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Central Solar (District) Heating Plants
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Introduction

Denmark has a leading tradition for large-scale solar heating connected to district heating, short CSHP. Such plants can include any type and size of seasonal storage, whereas the pit water storage seems to be the cheapest and most promising thermal storage technology for large-scale applications.

In 2012 a first full scale demonstration was presented in Marstal, Denmark. Today the plant is grown to over 33,000 m² of solar collector and a storage capacity of over 85,000 m³ pit water storage.

District Heating in Denmark

In Denmark, DH has been actively promoted as an important component in the national strategic energy planning. Denmark has 670 CHP plants and 77% of total DH and 55% of electricity come from CHP plants (Fig 2). Over 50% of total heating supply in Denmark comes from DH and around 62% of residential buildings connect with DH.

World large pit water storage is present at the Marstal:
- Built 2011-12
- Size: 75,000 m³ water
- Price 2.65 mio. € excl. transmission pipe or 35.5 €/m³ or 0.38 €/kWh
- Temperatures 10 – 90°C
- Capacity: 6,960 MWh
- Charge and discharge capacity: 10.5 MW
- Calculated heat loss: 2,475 MWh/year

The heat store

The Floating Lid Construction

The insulated lid is floating on the water surface avoiding a static construction and hereby a very cheap solution. (Fig. 5).

The Heat Pump

There are involved 2 heat pumps as shown in (Fig. 7)

- MWh/year
  - 9,000 m² 3,388
  - 15,000 m² 3,727
- Collectors total 13,546
- Propane heat pump 214
- CO2 heat pump 1,044
- Heat pump total 1,257
- SCRIBBEN 4,008
- Wood chip total 16,031
- 3,300 m³ 1,119
- 10,000 m³ 527
- Pit water m³ 2,190
- Storage losses total 2,855
- Boil off 6,000
- Total 32,000

Heat pumps are utilized for half of the year in winter periods with no seasonal storage, or low temperature in storage.

Energy balance for the year 2013 monitored. The solar share is 34% even with a large-scale seasonal storage. Flexibility opportunities are very large.

Further Information

A European Cooperation with web site: http://www.solar-district-heating.eu
Project Sunstore 4: http://sunstore4.eu/newsroom/events-presentations/
Web Blog: http://centralsolarheating.wordpress.com/

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