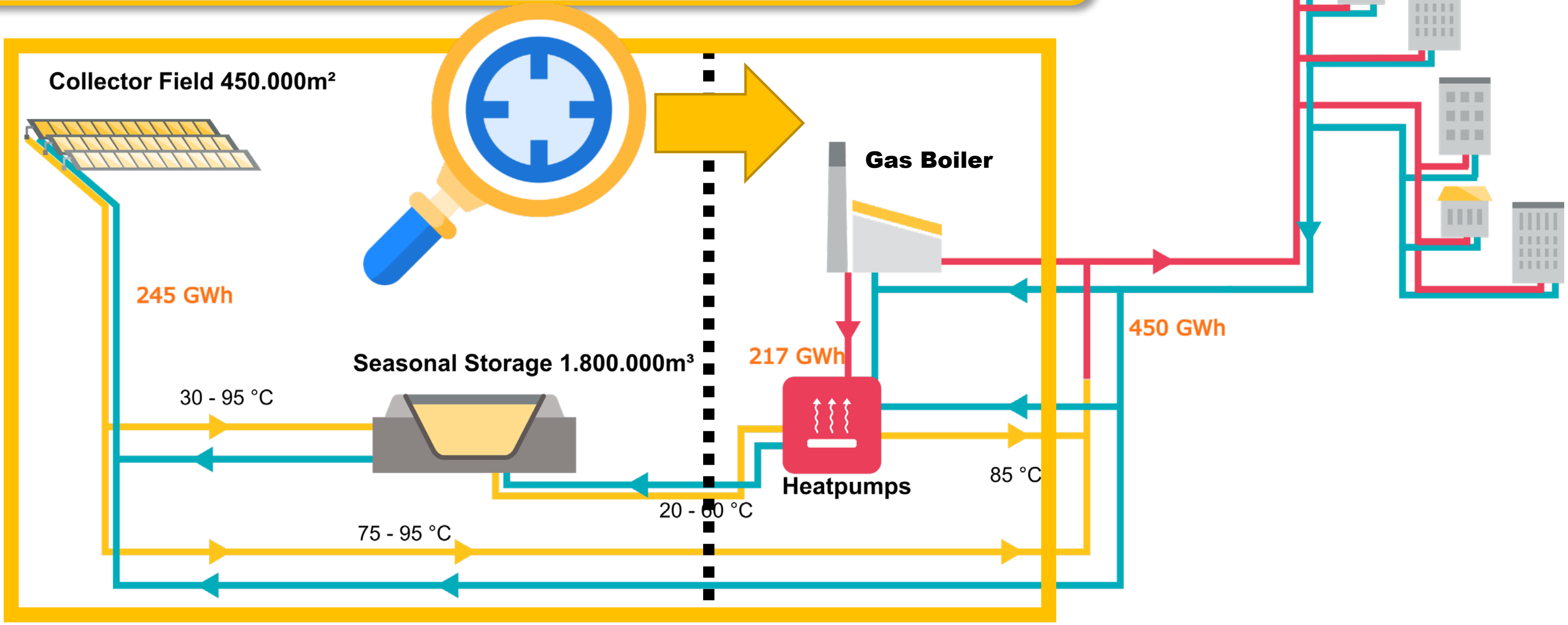


Feed temperature indirectly by solar ➔ combination of technologies

Extend focus

How to eff. provide desired feed temperature by solar + others

➔ Looking for the best (efficient) combinations

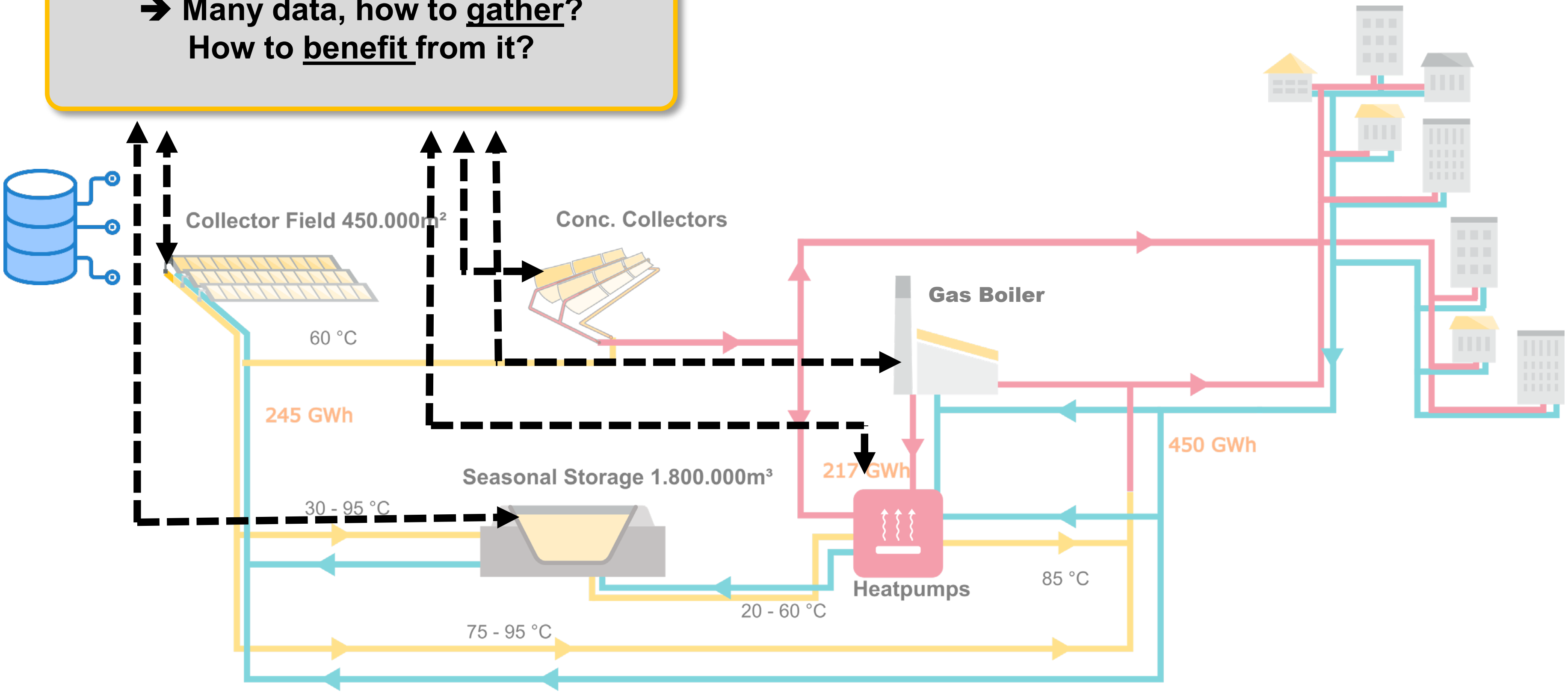


1st Main Objective

How to provide the **heat most** efficiently at the **desired temperature level** (focusing on the system aspect), considering also medium-high temperatures

Solar District Heating (SDH) – Data

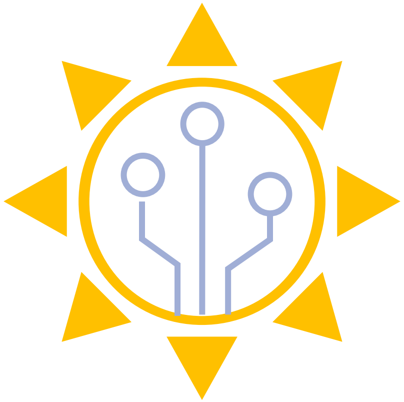
➔ Many data, how to <u>gather</u>?
How to <u>benefit</u> from it?



2nd Main Objective

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**

4th Main Objective

Gather results and **operating experience** to **raise awareness** for solar technologies **and** efficiently **disseminate this knowledge**

Task Structure

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 …)

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

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 ….

➔ viktor.unterberger@best-research.eu

Bioenergy and
Sustainable Technologies

solar energy systems

innovation
for life

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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

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

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

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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

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Subtask D
– Use Cases and Dissemination

Subtask leader

Joakim Byström Absolicon, (Sweden)

ABSOLICON

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

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