District Heating Expansion Spandau

Spandau Saves CO_2
The counter shows CO_2 saved in Spandau due to buildings using Vattenfall Europe Heat AG District Heating from co-generation.

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The Company
Vattenfall Europe Wärme AG in Berlin

The company provides customers with District Heating, Cooling and individual energy services in Berlin and Hamburg. The Business Unit Heat is described briefly below:

31 generation sites (combined heat and power plants, heat plants, block heating stations, fuel cells, solar plants):

- 7,600 MW thermal installed capacity,
- 3,100 MW electrical installed capacity
- 2,300 km district heating grids
- 1.4 million households supplied
- 2,700 employees

In Berlin, the capital city, every third flat uses heat from Vattenfall. This is generated from environmentally friendly co-generation plants in Berlin. These work on the principle of combined heat and power (CHP), that is, the parallel production of energy and heat. The total CHP share of all Vattenfall generation plants in Berlin is 93 % which also includes using biomass to generate heat.

Additionally, about 1.6 million Berliner electricity customers in private, trade and industrial segments have confidence in Vattenfall's expertise. The company provides a safe and reliable energy supply to the Berlin population and is pushing ahead with future-oriented projects such as Smart Metering and electrical mobility.

1. Climate Protection Agreement

In order for Berlin reach its political climate protection targets – reducing CO_2 emission by 2020 by 40 percent compared to 1990, this agreement has a key role. Vattenfall's commitment to this energy concept began in March 2009. Due to a variety of measures, Vattenfall will reduce its CO_2 emission from the current 7.5 million tons per year by 2020 to approximately 6.4 million tons per year, that is, by more than 1 million tons. Compared with the base year 1990 (13.3 tons p.a.) this is a reduction of good 50 percent.

The current Mayor of Berlin, Klaus Wowereit said: "The Climate Agreement between Berlin and Vattenfall is still, after one year, a model in Germany. No other state has signed a similar agreement. We have succeeded in binding the biggest energy provider of the city to Berlin's climate protection targets. This was a key step towards achieving Berlin's targets to reduce CO_2 emission by 2020 by 40 percent. Establishing the climate protection agreement has led energy providers involving citizens in a better way, especially in bigger projects.

Vattenfall is extending the District Heating grid further. Because the heat is produced using CHP, the CO_2 emission is reduced by about 1 ton p.a. for every new home connected. Additional savings come from the increased use of biomass for heat production.

This and further measures will lead to more than halving the CO_2 emission from Berlin power plants by 2020 compared to 1990. This is an important contribution to reaching Berlin's climate protection targets.

2. Introduction

Vattenfall Europe Wärme AG has constructed a new District Heating grid in the Berlin Municipal of Spandau. Within 9 years approximately € 60 million will be invested within the framework of the investment program approved by the company in 2007. Through this new connections will be created with a similar value of the current district heating provisions in the cities of Lübeck or Magdeburg.

Construction began in spring of 2007. Overall within the time period approximately 121 MW will be connected to the District Heating network which is about 35,000 households or the equivalent. The supply for the new District Heating grid is from the power plant Reuter. The heat is generated using environmentally friendly co-generation. Using this, the utilization percent of the energy is doubled and fuel is saved.

The existing local heating grid (An der Kappe) of oil and gas boiler plants and the shopping center Spandauer Arcaden which is currently supplied with gas, will be connected to the new District Heating pipelines as part of the measures.

The supply pipelines of the area being connected will be constructed as a two-pipe system, with a supply pipe temperature of 110 °C. The pipe system will be constructed for a maximum supply temperature of 130 °C. In the case of a full load, additional supply potential is available simply by raising the pipe supply temperature. Overall, 19 kilometers of main pipelines will be laid (DN 700 to DN 150). To connect Spandau it was necessary to use construction method of concrete pipe pressing (a walkable pipe tunnel DN 2600 with two pipes of DN 700) below the Havel River.

In the Berlin Climate Protection Agreement Vattenfall and the state of Berlin commit themselves to a significant reduction of CO_2 emission. The expansion of the District Heating grid is one component working towards reaching this ambitious target.

