Energie. Verkehr. Umwelt.

Sustainable Energy Solution with the highest Efficiency.

Application for International District Energy Climate Awards 2011

System

Name	Heizkraftwerk an der Friedensbrücke
Location	Veitshöchheimer Str 1 97080 Wüzburg Germany

Owner

Name	HKW GmbH
Type of ownership	16 % WVV GmbH (owner: 100 % city of Wuerzburg) 59 % STW (owner: 57 % WVV GmbH, 21 % city of Wuerzburg, 22 % Thüga) 25 % Thüga

Submitter

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Dear Sir
Dear Madam

Wuerzburg as a German Franconian citiy with more than **130,000 habitants** and a University with more than 30,000 students has always emphasized the importance of a municipal energy solution. Hence a cogeneration plant was built in 1954 serving both electricity and heating. The choice of fuel was a coal due to the resource situation in that time. The most advanced and efficient technique back then was the use of steam as medium for heat transportation through the grid in the Wuerzburg inner city.

With the liberalization of the energy market and the rising sensitivity for climate issues Wuerzburg has been seeking a sustainable opportunity modernizing the coal based cogeneration plant in 2003. The aims were set at the highest level:

- Most efficient technology that can serve in future as a reliable source of
  - electricity and
  - heating.
- The technology must have potentials to be modified and updated in terms of future developments.
- Significant improvement of air quality in the Wuerzburg vale.
- Highest scenic standards due to the vicinity of the plant to the historic inner city of Wuerzburg.
- And due to the municipal character of this project: The technology must meet the budget of the Wuerzburg area.

The choice of technology for this **dramatic modernization** of the plant fell on a cogeneration based on gas. Gas has been assessed to have greatest potential also due to the achievements in converting (green energy) power into gas.

In the years 2003 to 2005 the cogeneration plant was very successfully modified and converted to a cogeneration plant of the highest standards. Thereby the CO2-Emission were reduced by 100,000 t/a. Due to this huge success and the energy need (both electricity and heating) another gas turbine was installed in 2009 leading to another CO2 reduction by 50,000 t/a. This project and the modernization was fully accepted by the Wuerzburg habitants and serves with an efficiency rate of 65 % the heating and electricity needs of the region.

In addition this modification was the foundation of the most recent upgrade of the district heating system: the transformation of the heating medium from steam to water, thereby reducing the temperature and the energy losses substantially. We are confident having installed a sustainable district energy system that is based upon technology and an energy source that is a 100% honest solution for the region of Wuerzburg and environmentally friendly.

This award would honour our joint efforts in Wuerzburg to sustainability and clean energy solutions.

Sincereliest yours

Thomas Schäfer.
Geschäftsführung WVV GmbH

Brief:

The publicly owned company WVV in Wuerzburg has successfully transformed a coal based cogeneration plant for heat and power (built in 1952) into a gas driven plant which is highly efficient and therefore complies to the new energy and heat requirements of the residents. Today the EMAS-certified generation of energy is performed at an efficiency rate of 65%. Another result was a reduction of CO2-Emission of 100.000 tons each year. Today the reduction is even higher: The installation of a second gas turbine led to a further reduction of 50.000 tons each year.

Because the cogeneration plant is in the centre of Wuerzburg it is a prominent and striking part of the skyline. It has always played a dominant role in Wuerzburgs existence.

Thus the transformation was twice successful:
Now Wuerzburg is able to provide a means of energy that meets the latest demands of climate programs. Due to renewable energy production the plant has evolved from a coal fed industry into a centre of cultural life. Each year a famous open air festival is held at the old coal harbour.

Today the effort pays of: The company is able to take the next step by altering steam to water as the medium of the district heating system.

Logo:

Plant History.

Since 1954 the heating plant of Wuerzburg has been supplying the city with both electricity and heating. The heating is distributed within the inner city of Wuerzburg through a district heating pipline system of approx. 55 km in length.

By 2003 the plant still had been used coal for the production of energy. Due to both the rising interest in climate issues along with the efforts to enforce climate protection within Germany and the liberalization of the energy market the WVV has decided to modernize the plant dramatically to meet these determining factors. Therefore the choice was to switch to the most friendly and promising technology: gas turbines. Switching to gas turbine technology it was possible to optimize the Wuerzburg city both economically and ecologically.

Not only the system and the technology has changed. The plant has always been a prominent building at the heart of Wuerzburg (Fig. 1). Therefore any change in the appearance and the technology was absolutely visible to the habitants and has always been tracked closely.

Fig. 1: Map of Wuerzburg (Source: Google Maps 2011).

Within the years the plant has changed several times its appearance.

Very early post card theme from early 1900.
The picture shows the harbour later used to supply coal to the plant.

The plant was built in 1953 as a pure functional building.

The plant had undergone several changes and expansion to meet the energy need of Wuerzburg.
The technology was improved but coal was used up till 2006.

The hull of the plant was changed several times over the years.

With the technological transformation the hull of the plant was changed again in order to underline the dramatic consequences of the latest change for Wuerzburg: no coal particle emissions and a source of high efficiency energy production.

