

**Application
for the
Global District Energy Climate Awards**

**Energy supply of the housing area Kreuzäcker/Ellental
in Bietigheim-Bissingen**



Central biomass heating plant Kreuzäcker/Ellental

General Information

System:	District Heating with Central Biomass Plant
Location:	Ellentalstr. 1 D – 74321 Bietigheim-Bissingen
Owner:	Stadtwerke Bietigheim-Bissingen GmbH Rötestr. 8 74321 Bietigheim-Bissingen
Responsible Person:	Rainer Kübler Tel. +49 (07142) 7887-101



Low energy multi family houses in “**Kreuzäcker/Ellental**“ in Bietigheim-Bissingen,

History of the System

- 1996 Integrated Energy Concept for the planned new Housing Area „Ellental/Kreuzäcker“ with about 1.200 apartments and terraced houses. The concept aimed at a 50 % reduction of fossil fuels for heat and electricity supply, compared to 1996 German Standard. This was achieved by improved insulation and a central heating system using wood chips for heat production and a combined heat and power (CHP) unit
- 1998 Start of construction of heat distribution system and central heating plant with a wood chip boiler with 1.500 kW and two gas/oil fired peak boilers with 2.000 kW each. Connection of a large school with heat demand of 1.700 MWh/a. The heating plant started operation In October 1998.
- 2002 The heat generation reached 6.200 MWh and two new large consumers, the indoor swimming pool and a sports hall were connected via a 550 m pipe in the ground thus increasing the heat demand by almost 50 %.
- 2005 negotiations with a group of farmers who planned to build a biogas plant about 4 km away from the heating plant. The plant would generate about 350 m³/h biogas, sufficient to operate a 500 kWel gas engine continuously. An agreement was made, that SWBB would build a biogas pipeline between the biogas plant and its central heating plant and buy the biogas from the plant for 20 years at a fixed prize.
- 2006 Biogas plant and biogas pipeline were built and a 625 kWel and 691 kWtherm gas engine was installed at the central heating plant, operation started in December 2006.
- 2008 The new housing area Kreuzäcker/Ellental has about 1.900 inhabitants and the central heating plant has generated 11.800 MWh heat by 80 % from Biogas and Wood chips and 4.540 MWh electricity from biogas. The CO₂-emissions of the housing area are close to zero. The heat prize for customers is less than from natural gas and the project runs commercially successful. The second section of the housing area is almost completed and the planning of the third section has started.

Description

In 1995/96 the city of Bietigheim-Bissingen started the planning of a large new housing area, which should in the end contain homes for up to 2.800 persons in 1.200 apartments, terraced and detached houses. The aim was to consider and apply ecological principles on all levels in order to minimize the negative impacts on the environment as much as possible. The integrated energy concept therefore included both, reduced demand of heat and electricity and the use of renewable sources and efficient technologies for the generation of energy. This should lead to a 50 % reduction of fossil fuel use in the area.

The houses were designed for low energy standard which resulted in 25 % lower heat demand than the 1995 legal requirements (Wärmeschutzverordnung 1995). The specific heat demand was designed to less than 90 kWh/m²/a (see Fig. 1 below marked “Kreuzäcker Planung”) including domestic hot water, in practice it turned out to be only around 75 kWh/m²/a (see Fig 1 below marked “Kreuzäcker ist 2003”).

