Scandinavia's first district heating plant with

ORC-based power generation

In Marstal Denmark, a small city with approx. 2.347 inhabitants, located on the island of Ærø, a biomass combustion plant with oil circuit that can produce both heat and electricity is right now being built. The concept is expected to be used in 20 other locations around Europe, and the EU-funded project also includes the world's second largest solar plant.

The components were placed 4th October, after which the assembly work begins.

Marstal District A.m.b.a. is just now starting to build a facility that combines four different energy-producing units - the world's second largest solar plant, a biomass combustion plant, a power generating unit and a heat pump. The project, totally amounting to € 14.8-16 million, is funded under the EU's 7th Framework Program with €6 million.

The plant is part of the EU project SUNSTORE 4, which will demonstrate an innovative, cost effective, renewable and sustainable energy on a large scale. According to the operating manager Leo Holm, who is also deputy mayor in Ærø Municipality, it is the work's ambition to provide consumers with cheaper and more environmentally friendly energy.

- Our current generation is based on 30% solar and 70% bio-oil, while the distribution of the new plant will be 55% from solar, 40% from wood, 4% from the heat pump and 1% from bio-oil. The idea is that we may eventually use local 'willow' here from Ærø. This avoids polluting transportation to the island, while we can create local jobs and give our consumers lower heat rates.

Expecting one million earnings power sales

The biggest innovation is that the woodchip biomass boiler is integrated with a facility to generate electricity according to the ORC principle (Organic Rankine Cycle), which is the first of its kind in Scandinavia. Thus, a part of the thermal power is converted into electricity, and the biomass combustion plant will produce a heat output of 3.4 MW and further supply 0.75 MW of electricity, which it expects to sell at an annual prize of € 222,000. The total biomass combustion plant is provided by the Danish company **Euro Therm**, which also is responsible for assembling and commissioning the entire facility.

Insertion of the water-cooled step grate, requiring great precision

- The step grate and boiler is designed based on CFD simulations in order to optimize combustion and physical design, explains Michael Jorgensen, CTO of Euro Therm. – In the wood chip boiler, the water normally used is replaced by recirculating thermal oil which is heated to approx. 310 degrees and then routed to the ORC unit.

Inserting of the oil boiler, which like the step grate is specially designed in collaboration with the Austrian Research Institute BIOS.

Here the thermal oil heat is exchanged with silicone oil, which thereby evaporates. The steam goes from here into a turbine which drives the generator, and then through a condensing unit, whereby the silicone oil is again brought into liquid form. The process takes place in a closed loop and is repeated as long as the production of electricity goes on.

20% of the power from the boiler and the enormous economizers, here inserted, turns into electricity.

The chilling process in the condensing unit uses water, which is then heated to the consumer. If the ORC device is not active, the thermal oil is used directly to heat the water to consumers

The Condensing Unit (Scrubber) ensures that the final energy is pulled out of the flue gas.

Great potential for the ORC at home and abroad
At Euro Therm CEO Jan Depenau has a great expectation for the coming year's sales of district heating systems with integrated ORC units.

– The sales potential of this kind of CHP is huge in our neighboring countries, e.g. in Germany, where the Plants can sell sustainable electricity for good prices. We will also bid for the 20 similar plants expected to be introduced elsewhere in Europe.

Although solar and wind energy become increasingly involved in district heating production, the director does not expect that biomass combustion plants' dominant role will change dramatically soon.

- Biomass is CO2 neutral, and it is necessary to have a stable supply source that is independent of the weather, he concludes.

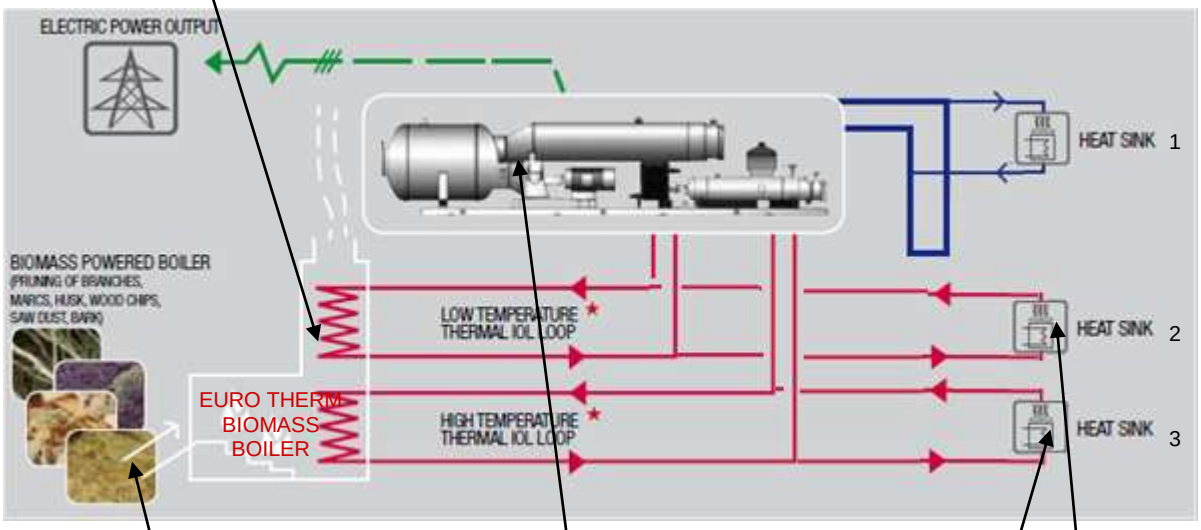
Biomass combustion plant
with
ORC-based power generation

Euro Therms system

System Description

The plant is built around Euro Therms biomass combustion system for thermal hot oil. The thermal oil heat exchanged with the district heating network and with an ORC unit for production of electricity.

The principle is shown in the figure below.



Wood chips at Marstal

The ORC unit

Heat exchange units

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