How to integrate solar heat in an existing district heating network

Workshop on Solar District Heating
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Overview

• Why solar heating?

• Solar district heating (SDH) status and development in Denmark.

• Technical installations & system control.

• Examples of concepts.
Why solar heating?

- A solar heating system can make it possible to shut off boilers in summer.
  - Longer lifetime of boilers.
  - Possibility of maintenance without using more expensive backup fuels.
  - Less CO\textsubscript{2} SO\textsubscript{2} NO\textsubscript{x}.
  - Less traffic for supplying biomass for the DH plant.

- Cost is independent of market prices of fuels.
  - Fixed heat cost for ~ 30 years!

- Compare the average costs for with/without a solar heating system.
  - If the result with SDH is lower then why not? (Try to ask a fuel supplier for a fixed price for 20-30 years...)
SDH status in Denmark

- All heat and power production shall be without fossil fuels in 2035.

- In total 500,000 m² of solar collectors at 55 plants (+ 26 new/expansions in the pipeline).
  ➔ Approx. 9,000 m² of solar collectors per system in average.

- Larger plants and plants with high solar fraction are coming.

- Reliable and durable technology with guaranty for efficiency.
Development

Solar District Heating in Denmark

Sum of collector area and the number of operating and upcoming plants
SDH plant status

In operation: 503,745 m²

September 2014
Solar collectors

- Right now two main manufacturers on the Danish market.
- Both flat plate, harpe design, inlet & outlet at the top, 12-14 m².
- With or without convection barrier.
SDH system configuration

Solar collector field

Balancing valve

Pressure relief valve

Vent valve

Over roof

Blow off

Expansion vessels

Building for technical equipment

Transmission pipe

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SDH workshop in Kaunas, Lithuania, November 4th 2014
System control

• Variable flow
  → By controlling the pump speed, the desired outlet temperature can be met, i.e. constant outlet temperature even though the irradiation varies.

  → This way you avoid
    a) too high temperatures => lower collector efficiency
    b) too low temperatures => Need for auxiliary heating to reach desired supply temperature.
System control

- Collector outlet temperature
- Temperature of flow to the top of storage tank
- Collector inlet temperature
- Temperature of flow from bottom of storage tank
- Irradiation on collector surface
- Thermal power - actual
- Thermal power - calculated

Example from Marstal
Integration in a DH network

• Feed-in (i.e. adding solar heating to the district heating network) is typically done by heating the return water to the desired forward temperature.

• This can be done centralised (at the DH plant) or decentralised (somewhere in the network)
Example of decentralised SDH system

- Noise reduction for residential area because of a main road.

→ Solar collectors feed into the DH system and supplies mainly the nearby buildings.

System control, heat exchanger, expansion tanks etc. in small building in the hill.
Example of centralised SDH system

• Typically the solar heating system is placed near the CHP plant.

• This way the storage can be used both by the CHP plant and the solar collectors.
Energy system integration

- A storage makes it possible to incorporate more fluctuating RE
Benefits from combining technologies

Solar:
✓ Produce free heat

Heat pump:
✓ Produce cheap heat
✓ Fast capacity regulation (load) → earn money
✓ Reduce storage volume

CHP:
✓ Produce valuable electricity → earn money
✓ Fast capacity regulation (prod.) → earn money

Storage:
✓ Gives flexibility
✓ Makes combinations possible
Thank you for your attention