2011 HIGHLIGHTS
Large Solar Systems

SHC Task 45
Large solar heating/cooling systems, seasonal storage, heat pumps

I. Smart district heating

Growing interest for "Smart district heating" is seen in North and Central Europe.

Smart district heating is combining renewable energy technologies and thermal storages in such way that the district heating system is linked in a very flexible and constructive way with the liberal electricity market.

Main features of a smart district heating system are:

- Long term storage
- Solar collectors
- Heat pumps
- Combined heat and power production (CHP units)

In a growing number of countries more and more electricity is produced from wind and solar. This means:

- more and more variation - both short and long term - in the electricity production.
- more difficult conditions for the traditional CHP units

Smart district heating can (assist in) solving the problems connected to these two issues.

The "heart" in the smart district heating system is the storage. With a large thermal storage you can:

- use cheap "excess" electricity to make heat for use later when the heat is actually needed
- run you CHP unit when you have good price for the electricity - no matter if there is a need for heat

Also a solar system of course benefits from having heat storage; the more heat storage available - the higher solar fractions can be achieved.

Introducing heat pumps give better efficiency on the electrical heating - and reduces the need for storage volume (as the storage can then by cooled to very low temperatures).

In fig. I.1 an example of a smart district heating system is shown.

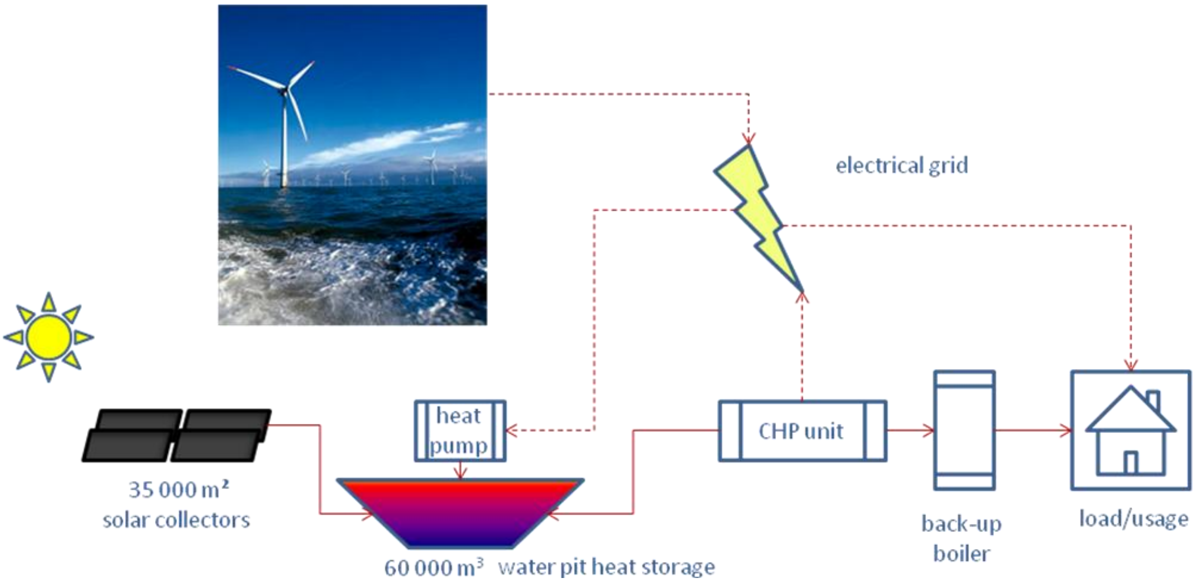

Figure I.1. Example of "Smart district heating system" in Dronninglund, Denmark. Source: PlanEnergi.