The architectural changes were honored by the prize “BDA Preis Bayern – Stadtraum und Energie” in 2006. Today each year the former harbour used to deliver the coal is at the heart of a cultural event.

http://www.hafensommer-wuerzburg.de

The facts and data

The cogeneration plant was transformed from a coal based plant to a high efficiency gas plant. The project was initiated in 2003 and the transformation was finished in 2006. In the following the two reference years 2004 (coal based) and 2006 (gas based) are shown to clarify the efforts and especially the huge improvements.

The less than expected increase in primary energy input of 16% from 983 GWh to 1,2 TWh between 2004 and 2006 is due to both an increase in energy output of 52% from 498 GWh in 2004 to 758 GWh in 2006 and the tremendous improvement of the overall efficiency of the plant.

cogeneration plant data		**2004**	**2006**
coal	1000 t	111	3
gas	Mio. m³	1	110
coal, fuel value based	GWh	971	23
gas, fuel value based	GWh	11	1.139
primary energy	*GWh*	*983*	*1.161*
system		grate firing	Gas turbine SGT-800 by Siemens
electricity	GWh	165	429
heating	GWh	333	329
totel energy produced	*GWh*	*498*	*758*

efficiency	**2004**	**2006**
overall efficiency	51%	65 %

In addition to the very positive development in fossil fuel saving the emissions could be cut back by a huge proportion as well. Despite of the incease in energy production the emissions were reduced not only specifically but also by an absolute value. Already in 2006 Wuerzburg was able to undercut the German-benchmark-2009-values for spec. CO2 and spec. NOx by 5% and 76%, respectively.

emission data		2004	2006	Benchmark 2009
CO2, absolute	1000 t/a	336	236	
CO2, spec. el.	t/GWh	2.036	550	575
CO2, spec. total	t/GWh	675	311	
Nox, absolute	t/a	458	172	
Nox, spec. el.	t/GWh	2,8	0,4	1,7
Nox, spec. total	t/GWh	0,9	0,2	
Particle, absolute	t/a	2,9	0,3	
Particle, spec.	kg/GWh	14,7	0,4	

The secondary systems have been improved as well. Water for cooling is been taken from the river Main which is running through Wuerzburg. In order to minimize the effects for the river the cooling volume per energy produced has been reduced by 20 % thereby keeping the overall water usage for cooling nearly constant over the years.

Apart from cooling water also the water from condensation has been cut by more than 50% absolute.

water		2004	2006
feeder water treatment, spec. heat.	t/GWh	295	182
condenser water treatment, spec. el.	m³/GWh	2.610	1.036
city water treatment	m³	44.865	21.292
cooling water, absolute	Mio. m³	52	60
cooling water, spec. el.	m³/GWh	0,3	0,1
cooling water, spec. total	m³/GWh	0,10	0,08

The district heating grid itself was not modified at that point. The changes aimed at were necessary as a foundation for the changes being executed right now in Wuerzburg pushing the efficiency and the sustainability further to the limits. Right now the grid is changed from steam to water – a transformation not possible without the project presented here.

district heating grid		2004	2006
medium		steam	
temperature	℃	180	
cummulated grid length	km	55	
customer number		1.360	

Level of innovation

The cogeneration plant significantly enables Wuerzburg to be a leader in climate protection measures and to setup a program to reduce CO2 within the city by 50% until 2020. We are very proud to assess the transformation process innovative and a huge success in the following aspects:

Climate benefits

- Reduction of absolute CO2 emission
- Reduction of specific CO2 emission
- Reduction of NOx, SOx emission

Please refer to the tables above for detailed information about the values.

Economical benefits

Economically the project had huge effects on Wuerzburg and the WVV:

- Investment optimized due to modernization instead of new builds
- Latest technology developments included
- Increasing efficiency and
- Reducing fix costs
- Enabling a further increase in distributing heating

Social benefits

Since the plant is in the heart of Wuerzburg the building has always been very prominent. Due to changing from coal to gas the plant lost its dirty image and each summer an event is held at the former coal-harbor directly at the plant.

- The acceptability has increased tremendously
- Wuerzburg has lost its bad image of a coal plant dominated city
- The skyline of Wuerzburg was improved

Benefits for Wuerzburg

Along with the modernization of the plant Wuerzburg got more attractive for the people as city worthwhile to live in.

Challenges during the program

The challenges can be clearly seen in:

- Transformation by modification instead of new builds
- Modernization while plant was active and online
- Special requirements due to architectural and scenic aspects
- Installation of new technology in 2009 (gas turbine SGT-700 was never installed before)

All theses challenges were met absolutely successfully: The plant converted from a dirty coal burning plant towards a clean center of cultural life and the architecture was honored by a prize. In addition no unplanned shutdowns were necessary, thus the supply of energy was always secured.

Finance structure of the program

The invest of 55 Mio. € was carried by WVV GmbH.
Regarding the lifetime of at least 20 years this invest can be calculated as 27 € / t CO2 reduction.