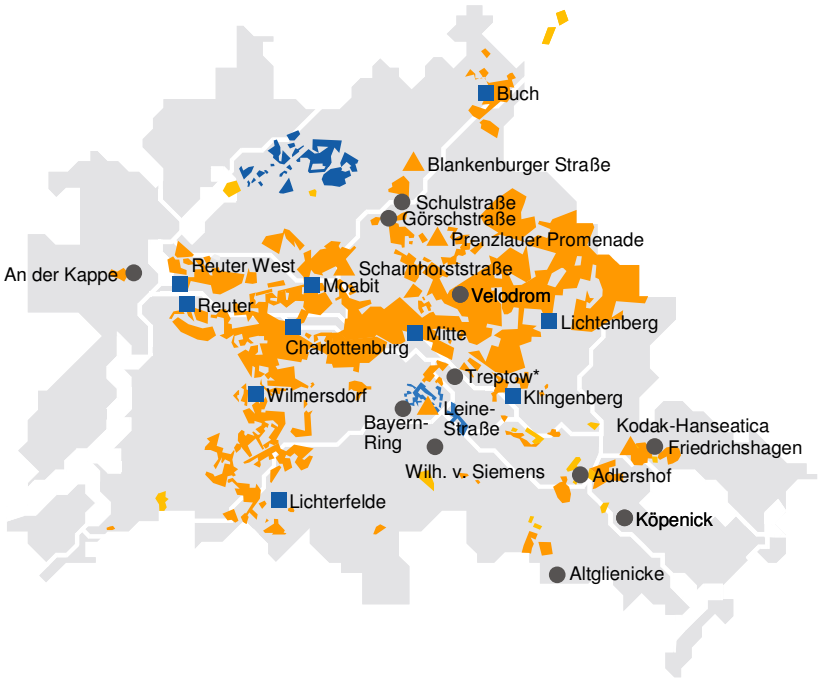
Ground breaking ceremony (04/2007) at the power plant Reuter with the Plant Leader, the City Councilor for Construction, the local Mayor, the Regional Leader of District Heating and the Heat Board Member (from left to right).

Inauguration Construction Site Sign – with Councilor for Construction (left) and Board Member for Heat

3. Description of the Development Measures

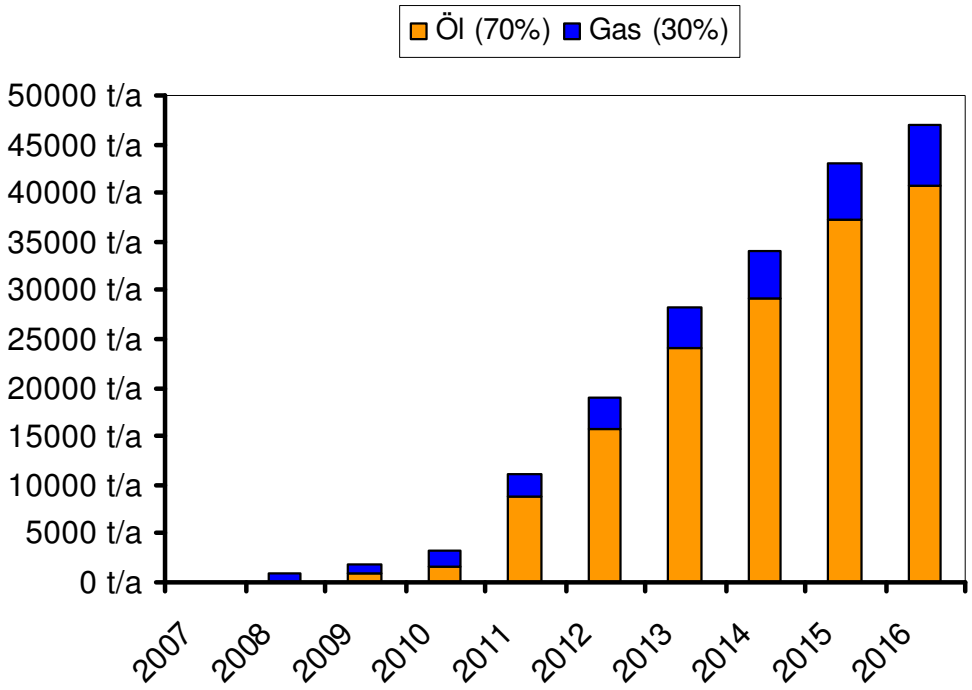
The Berlin Municipality Spandau is in the north-west of the city. The development area consists of an older, densely built-up area as well as numerous newer built-up areas from the 50's and 60's. In addition, there are several local recreation areas including various inland water areas within the municipality.

Total area of Spandau Municipality (2009)	9,188 hectares
Built-up area (figures: 2009)	18.5 million m²
Housing (31.12.2009) in households	118,252
Total population of Spandau	215,696



Results from an analysis of the heating structure within the planned development area showed 50% oil, 45% gas, 5% tiled stove and night accumulator heating.