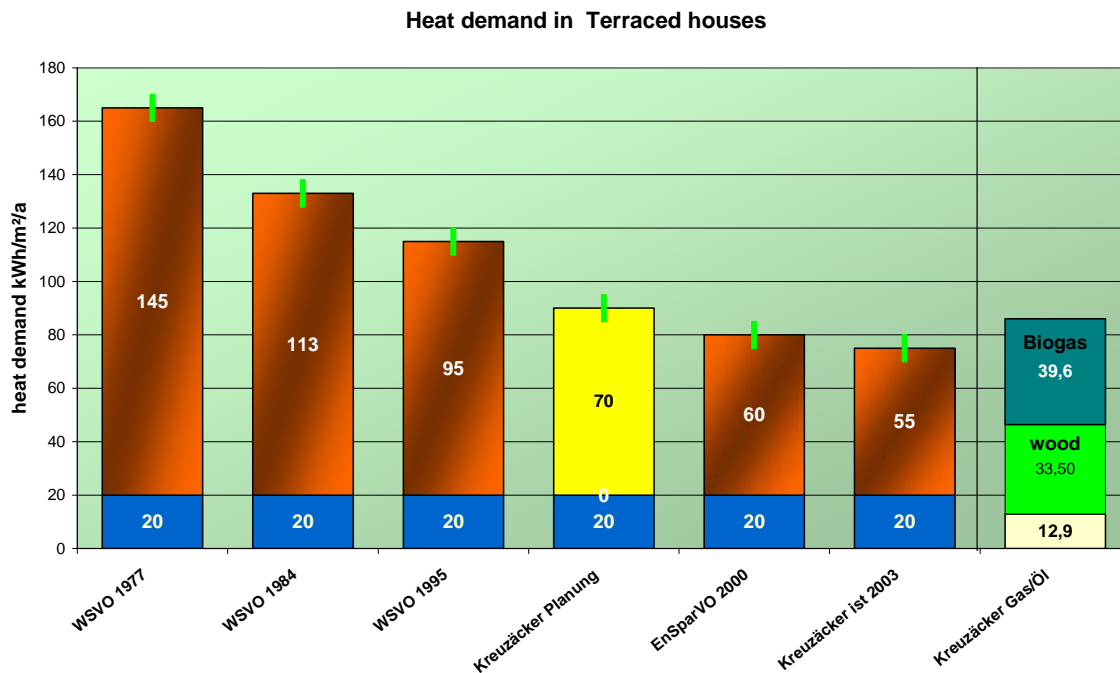


Fig. 1: Total heat demand of a typical terraced house according to different insulation standard in Germany. The right column shows, that for the heat supply of the houses only 12.9 kWh/m² are generated from gas and oil

A central heating plant with a heat distribution system was designed, as in a large heating plant the economic utilization of efficient energy technologies such as combined heat and power and of renewable energy sources such as burning of wood chips was much easier to apply. Moreover a central heating system offers more flexibility for the future as a large amount of decentralized boilers.

Due to the very compact design of the area, the heat distribution system could be kept short and comprises today about 2.800 m of duct length. The central heating plant was built close to the housing area and was from the start equipped with a 1.500 kW wood chip boiler supplying base and middle load. Due to the connection of the school, the indoor swimming pool and a large sports hall, a continuous operation of the wood chips boiler could soon be achieved and the benefits of the renewable heat production could be extended also to the three largest heat consumers among the public buildings in town. As a result, the share of heat from renewable energy in all public buildings in Bietigheim-Bissingen is today around 30 %.

Two conventional boilers fired by natural gas or oil are supplying the peak demand and serve as backup in case of failure of the wood chips boiler. The boilers are only operated with oil for a few hours a year during peak demand of gas in town, nevertheless for environmental protection only low sulphur oil is used.

With increasing heat demand and especially increasing summer load the application of a combined heat and power unit was considered, primary aim was to use biomass as fuel. A solution was found in the cooperation with a group of farmers who planned to build and operate a biogas plant in the neighbourhood. Due to the local situation with a densely populated area the biogas plant was finally built about 4 km away in an agricultural region. For the biogas transport Stadtwerke Bietigheim-Bissingen designed and constructed a biogas pipeline between the biogas plant and the central heating plant. Pioneer work had to be done as neither experience was available for biogas pipelines of such a length, nor experience on contractual matters regulating the purchase of biogas for 20 years. Even the biogas plant itself uses a new process technology, the fermentation of sweet corn, grass and other material is done using a so called "dry fermentation process" without adding water.

After production in the fermenter, biogas has a temperature of about 40 °C and is saturated with steam, which would immediately condensate when led into the underground and cold pipeline. Therefore the gas is dried by cooling it down to about 6 °C and compressed to 450 mbar before it enters into the pipeline. In the central heating plant, the gas is preheated and finally burned in the gas engine, producing a maximum of 624 kW electricity and 690 kW heat. Most biogas plants have the electricity generation on site of the plant itself and are using only little or no of the heat at all. The project described uses the biogas completely all year round as the base load even during summer is large enough. A heat storage serves to balance fluctuations of the heat demand during the day.

