# Conversion of existing district heating grids to low-temperature operation and extension to new areas of buildings

The first seminar for 4DH Ph.D. fellows

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4DH
4th Generation District Heating Technologies and Systems

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# Outline

- 4th generation of district heating technologies and systems
- District heating schematic
- Research focus
- Case study
- Collaboration in relation to other PhD projects in 4DH
- Collaboration with private partners from industry and consultancy




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# 4th generation of district heating technologies and systems

- There is 50% share of district heating in Denmark.
- Denmark is going to be 100% renewable energy by 2050.
- District heating has an important role in future sustainable energy systems but the technology has to change.
- Developing low-temperature district heating meeting the challenge of more energy efficient buildings as well as electricity smart grids operation.
- Low-temperature district heating makes it possible to utilize low-grade energy sources in providing district heating demand.

Developing 4th generation district heating technologies and systems

# Research focus

## Hypothesis:

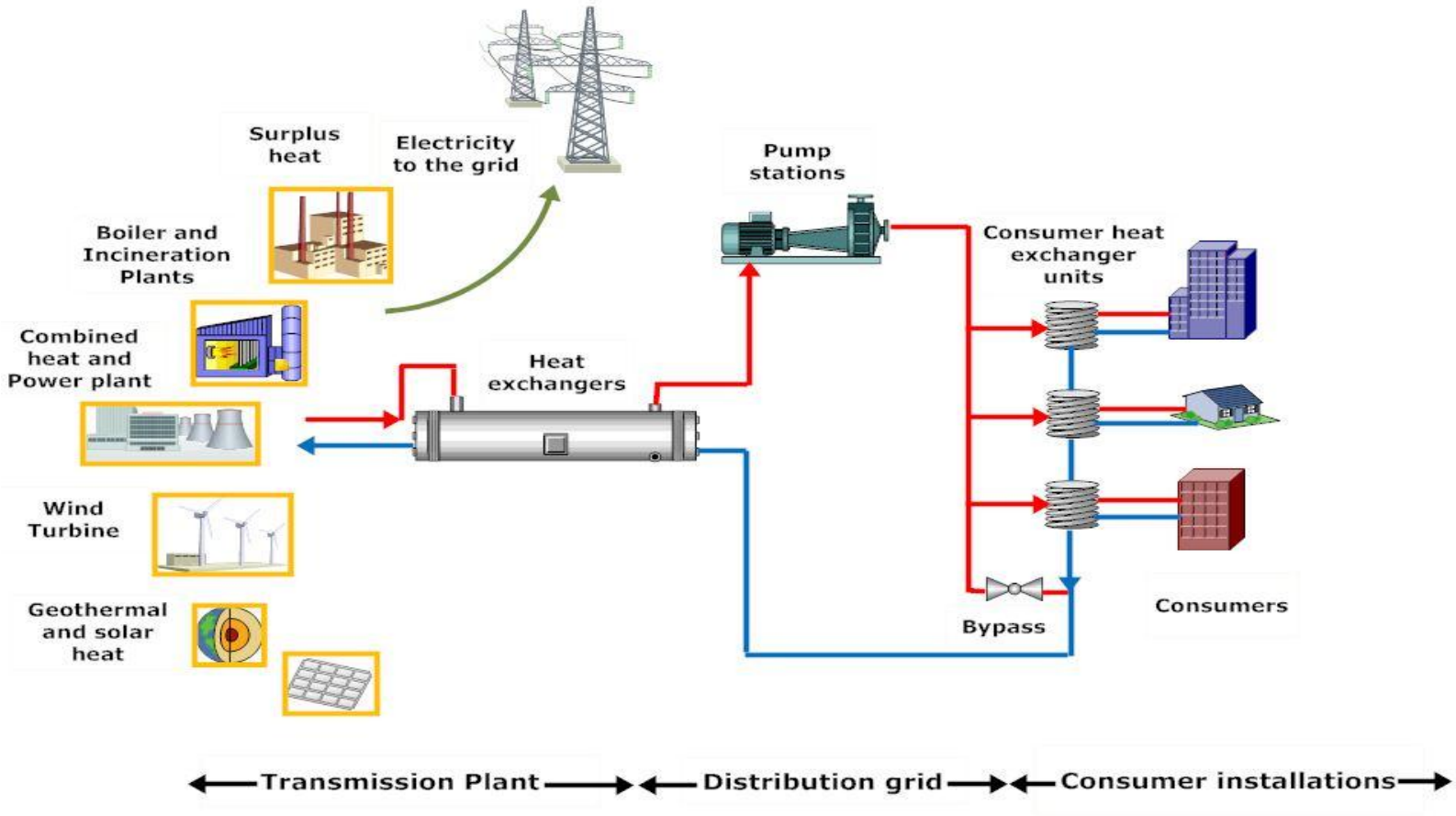
The hypothesis of this project is that it is possible to convert/extend the existing DH grids to low-temperature DH concept with typical supply/return temperatures of 50/20°C to the areas with low-energy demand buildings. Thereby it becomes possible to supply renewable heat to new and renovated buildings.

