

„Hungerkamp“ New heating & power station connected to a new 4 km small district heating network – Braunschweig, Germany.

Summary:

The “Hungerkamp” project is an innovative initiative led by BS|ENERGY, the energy provider of the city of Braunschweig. Its origins are rooted in the energy provider’s ambition to contribute to climate protection and its long and expansive experience in the fields of energy generation and district heating.

The creation of the project was then triggered by the need for renovation in a police station. Its old heating installation ran on oil and coal and had to be replaced. The project leaders decided to use this opportunity to go beyond the mere replacement of the heating plant and to develop a project of green and local heating network in the neighborhood. The meeting with a wood trader further helped to work out the concept of the system. The project creation was then completed by the search for a suitable location for the plant, by winning other potential customers and the signature of long-term contracts for heat delivery.

All in all, the construction time for the network and the plant only lasted 6 months. The station was fully operational in October, right in time to provide its 32 customers with heat for the winter period 2013/2014.

The heating and power station is composed of four main components. The CHP unit powered by biogas, has an electric capacity of 1,19 MW_{el} and a thermal capacity of 1,16 MW_{th}. It produces heat as a base load and is running throughout the year. Secondly, the wood warm water boiler is powered by wood chips and has a thermal capacity of 2 MW_{th}. It is running from October to March / April as a medium load, and completes the warm water production from the CHP unit during winter times. It is owned and operated by a business partner. The third element is a 6,5 MW_{th} warm water boiler powered by natural gas. It is used for the peak load and as a reserve. The last component is the hot water storage, composed of two 50 m³ tanks, which enables to balance supply and demand.

The local heating network is 4 km long and distributes warm water for heating purposes to 32 customers. The maximal heating demand amounts to 8 MW_{th}, and the network distributes about 14,200 MWh per year to the customers.

As a result, the heat and power installation produces 9,200 MWh per year of 100% green electricity and 15,600 MWh per year of 98% green heat. The whole system replaces 34 old plants running on heating oil and coal and achieves 8,000 tons of CO₂-savings, thanks to the use of cogeneration and the replacement of fossil fuels by renewable raw materials. The use of different fuels, as well as the thermal storage allows the system to be flexible to fuel prices and to daily fluctuations.

Project creation

The “Hungerkamp” project was created on the initiative of the energy provider of the city of Braunschweig, BS|ENERGY, a subsidiary company of the Veolia group. As a regional producer of electricity and heat, as well as the district heating network operator, the energy provider had extensive experience in the fields of energy processes and heating network infrastructures. Therefore, it was always for the firm an interesting prospect to offer its customers green energies and local supply, and this way contributing to climate protection.

These aspirations were brought to fruition at the end of the year 2012, when the need for renovation arose in the police station located in the eastern district of the town. The heating installation of this building was running on heating oil and coal, and needed to be replaced. Instead of simply replacing the installation with a more efficient one, it was decided to bring the line of reasoning further by creating the project of a green local heating network. With these first concept’s elements in mind, a local fuel trader, was contacted and proved to be interested in using its wood waste to build a wood boiler.

The next stages of the project were spent looking for a suitable location for the plant, specifying the technical elements of the system and winning more customers for the heat network. The wood trader turned out to own a small storage facility for his wares in the immediate vicinity of the first interested potential customers, and the site on Hungerkamp Street was finally chosen as the system’s location. The technical conception of the station was carried out by BS|ENERGY with its broad experience in the matters of energy processes. In order to convince potential customers and sceptics, a lot of attention has been given to the communication with the population surrounding the plant, like flyers, meetings and a visit to a similar plant to explain the advantages of having a local plant in their neighborhood. As a result, 32 customers choose to join the adventure, and were offered long-term contracts for heat delivery.

In the end, this project received the support from local firms, political committees, the public authorities of the city of Braunschweig and its citizen, and greatly improved the image of innovative local production plants in the region.

Energy production

The heat and power station is located in the Hungerkamp Street, in the eastern district of Gliesmarode of the city of Braunschweig. The main components for the power and heating station were delivered in June 2013. The system was then put into service in August 2013 for the trial operation phase, and the first heating MWh were effectively delivered to the customers in October 2013.

The installation for energy production is composed of four parts:

- A CHP unit, used as base load, and working throughout the year;
- A wood boiler, for the medium load, used from October to March/April;
- A natural gas boiler, for the peak and stand-by load, working approximately 150 hours per year;
- A heat storage, to optimize the production.

The cogeneration unit has a 1,189 kW_{el} electrical capacity and a 1,191 kW_{th} thermal capacity. Used as a base load plant, it is running all year long. The CHP unit produces 9,200 MWh of electricity, which is the equivalent of 2,300 households, as well as 9,200 MWh of warm water, corresponding to the needs of 600 households.

The unit runs on biogas, supplied by pipeline connected to a network, and consumes yearly 2 million m³ of biogas. The biogas comes from biogas production sites located everywhere in Germany, and is produced through fermentation of renewable raw materials and waste from the agriculture and breeding farms. According to this supply circuit and “extraction” means, the produced energy can be considered as fully renewable.