The biogas plant, the pipeline and the gas engine started operation successfully in December 2006 and since then it is continuously in operation. The engine was out of operation only for few hours during the year due to maintenance and repair. Most of the time the power production was around 600 kWel, based on the maximum electrical power of 624 kW almost 7.300 full load hours of operation could be achieved in 2008 and about 43 % of the heat demand delivered. The wood chip boiler is now only operated during winter time and supplies another 40 % of the heat supply, thus 83 % of the heat comes from renewable sources (see Fig. 2 below). One of the conventional boilers has been equipped with a burner which can also utilize biogas in case of failure or maintenance of the biogas engine.

Results and future development

The new housing area developed well and in 2002 already 6.200 MWh heat were generated, in 2008 this amounted to more than 11.800 MWh, equivalent to 1,2 Million l of oil. Today about 1.900 inhabitants are living there in 220 houses.

In 2008 the following energy balance was achieved by the central heating plant:

- Heat production 11.828 MWh
- Electricity production 4.542 MWh

Fuel used:

Biogas (in CHP)	12.299 MWh
biogas for electricity production	5.783 MWh
for heat production	6.516 MWh
wood chips	5.688 MWh
natural gas	2.251 MWh
oil (low sulphur)	4 MWh

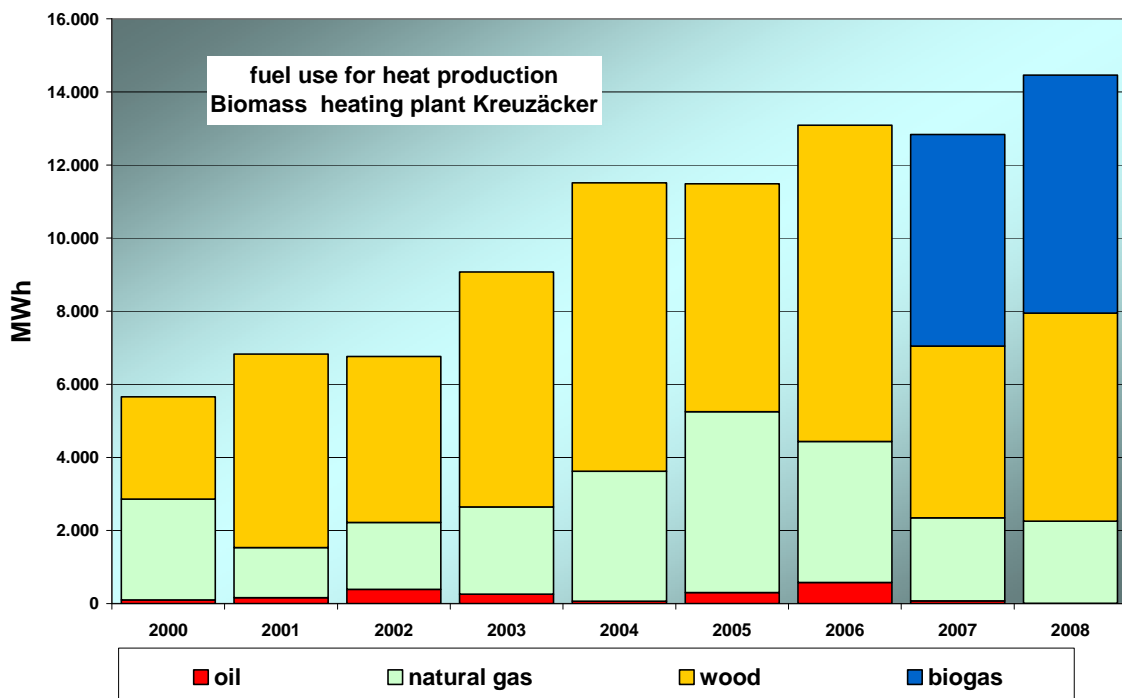


Fig. 2: Development of the heat production in the Biomass heating plant Kreuzäcker/Elletal and the fuel applied.

The share of fossil fuels for the heat and power production is therefore only about 12 %. Based on the average electricity consumption of households in Bietigheim-Bissingen, only about half of the electricity generated from biogas is used by the households in the area, the rest is “exported” so that the energy balance of the whole area is even positive.