In this example a large part of the electricity production is based on wind energy, and prices for electricity depends very much on the varying wind speed. So - simplifying things a bit - the system will run as the wind blows and the sun shines:

- Wind blowing → cheap electricity → run heat pump
- Wind not blowing → expensive electricity → run CHP unit
- Sun shining → run solar collectors
- Heat missing → run back-up boiler
- Excess heat production → store heat

If the system is designed correctly the heat pump and the CHP unit will always be ready for immediately start (and stop); this "power give/take availability" has a good value in the marked and will give and extra income to the operator.

Two-three smart district heating systems will start operating in Denmark in 2012: Braedstrup, Marstal and (maybe) Dronninglund.

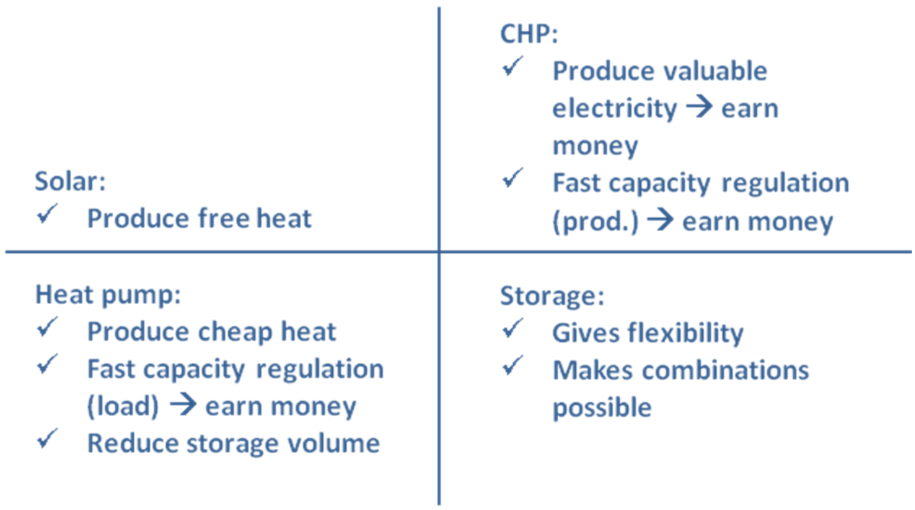

Figure I.2. Overview of benefits of "Smart district heating". Source: PlanEnergi.

II. Price winner: Towards 100 % solar fraction in Canada

From IEA-SHC Press release:

Figure II.1. Doug McClenahan proudly accepts the Energy Globe Award
Source: http://www.energyglobe.com/news/details/category/2/id/1823/

1st December 2011. This year's prestigious Energy Globe Award is awarded to a solar heating and cooling project in Alberta, Canada. The Drake Landing Solar Community achieves to more than 90% of the heat demand with solar thermal energy. Former IEA SHC chairman Doug McClenahan was personally involved in the project development and proudly accepted the award at a gala ceremony in Wels, Austria.

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This solar heating system is part of a larger research project of the International Energy Agency's Solar Heating and Cooling Programme (IEA SHC). "Large Solar Heating/Cooling Systems, Seasonal Storage, Heat Pumps" (Task 45) aims at supporting the fast growing market for solar district heating systems with research, which could lead to higher performances as well as improved cost effectiveness. Already today, large solar thermal systems can be competitive with conventional energy solutions.

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During the summer, 800 solar collectors heat up a system of underground heating tubes – to store heat for the winter. The area is now overgrown by a beautiful park. DLSC is en route to achieving its target of 90 percent in the year 2012 and a reduction of five tons of greenhouse gas emissions per home per year.

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Further information:

- Drake Landing Solar project: http://www.dlsc.ca/
- Energy Globe Award: http://www.energyglobe.com/en/award/

III. Low solar heat production costs: 30 - 40 €/MWh

In Denmark the market for large solar district heating systems still has epidemic growth. On the map below is shown how the “decease” is spreading. It is seen that more m²s are underway than already totally installed!