Due to central generation of District Heating using the CHP process at Vattenfall in Berlin, compared to de-centralized oil supply, about 50% of primary energy can be saved. Through this a significant amount of CO_2 emission in Berlin can be avoided.

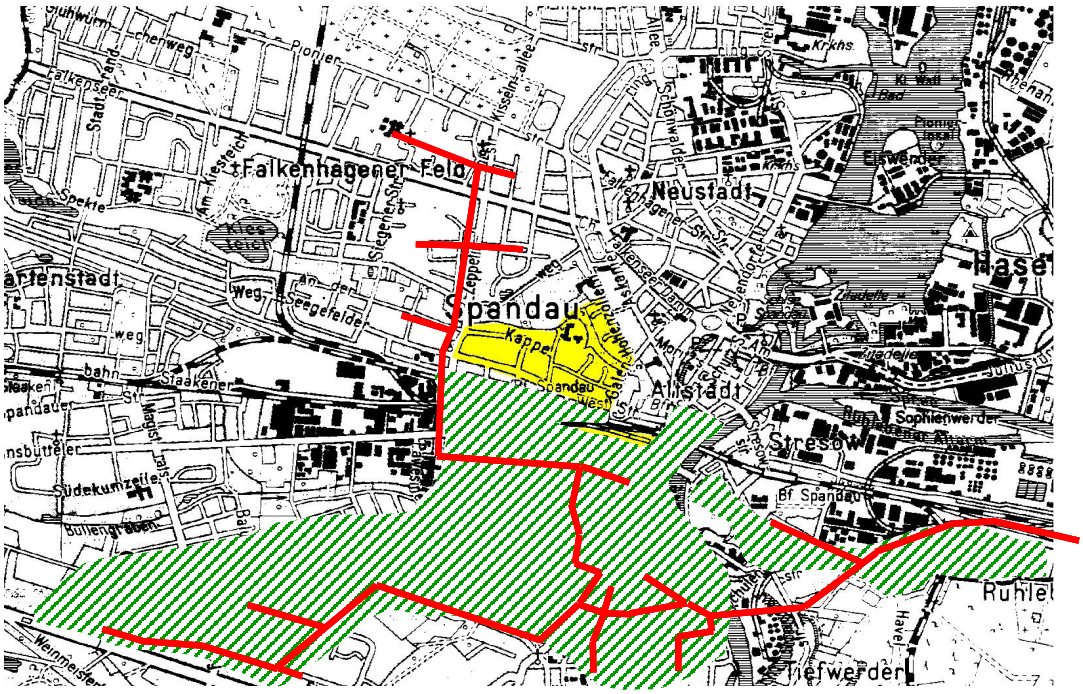


CO_2 savings as of 03/2011 for the planned capacity development

The municipality of Spandau sees the possibility of reaching its carbon dioxide reduction commitments by connecting its buildings as well as expanding the District Heating grid. The "Spandau CO_2 Clock", in the foyer of Spandau Town Hall shows the current amount of CO_2 saved due to conversion to District Heating supply. Signing of 14 District Heating contracts for municipal properties: Construction Councilor Carsten-Michael Röding, Detlef Lohr and Thomas Bünger from Vattenfall Europe Wärme AG (from left to right) on 25th November 2009. Because of the conversion of heating to District Heating about 1,800 tons of CO_2 will be avoided.

Within the development area there are approximately 2,800 buildings with a living area of approximately 3.5 million m^2 (including public buildings and schools). This requires an estimated 250 MW of heating. Within the framework of the District Heating expansion in Spandau, which is competing with other heat carriers, there is an expected connection potential of 121 MW. This corresponds to about 2.5 million m^2 of heated area or 35,000 households. This includes 111 MW of new connections as well as the replacement of a heat plant with 10 MW capacity. The connections are anticipated to be completed by 2016.

Due to the District Heating grid extension with the planned capacity, the municipality and Berlin will save about 48,000 tons of CO_2 emission per year.



Bereits versorgt (An der Kappe u. Spandau Arkaden)

Overview of District Heating Connections in Spandau

Overall, District Heating pipelines with a total of 19 kilometers with a diameter DN 700 to DN 150 are planned. The house connecting pipes required are not included. The district heating pipelines have been designed with a variable operation mode in a two pipe system. The parameters are supply temperature of maximum 110°C with a supply pressure of maximum 16 bar as well as a variable operation mode in summer of 80 °C. The pipelines are constructed for a maximum supply temperature of 130 °C. This results in the possibility to raise the supply temperature when the current pipeline is being used at full capacity, thus allowing the connection of the additional potential customers.