The better insulation standard of the houses saves in practice about 690 t of CO₂ per year. For the heat supply of the customers (including school, sports hall and swimming pool) the CO₂ savings amount to about 2.130 t/a. And the electricity production saves another 1.670 t of CO₂ per year compared to today's most efficient conventional power generation technology, a combined cycle gas power station. The total heat demand of the houses is covered by more than 80 % from renewable sources, only about 13 kWh/m² comes from natural gas. So called passive houses have a heat demand of less than 15 kWh/m²a, the complete housing area meets therefore passive house standard. And the electricity demand is covered by 200 % with renewable energy. The total savings of CO₂ amount to almost 4.500 t/a.

The whole concept was realized with almost no subsidies, except for the electricity production which receives the feed in tariffs according to the EEG law. And the inhabitants of a typical terraced house pay for their heat supply only between 500 and 700 €/a at ordinary investment costs of the houses.

The second part of the housing area is close to completion now and the third part with another 350 – 400 flats and detached houses under planning. It will be constructed according to the same principles. The technology in the central heating plant is continuously developed to meet the latest technical standards and requirements, a reduction of the emissions of sulphur and formaldehyde in the exhaust gas of the CHP-unit is presently investigated.

Based on good experiences with the cooperation between the farmers and SWBB an extension of the biogas plant is planned which would allow for another CHP unit to be operated on biogas in the second central heating plant which SWBB is running.

Successfull public relation

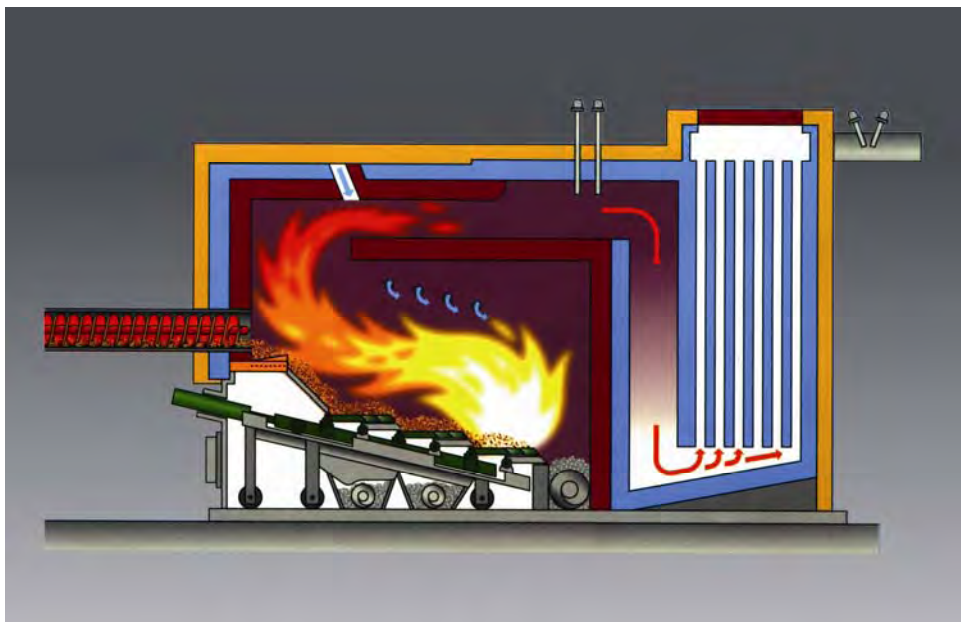
The public was intensively informed about the project and its development from the very beginning. An information leaflet is regularly updated and distributed on the occasion of open door events with the public and the press that take place at least once a year. Numerous visitor groups are visiting the plant each year, coming from universities, city councils, utilities and environmental organisations. Even an international group of young people who attended a UNESCO youth conference on climate protection in Stuttgart visited the plant in summer 2009. This appreciation by the public gives a good opportunity to SWBB to show its engagement for climate protection and to demonstrate its technical and economical competence in the management of such innovative and complex projects.

At the inauguration of the biogas plant and the biogas CHP in May 2007 the prime minister of Baden-Württemberg, many mayors and more than 120 representatives of communes in the region visited the plant and great attention was paid in the press to this project (see picture below).





Wood chip delivery and transport in the heating plant



Section through Wood chip boiler



Biogas- CHP-unit, 624 kWel



Construction of the Biogas-pipeline



The Biogas plant in Sachsenheim



**Inauguration of biogas plant in 2007
with prime minister Günter Oettinger**