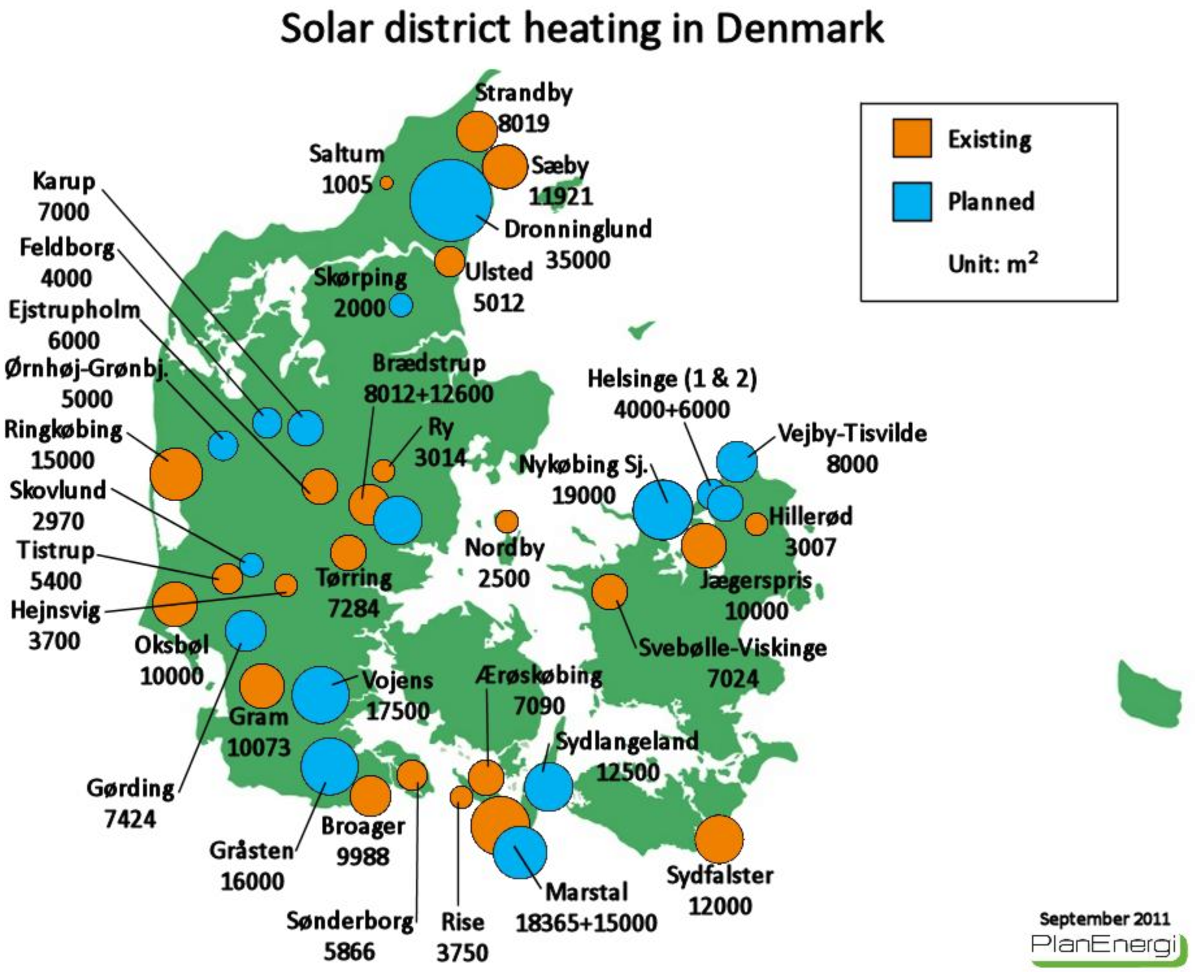

Figure III.1. Solar district heating systems in Denmark. The orange dots represent existing plants - the blue dots plants being built or being planned. The numbers are collector area in m². Source: PlanEnergi

The most important reason behind this development is the competitiveness of solar heat; heat production cost for solar heat is typically between 30 and 40 €/MWh - which corresponds to price of natural gas.

