Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 70 (2015) 580 – 586

Energy Procedia

International Conference on Solar Heating and Cooling for Buildings and Industry, SHC 2014

Towards solar district heating with more than 70 % solar fraction

Daniel Trier[a]

[a]PlanEnergi, A.C.Meyers Vaenge 15, DK-2450 Copenhagen SV, Denmark

Abstract

In Denmark solar fractions up to about 50 % are seen for large scale solar district heating systems. The feasibility of higher solar fractions has been investigated in a case study. There is no direct subsidy for solar heating in Denmark, but the taxes on the alternative (fuels) affects the feasibility of solar heating for any district heating plant. The results show that solar heat can be provided at competitive costs compared to what is seen at many Danish district heating plants. The utility in the case study has not yet decided on a solar district heating system size.

Peer-review by the scientific conference committee of SHC 2014 under responsibility of PSE AG

Keywords: Solar district heating; large scale; solar fraction; business model

1. Introduction

In Denmark there is a trend towards larger and larger solar collector fields along with increasing solar fractions. So far solar fractions are seen up to about 50 %. The feasibility of having an even larger solar fraction than what have been seen before in this scale (e.g. above 70 %) has been investigated in a case study. This study is made for a possible realisation on the Danish island Bornholm in the Baltic Sea where the local utility is planning to expand one of their district heating networks. At the moment the network is supplying the villages Nexø, Balka and Snogebæk from a straw fired district heating plant in the outskirts of Nexø. The extension consists of establishing district heating in the nearby villages Listed, Svaneke and Aarsdale, and coupling them to the same district heating plant while increasing the boiler capacity. At the moment the utility considers to what extent a solar heating system should supply part of the demand.

Peer-review by the scientific conference committee of SHC 2014 under responsibility of PSE AG
doi:10.1016/j.egypro.2015.02.163

2. Business model

It is well known that a barrier for large scale solar heating systems can be the big up-front investment costs. The business model for the utility at Bornholm is to keep the up-front costs as low as possible and to get the income from the heat bill. This is possible because the district heating utilities in Denmark are able to get loans with a very low interest rate and thereby spread out the payment over a long period of time (up to 25 years). This strategy can be applied for investments in the capacity of the district heating plant as well as for the network. The result is that investments in renewable energy implementation and efficiency improvements of the heat production system are not held back by large investment costs. Most of the investments required to supply district heating for a new area is paid back by the customers over a number of years (i.e. included in the heat bill). For a house with an oil boiler the customer has to pay approx. 2,200-2,300 € for the district heating connection in the case study. This includes the pipe connection to the house incl. installation, a heat meter, district heating unit with hot water tank installed and shunt regulation, and removal of oil boiler, old hot water tank and oil tank. For electric heated houses there is no connection fee. On the other hand these customers need to install a water based heating system in their houses. When the transition is completed, the customer is left with 30-40 % reduction in annual heat costs knowing that also the environment benefits from the solution. The offer only applies for a limited period of time and only if a certain share of the potential customers sign up for being connected to the district heating network before the utility begins the construction. This way the utility do not risk installing a network where only a few customers want to be connected. Customers who choose to connect to the district heating network at a later time will have to pay a higher connection fee.

3. Possible district heating plant configuration

The present heat production in the case study is based on straw boilers and this will also be the supply of some or all of the expansion of the network. The fuel is available from the local farmland. Besides the boilers the utility are looking towards introducing a large scale solar thermal system which – for large solar fractions – could include a seasonal heat storage and a heat pump. In that case the system could be constructed as shown in Fig. 1. The supply and return temperature in the district heating network is 76 °C and 45 °C respectively in the period from April to September and 79 °C and 41 °C respectively in the period from October to March.

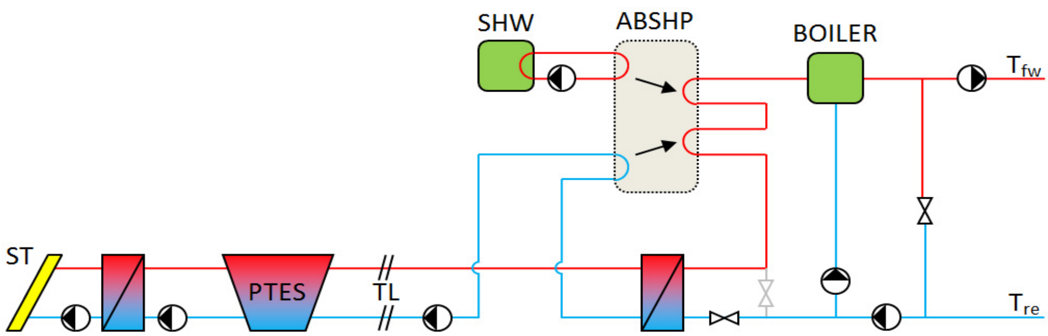

Fig. 1: Principle diagram of a possible configuration for a solar district heating system. (See nomenclature for description of abbreviations.)

The solar heat is supplied to the heat storage from where it is supplied to the district heating network by means of a heat exchanger (directly), by using a heat pump or a mix of these. The heat pump makes it possible to extract heat from the storage at lower temperature levels than the return temperature of the district heating network. This means that the storage volume is utilised more efficiently compared to a storage which can only use heat by means of a heat exchanger (i.e. only down to the return temperature level). In other words it is possible to store a larger amount of energy in a storage connected to a heat pump than if there is no heat pump. Another benefit is that the lower temperature in the storage improves the efficiency of the solar collectors. (However one should be aware not to "count the solar heat production twice" when assessing the performance of the heat pump since the heat extracted