

Stirling Engine, Solar & Efficient Heat for Eco-village in Hjortshøj.

Overview

The heating system in the eco-village "Andelssamfundet i Hjortshøj", near Århus, Denmark is an outstanding example of a local heating system. It is made for 105 energy efficient households plus community buildings and an institution. It supplies heat from a wood-chip and a wood pellet boiler, and from a small (35 kW electric) combined heat and power plant with a stirling engine. The scheme also includes decentralised solar heating allowing the network to be stopped during summer, and for 23 houses pulsating district heating to reduce heat losses in the network.

Organisations Behind

The Ecovillage "Andelssamfundet i Hjortshøj" is an intentional community started in 1991 on the edge of the village Hjortshøj near the Danish smaller city "Århus". The aims include to allow interested people from the Århus area to live a more environmental lifestyle including use of local renewable energy supply, and to create a living space with more community activities than normally found in suburbs. The eco-village is organised around house groups, where each house group organiser has bought the land for the houses from the municipality that owned it before. There are three groups of houses, where community members bought the land together, two groups with social housing (rented), one group with co-housing and one group with houses developed by a local, development company into individual houses. For the heat supply is formed a heating association with status as a cooperative with limited responsibility, and recognised according to Danish regulation as a heat-supplying entity. For the first groups the heating cooperative operates on an exemption from the obligation to have heat supply from the municipal district heating, while in the new developments, it has the sole right to supply heat according to Danish regulation of energy supply.

The heating cooperative is managed by a board with one person from each group of houses. The board is responsibility for the economy of the cooperative, for extension projects, etc. The work in the board is voluntary, but the cooperative has an accounting that is paid. Sometimes board members are paid for work related to new developments. This has been the case for the preparation and installation of the stirling engine and the for the new development with pulsating heat supply. A consulting engineer is advising the board new developments: stirling engine and pulsating heat supply.

The heating station is operating automatic, while adjustments, smaller maintenance, and solving of smaller problems is done by a group of volunteers, one or two from each of the house groups. From many groups it is in this group and in the board. While the work is voluntary, in some groups the chores are divided, so the person(s) involved with the heating station are not having other obligations in the group.

A chimney sweeper has the overall responsibility for the operation of the heating station. When the station is in operation he clean the boilers and performs safety checks every week or every second week, depending on the season.

Development and Current Status

Until 2002 the heating was provided by a wood pellet boiler, but in 2002 it was decided to increase the heating station with a wood-chip boiler and a stirling engine for combined heat and power production. The stirling engine was installed in 2007-2008, but due to technical problem it has not operated regularly yet. By end of September 2009, total power production was just above 1000 kWh. After a number of improvements, including measures to reduce vibrations and noise, the testing is now ongoing to enable automatic operation soon, including automatic change between operation and hot stand-by.

In 2008 it was decided to supply 23 houses in an extension of the eco-village with an innovative heat supply, where heat is only provided part of the day. During that period a heat tank in each

house is charged to store heat for the rest of the day. This saves up to 50% of the heat loss in the network. All the new houses are de-tatched, low-energy houses, and the network losses are therefore potentially large compared with useful heat delivered to the houses.

The first one of the 22 houses was connected to heating in December 2008. By October 1, 2009, 8 houses are connected to the heating. They are also being connected to the control system of the pulsating heat and to remote heat metering. The automatic control of pulses and remote metering will be installed during October 2009. For the 2009-2010 heating season, various modes of pulsating heating will be tested, and the results will be gathered with detailed remote metering.

Future plans include:

- To buy an electric car for the community car-sharing club. The car will then be placed at the community parking lot beside the heating station and will be charged from the stirling engine, when it is running. The car club is starting to analyse costs etc., A decision can be expected in 2010.
- To buy solar PV that can produce electricity in the summer, when the stirling engine is off. This will be done by individual houses, not by the heating association. Currently one house have installed a small PV, but only few other systems are expected soon.

Economy

Each member of the heating cooperative has paid 135 DKK incl. 25% VAT (xx €) per m² of heated area + a meter to become member. The heat price is set to cover costs including depreciation of investments. There are separate tariffs for winter and summer tariffs, to give those with good solar heating the they no summer demand a benefit, as prices are highest in the summer. The current prices are 0.85 DKK/kWh (xx €/kWh) during winter and 1.00 DKK/kWh (xx €/kWh) during summer. All payments are according to consumption, no fixed charges are applied.

The main investments have been the original heating station (548,000 DKK, 57,000 Eur in 1995), new heating station with stirling engine, including development (4,662,000 DKK, 622,000 Eur in 2002-2004), network, including new development with pulsating heating, 500,000 DKK (66,000 Eur), in total 5,710,000 DKK (761,000 Eur). The investments have been covered by a loan for the original heating station of 548,000 DKK (57,000 Eur), a loan for the increased heating station with stirling engine of 1,850,000 DKK (247,000 Eur) with a municipal guarantee, subsidies/support for the heating station of 2,570,000 DKK (343,000 Eur), subsidies for the pulsating heating of 97,000 DKK (13,000 Eur), and membership payment of 645,000 DKK (86,000 Eur).

The running costs are mainly fuel (139,000 DKK, 19,000 Eur), while other costs (operating, maintenance and administration) are together 83,000 DKK (11,000 Eur).

Technical Description

The heating station includes a 185 kW wood pellet boiler, a 160 kW wood chip boiler for up to 40% humidity in wood-chips, a stirling engine of 35 kW electric and 115 kW heat, a 70 m³ wood-chip storage made tipping of lorry with chips, a 10 m³ wood pellet storage made to blow wood pellets into, a 8 m³ heat storage tank (hot water).

The heat network is made of pre-insulated double plastic pipes, 2*50 mm for main lines and 2 * 16-25 mm for connections to individual houses. The energy demand was in 2007-2008 (one year) 617 MWh including network losses inside each group of houses. The network loss was 52 MWh (8%) in the network of the heating cooperative (between house groups).

Links with national and EU Policies

The stirling engine is grid-connected as independent power producer. It paid only additional connection costs at installation, and it will receive a feed-in tariff of 0.75 DKK (0.10 €) per kWh. This is according to Danish legislation that implements the EU Renewable Electricity Directive.

Description from INFORSE-Europe database, see http://www.inforse.org/europe/success/SU_About.htm