Data for 17 systems are public available at: http://www.solvarmedata.dk/side5696.html. These data include: Description of the system, measured performance and costs. Based on these data it is possible to calculate the solar heat price. In the following calculation results, the following assumptions are made:

- Net interest rate 3 %
- Lifetime 20 years
- Operating & maintenance 1 % of investment annually.

Using data from the 8 those systems having measurements from at least one year, the heat prices are calculated and presented in the fig.III.2 below:

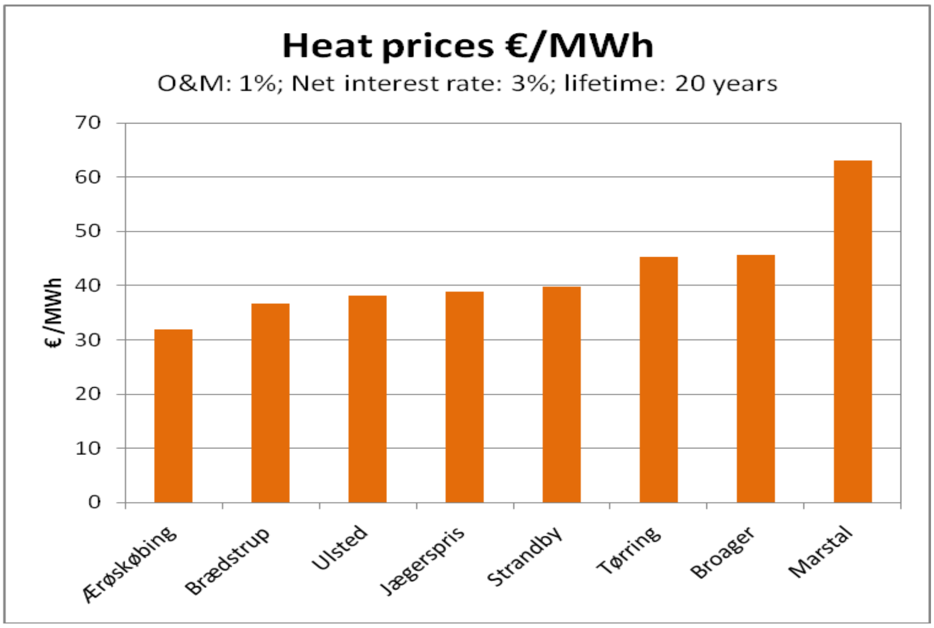

Figure III.2. Heat production costs for different Danish solar systems based on measured performance and real investment costs. O&M means annual Operating and Maintenance costs (set to 1 % of total investment) Sources: www.solvarmedata.dk and PlanEnergi.

It is seen that most of the systems have a heat production price between 30 and 40 €/MWh. As the gas price in Denmark at the moment is around 35 €/MWh, heat from solar is very attractive for the heating companies - especially because the solar heat price is fixed for the next 20 years - and the gas price is not!

IEA-SHC Task 45 - in short

Task 45 deals with large solar heating and cooling systems - with focus on district heating systems. Use of seasonal storage and combining solar with heat pumps (and other technologies) are important issues for the task. The task is organized into three Subtasks:

- ***Subtask A.*** Deals with large collector fields and including piping and heat exchanger.
- ***Subtask B.*** Deals with thermal storages.
- ***Subtask C.*** Deals with the whole system - and with combination of technologies (e.g. heat pumps).

The following countries are so far participating in the task (and more are considering participation):

1. Denmark - Operating agent and leader of subtask A
2. Germany - Leader of subtask B
3. Austria - Leader of subtask C
4. Canada
5. Italy
6. Spain
7. Sweden

Task Website:	**http://www.iea-shc.org/task45/index.html**
Operating Agent:	**J. E. Nielsen, PlanEnergi, Denmark, jen@planenergi.dk**
Time schedule:	**January 2011 - December 2013**
Next expert meeting / workshop:	**May 21- 22 / May 23 , Braedstrup, Denmark**