## Objectives

Conversion of existing district heating grids to low-temperature operation and extension to the areas where existing buildings are going to be energy renovated over next decades or newly built areas and integration with renewable energy sources (WP 1.3)

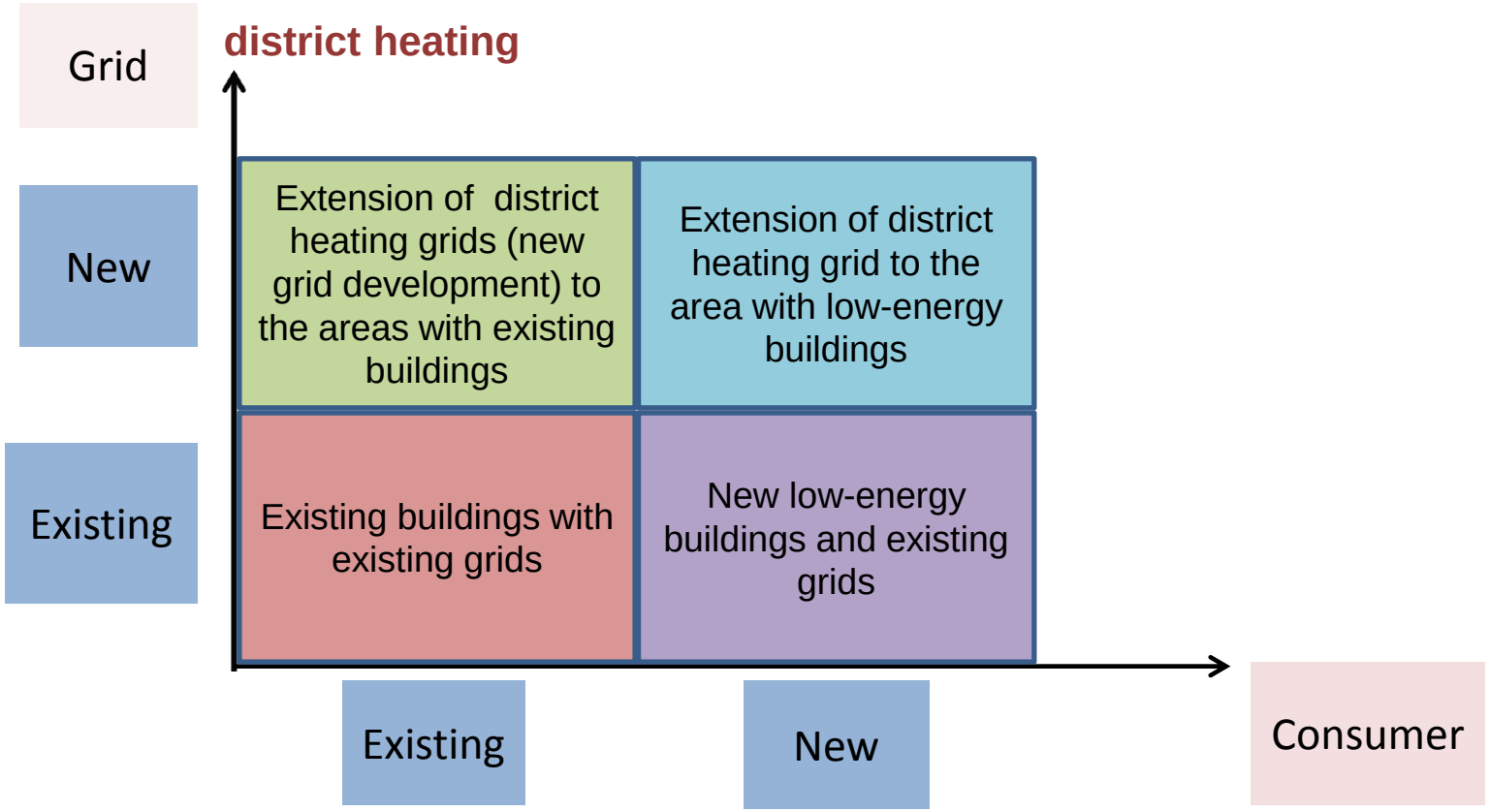
Minimizing losses in district heating distribution grids (WP1.4)