Since the project is located inside an inhabited area, the CHP unit is certified by a noise expertise. The unit is surrounded by a concrete sound insulating cover, and is provided with further noise-reducing measures. As a result, when running, the installation is barely audible from the outside, and even at night there is no additional unpleasant noise.

The second component of the system is the wood boiler, to complete the heat generation. The wood boiler has a thermal capacity of 2,000 kW_{th} and serves as a medium load producer, functioning from October to March / April according to the weather conditions. It produces 6,000 MWh of renewable warm water, and answers alone to the needs of 375 households. The wood boiler is own and operated by the fuel trader who acts as business partner. The produced heat is then sold to BS|ENERGY and injected on the heat network.

It consumes 1,600 tons per year of residual forest wood and materials from landscape management, like treetops and smaller branches. The wood mostly comes from the surrounding region, from the forests, municipal landscaping and neighboring mountains. So, apart from using renewable materials, this boiler runs on waste that would otherwise be lost.

Since the plant is implanted inside an urban area, aspects such as trucks traffic had to be tackled. For the wood supply, the deliveries by truck occur by an average of once to twice a week. The frequency of delivery is higher in winter, when the need for heat is greater. In summer there is no delivery since the boiler is not in operation. Altogether there is only a minor increase in the delivery traffic, with little disturbances for the district.

The third producing component is a natural gas boiler, used for the peak load and as a short-time replacement, in case any of the former units were to suddenly malfunction. Its thermal capacity is of 6,500 kW_{th}, and it runs approximately 150 hours per year. The gas boiler produces 400 MWh of warm water per year, which is the equivalent of 25 households, and could produce, if need be, up to 57,000 MWh of heat per year, that is to say answer to the needs of 3,500 households. The boiler runs on natural gas from the network, and consumes annually 41,000 m³ of natural gas.

The last component of the system is the heat storage, composed of two tanks with a capacity of 50 m³. Each tank has a diameter of 3,2 m, is 10 m high and has a 20 cm heat insulation to limit heat losses. The combination of both tanks can store and give back up to 3 MWh of warm water.

This component does not produce heat, but enables to optimize the heat production from the other boilers, by balancing supply and demand. For example, when the heat production exceeds the needs of the network, like at night, the heat is stored into the tanks, and later reinjected into the network to cover the daily peaks, without having to increase the

heat production from the boilers. The CHP unit and the wood boiler have the best yields at high capacities and steady loads, and can hardly adapt to the daily fluctuations or to the weather conditions. In this regard, the heat storage unit permits to keep them as much as possible in their nominal capacity, and in autumn it can even delay for a few days the lighting of the wood boiler.

Energy distribution

The second major element of the system is, after the station itself, the local heat distribution network.

The network was build and is operated by the energy provider of the city of Braunschweig, BS|ENERGY. The network's construction was realized in parallel with the building of the production station, minimizing the global duration of the work. The construction began in April 2013, after the frost period, and at the end of September, all the customers were connected to the network. The end of the works coincided with the moment when the station was put into service, and the heat delivery could start in time for the winter period 2013/2014.

In its basis version, the 4 km long network distributes about 14,200 MWh of heat per year to the 32 customers. The maximal thermal demand amounts to 8,000 kW_{th}. However, the expansion potential was taken into account in the conception stage, and the network could deliver some 3,600 MWh more per year in the north of the station, which represents an increase of 25% of energy delivered. The system could expand as well in the south of the existing network, adding approximately 5,000 MWh per years (increase of 35%) to the energy output.

Finally, if it turned out to be interesting and profitable, the local network could be connected to the greater network of the city of Braunschweig, since a network connection point can be found in the area.

Conclusion

The project's achievement is the production of 100% green electricity and 98% green heat injected in the local heating network. The heat and power station generates 9,200 MWh of green electricity per year, supplying the equivalent of 2,300 households, and produced for 100% out of biogas. The 15,600 MWh of green heat are supplied to approximately 1,000 households, with 60% produced out of biogas in the CHP unit, 38% out of wood chips, and 2% out of natural gas.

The energy is thus mostly produced thanks to sustainable raw materials and replaces the equivalent of 34 old heating systems, commonly running on heating oil and coal. The state-of-the-art filtering systems enable to improve the air quality in the district, which confirms the possibility of providing clean local energy solutions. By using the cogeneration of heat and power, and through the replacement of fossil fuel, the system enables to avoid the emission of 8,000 tons of CO₂ per year. This quantity would fill 260 tanks of 30 tons each, and the train of tanks would be 5,5 km long.

Finally, the system uses different types of fuel, biogas, wood and natural gas, which makes the plant flexible, and capable to react quickly to major changes in fuel prices.

Moreover, contrary to more commonly used renewable energies, the biogas CHP and the wood boiler are independent from the weather conditions, achieving a clean, renewable and reliable heat and power generation. This added to the use of a thermal storage unit, makes the system fully adapted to answer efficiently to the needs of a small and diversified urban neighborhood.