The main supply pipeline starts at the power plant Reuter. For about the first 1,000 meters it runs above the ground beside the railroad embankment on the plant property and then along a rail bridge that crosses the ICE line. Because this bridge is being re-newed, the existing District Heating steam pipeline will be temporarily used for the first four years. After this, the final pipeline (DN 700) will be laid across the bridge. Outside the power plant all pipelines are being laid below the ground along public streets. The

Havel River is crossed by a 110 meter long tunnel at a depth of 20 meters with an initial width of DN 700.

The security concept provides for a diameter from DN 700 to DN 300 of the pipeline and a maximum space of 500 meters between inspection shafts. This makes it possible to empty the pipeline sections in about 1.5 hours and to complete repairs within 24 hours. The pipe system is constantly monitored in order to identify any damage and repair this quickly.

Normally all District Heating house connection stations will be connected indirectly. This separates the customers` heating system from the primary net. For these measures a special heat supply contract with a specific description for the heat station and a circuit diagram was designed.

The Havel River crossing was a special technical challenge. It is near the Havel Channel intersection with the Berlin Glacial Valley. The water table level is influenced by the level of the Havel River and this is on average 2 meters below the surface.

An unused harbor area on the east bank of the Havel River, the start shaft side, provided adequate room for the construction site and material storage. On the west bank of the Havel River there is a 17 meter wide unsealed path with access restricted by a 3.2 meter high bridge. This was a hugh challenge for the construction logistics on the side of the second shaft. The Havel River is contained by 12.5 metre deep bank sheet pile walls. The placement of the pipe tunnel at this depth was not permitted by the authorities. The distance between the lower edge of the bank sheet pile wall and the upper level of the tunnel had to be at least the external pipe diameter of 3.2 metres. This meant that the external upper wall of the tunnel had to be at least 15.7 metres below the surface.

With the placement of the 24.5 meter auger piles in February 2009, the start construction trench was commenced. Two drills were used parallel in order to meet the deadline of the opening of the District Heating pipeline in September 2009. After this the auger pile wall of the target shaft was constructed. The 23 meter deep target shaft excavation trench was dug using a cable excavator on a stilt pontoon on the Havel River. The 2 meter thick and proven under water concrete soles were anchored via 10 cm deep pockets in the auger pile wall. After pumping the initial construction shaft dry, it was possible to install pressure equipment, the extendable seal and all other equipment necessary for the construction.

The tunnel was constructed using a concrete pipe pressing procedure. Here, a pipe section is pressed from the start shaft towards the target shaft with the assistance of an hydraulic driven pressing machine that is connected to the head of the pipe. A new pipe pressing machine was used, doubled to 3.2 mm, in order to progress against the high pressure from the ground water in the 114 meter long pipe tunnel.

The re-inforced concrete pipes with a harden case have a diameter of 2,600 mm, an external diameter of 3,200 mm, a length of 3,5 meters and a weight of approximately 25 tons. They were delivered from the concrete plant on 3 semi-trailers using a special transport permit.

The excavated earth and all the excavation material from the start and target shafts were transported for processing via the water. Guided by a computer supported laser system, the machine reached the flooded target shaft to the exact centimeter after only 8 days. The best daily distance was 17.5 meters in 12 hours.

To recover the 104 ton concrete pipe pressing machine and the drill heads and then load them onto a barge, a 500 ton crane had to be manoeuvered along the very narrow access path and under the low bridge to the target shaft trench.

Immediately after the recovery of the pipe pressing machine, the work for the inner re-inforced concrete layer for the target shaft began. Parallel to this, fitting pipes into the tunnel from the start shaft commenced.

Two steel pipes, DN 700, were connected by bolts to anchoring rails in the support construction (fitted in the factory) in the tunnel pipe. Between the pipes there is a passage allowing for inspections, technical service and maintenance work. A fixed pipe point was set in the middle of the tunnel. The strain is absorbed by the 15 meter long Z-bows in the start and target shafts without compensators. The tunnel can be separated from the grid via 4 isolation flaps located in the start and target shafts.

In September 2009 the pipe line in this construction section began operating on the scheduled date and the first customer in Wilhelmstadt was supplied on time for the start of the heating period with environmentally friendly District Heating.

3.1. Spandau Information

By 28.02.2011 customers' buildings with a capacity of 15.8 MW of heat were connected to the new District Heating grid. By the end of 2011 this should reach a total of 44 MW. This is a current CO_2 reduction of 3,800 tons p.a. which will rise to 10,600 tons p.a. by the end of 2011.