# District heating schematic



# Research perspectives

**4 different situations have to be taken into account in order to implement low-temperature district heating**



# Research perspectives

- Increasing the network energy efficiency and reducing heat loss by improving the performance of district heating network components. Improving and developing existing district heating network regarding heat loss in pipes, bypass application, pump performance, transmission side heat exchanger and consumers heat exchangers.

- Integration of renewable energy sources in existing and future district heating system. Evaluation of low-temperature district heating system based on renewable energy sources (Geothermal plants, central solar heating plants and waste heat from industrial process and replace fossil fuels and imported biomass in DH systems.)

- District heating system and individual heating system. (Varies by buildings types, area density)

- Optimization of district heating network for future district heating grids extension.

- Developing a tool for designing the distribution system

# Some considerations

**There are different aspects which need to be considered:**

- It is not possible to replace the existing network and existing buildings in close future considering their life time and huge investment cost.

- There are combinations of low-energy buildings and renovated and non-renovated buildings. There are also some buildings which have their own heating facilities.

- There is need for energy renovation in buildings to reduce their energy demand.

- Area density needs to be considered in order to implement district heating extension or utilize individual heating system.

# EUDP demonstration project

- **2001-2004: EFP 2001:** District heating supply to low-energy areas (Optimal design of district heating system for low energy density areas)
- **2006-2009: EFP 2007:** Development and demonstration of low-energy district heating for low-energy buildings
- **2008-2011: EUDP 2008:** $CO_2$ reductions in low-energy buildings and communities by implementation of low-temperature district heating systems (Buildings and network renovation and..)
- **2011-2014: EUDP 2010:** Full-scale demonstration of the future low-temperature district heating in existing settlements(Ongoing)

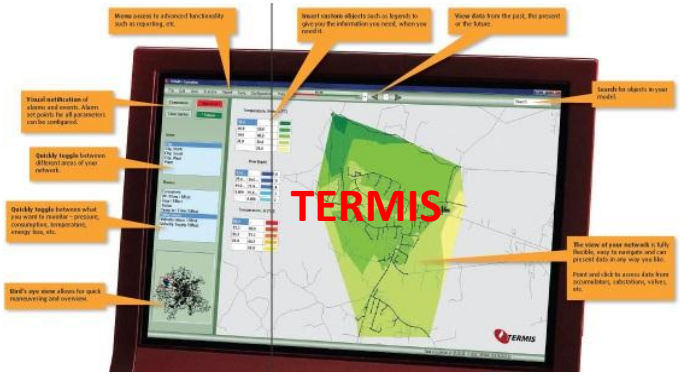
# Case study

- The town Harlev Area is selected as case study. It has 3563 inhabitants and it is located in east Jutland. Harlev is connected to Aarhus district heating grid.


- Current TERMIS model
- Define new scenarios and design the new network
- Getting actual condition data

  (Building heat consumption, Supply and return temperature)
- Validate design model with actual situation

  (In order to get better understanding of district heating system)



# Collaboration in relation to other PHD projects in 4DH (Data collection and joint paper)

- **WP1**(Data collection and joint paper)
  - wp1.1 (Heating of existing buildings by low-temperature district heating)
  - wp 1.4 (Minimizing heat losses)

- **WP2** (Data collection and joint paper)
  - wp2.2 (Integration of energy systems and Energy resources)
  - wp2.3 (Energy resources for district heating system): As it has been mentioned one of this project objective is the extension of district heating grids to the areas where the existing buildings will be energy renovated or newly built areas with low-energy demands, therefore the integration with renewable energy sources have to be considered.

- **WP3** (Data collection)
  - Wp3.3 (Energy Atlases to support planning)

# Collaboration with private partners form industry and consultancy

| Industrial Partner | Name |
|---|---|
| District heating production, transmission and distribution | AVA |
| Data metering | Kamstrup |
| Heat exchanger | SPX/APV |
| Pump | DESMI |
| Pipe | LOGSTOR |
| Software | TERMSI, EnergyPlan, HeatAtlas, Optimization software |

# Thanks for your attention