The Warndt Biomass Cogeneration Plant

Power and heat for the future

As the fifth biggest electricity producer in Germany, STEAG GmbH operates state-of-the-art power plants in Germany and around the world coupled with a wide range of services designed to secure future energy supplies – safely, efficiently and sustainably. STEAG is a pioneer in the generation of electricity and heat from biomass, biogas, mine gas, wind and geothermal energy. The engineers from STEAG Energy Services GmbH plan, construct and operate power plants all over the world. They are experts in the modernisation of existing plants and in customised energy supply solutions which go easy on the environment and are at the same time economical.

Power plants in Germany and abroad

In Germany, STEAG GmbH operates eleven power plants at ten locations with a total installed capacity of around 7,500 megawatts (MW); nine of these power plants utilise hard coal as their primary energy source. In two industrial power plants the company also recycles the by-products of refineries to supply them with steam, compressed air and electricity. Both industry and public utilities are numbered among the customers for electricity generated from hard coal; to a large extent, long-term supply and purchase contracts have been agreed with customers including RWE, EnBW and Deutsche Bahn. Cogeneration, in other words the simultaneous generation of electricity and usable heat, is practiced where it makes commercial sense. The heat is marketed for heating purposes or used by industrial plants as process heat for production purposes. Abroad, the company contributes to the public energy supply with three hard coal-fired power plants with a combined output of around 1,700 MW in Turkey, Columbia and the Philippines. The efficient power plants operated by STEAG GmbH actively contribute to securing and sustaining the energy supply.

Heat pump at the Erding II geothermal power plant (Bavaria). We are specialists for the utilisation of geothermal deep water to supply energy.

Biogas plant in Karstädt (Brandenburg). We plan, construct and operate plants to generate and process energy from biogas produced through fermentation of renewable raw materials and biowaste.

Michelm Energy Centre in Bad Kreuznach (Rhineland-Palatinate). As an industry contracting partner we provide high reliability, significant cost reductions and a positive environmental track record.

Energy from Warndt

The Warndt CHP plant was constructed on the site of the former Warndt mine and went into regular operation in April 2010 after a construction period of around one year. This is the first biomass CHP plant in the Saarland on the basis of untreated woodscrap. The Organic Rankine Cycle power plant technology (ORC for short) is also being used in the Saarland for the first time. The plant generates around 13,400 megawatt hours of electricity and up to 51,000 megawatt hours of heat per year. The electricity output is sufficient to supply around 3,350 single family households and the generated heat 2,833 single family households. The generated electricity is fed into the public grid on the basis of the German Renewable Energy Sources Act (EEG). The produced heat is partly fed into the district heating network of the community of Großröschen.

Boiler house

Machine hall

1 Pusher plate
2 Cross conveyor
3 Biomass boiler
4 Thermal oil heater
5 Economiser
6 Cyclone
7 Electrostatic filter
8 Flue
9 Turbine
10 Condenser
11 Evaporator
Converting untreated woodscrap into heat and power

The "fuel" for the biomass cogeneration plant – 40,000 tonnes of untreated woodscrap per year – is supplied by the Saarland forestry enterprise SaarForst, which has a split log processing and drying facility nearby. The woodchip is supplied by SaarForst directly to the wood bunker, which has a capacity of 140 tonnes. From there, it is transported – 120 tonnes per day – to the biomass boiler by means of pusher plates and chain conveyors. Here the wood is incinerated at a temperature of up to 1,000 degrees Celsius. The hot flue gases are fed into a thermal oil heater directly above the biomass boiler and through a thermal oil economiser. There, the flue gases are used to heat thermal oil to a temperature of up to 315 degrees Celsius. The hot thermal oil is then fed into an evaporator.

Here it causes silicone oil to vaporise and is fed back into the thermal oil heater (thermal oil cycle). The silicone oil steam is fed into a turbine. In the slowly running axial turbine, the thermal energy is converted into kinetic energy, which generates electricity in a generator. In a regenerator and condenser, the silicone oil cools and liquefies. In the process it gives off heat, which is fed into the district heating network. The silicone oil is then fed back into the evaporator and the silicone oil cycle, the actual ORC process, begins again.

Key figures

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal output ORC plant</td>
<td>8.2 MW</td>
</tr>
<tr>
<td>Electrical output ORC plant</td>
<td>1.8 MW</td>
</tr>
<tr>
<td>Thermal output peak load boiler</td>
<td>7.0 MW</td>
</tr>
<tr>
<td>Fuel input</td>
<td>40,000 t/a freshly cut wood</td>
</tr>
<tr>
<td>EEG electricity quantity</td>
<td>13,400 MWh/a</td>
</tr>
<tr>
<td>Maximum heat utilisation</td>
<td>51,000 MWh/a</td>
</tr>
<tr>
<td>CO₂ reduction</td>
<td>21,600 t/a</td>
</tr>
<tr>
<td>Investment</td>
<td>EUR 12.3m</td>
</tr>
<tr>
<td>Area required</td>
<td>4,500 m²</td>
</tr>
<tr>
<td>Employees</td>
<td>2</td>
</tr>
</tbody>
</table>

Wood transport in the bunker

Feeding wood into the biomass boiler

Organic Rankine Cycle (ORC)

ORC technology is a process for driving steam turbines using a working fluid other than steam. Instead of water, silicone oil is used, which evaporates at low temperatures and pressures, superheats and can be used for producing electricity in the turbine. Due to the excellent part-load efficiency and load variation tolerance, this technology is especially suitable for biomass cogeneration plants in the medium output range (200 – 2,000 kWₑ), as the ORC plant operates efficiently even with low temperature and pressure levels.
Emission protection

The biomass CHP plant was approved in compliance with the Fourth Federal Immission Control Act. The plant is subject to the emission limit requirements stipulated by the "Technical Instructions on Air Quality Control" (TA-Luft).

The values measured during plant operation fell significantly below these limits. Compliance with the stipulated emissions is monitored by means of regular measurements.

The flue gases produced by the combustion of the wood are treated in the flue gas scrubbing plant. The principal elements of this are a de-duster (cyclone separator) and an electrostatic filter that collects the contaminated dust particles.

Environmental protection

The ecological benefits of the biomass cogeneration plant are considerable. During combustion, the wood does not release any more greenhouse gas than it has absorbed and stored during growth. The CO₂-neutral combustion saves the environment around 21,500 tonnes of carbon dioxide annually.

Flue gas scrubbing Stack

STEAG New Energies GmbH
St Johanner Straße 101–105
D-66115 Saarbruecken

Phone +49 681 9494-00
Fax +49 681 9494-2211
info-newenergies@steag.com
www.steag-newenergies.com

Biomasse Heizkraftwerk Warndt
Gelände ehemaliges Bergwerk Warndt
Schloßstraße
D-66352 Großrosseln

Phone +49 6809 1807-73
Fax +49 6809 1807-81

As of September 2010.