This amount of CO_2 reduction is the same as saving 7.8 million liters of heating oil.

As a comparison: to transport this quantity of heating oil a train with 102 4-axle boiler carriages each filled with 77,000 liters would be necessary. The train would be 1,480 meters long.

3.2. Inclusion of Biomass in the Combustion Process

The use of re-generative wood fuel results in additional CO_2 emission reduction immediately. An increase in the use of wood chips is therefore an important part of our climate protection agreement with the Berliner Government.

To reduce CO_2 further, as of 2009, the inclusion of biomass in the combustion process at CHP Reuter was introduced. In 2009 1,874 tons and in 2010 3,358 tons of uncontaminated chips were used. It is planned to increase the amount burnt to 30,000 tons p.a.

Among other things, in January each year, the Berliner Stadtreinigung (BSR) collects about 400,000 Christmas trees that have been in Berlin living rooms. Since 2009 these Christmas trees, cut to wood chips, are used in the CHP plants to produce energy and heat. At the Reuter power plant these Christmas trees are substituted for about 2,000 tons of coal and reduce the CO_2 emission by about 3,000 tons p.a.

3.3. Primary Energy Factors

For the generation of district heating in CHP plants, Vattenfall was certified with a primary energy factor of 0.567 by the Technical University of Dresden. The total proportion of all Vattenfall's generation plants in Berlin is 93%. For buildings heated with gas and oil the comparative factor is set at between 1.1 and 1.3.

In 2010 the total heat requirements of customers connected to this system was covered by 61% hard coal, 27% gas and 11% from a refuse incineration plant and biomass.

3.4. Major Advantages, Positive Effects

Due to the measures a city area is developed by the efficient energy CHP heat production. Numerous individual furnace plants and night accumulator heaters were replaced. We are contributing a considerable contribution to climate protection in Berlin and the reduction of CO_2 emission, especially in the Municipality of Spandau. Beyond that the expansion of CHP plants in Germany is supported.

In this process the company alone carries the investment risk. The major pipelines are constructed before the customers are connected.

The technical preparation and construction process of the large pipelines (DN 700) within the inner city residential areas combined with the special construction sections for crossing the Havel River and an ICE train line of the Deutsche Bahn present exceptional challenges for the employees involved.

3.5. Quality of Life

The expansion and use of Combined Heat-Power generation has positive effects (saving of primary energy, CO_2 reduction) for the climate situation and work against global warming.

The quality of life in the expansion areas is positively influenced due to a reduction of fuel deliveries and pollution emission from individual furnace plants.

By delivering energy directly to the doorstep, the customer is relieved of purchasing fuel, boiler maintenance, chimney sweep, investment reserve funds, insurance risks etc.

Additional points are that less room is required as the boiler, chimneys, coal storage and oil or gas tanks are no longer required. The additional room is available for customers to use for other purposes.

Our moderization of the heat supply increases the value buildings and owners no loner need an investment fund for a new boiler.

CO_2 Button for Spandau

4. Summary

In the Berlin Climate Protection Agreement, Vattenfall and the State of Berlin are committed to a significant reduction of CO_2 emissions. The expansion of District Heating is one component for reaching this ambitious target.

Vattenfall Europe Wärme AG is constructing a new District Heating grid in the Berlin municipality of Spandau. Within 9 years approximately € 60 million will be invested. The financial resources have been approved by the company.

The construction began in spring of 2007. Within the period 121 MW will be connected to the District Heating network, the equivalent of 35,000 households. The heat will be generated using 93% environmentally friendly combined heat-power process. Each household connected to the grid reduces CO_2 emission by about 1 ton p.a. Overall the emission of approximately 48,000 tons of CO_2 will be avoided.

Overall 19 kilometers of main pipelines will be laid. To develop Spandau it was necessary to use concrete pipe pressing to construct a walkable pipe tunnel (DN 2600) under the Havel River.

Within the development area a two-pipe system is being constructed. The maximum supply pipe temperature is 110° C, the maximum pressure is 16 bar.

In the foyer of the Spandau Town Hall there is a "CO_2 clock" showing the current amount of saved CO_2 due to conversion to district heating.

The very favorable primary energy factor of 0.567 supports building owners to implement the requirements of the Energy Saving Regulation (ENEV).

Climate protection in Berlin is being considerably furthered due to the expansion measures of combined heat and power generation and the use of biomass for generating heat. In particular, CO_2 emission in the municipality of Spandau is being reduced.