FOCUS

DISTRICT HEATING IN GERMANY

DBDH - direct access to district heating technology
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In this edition of HOT|COOL we have put focus on district heating in Germany. Why? Because these years the district heating sector in Germany is really changing. Fuel is being replaced to reduce the CO2-emissions, and the national legislative framework is supporting the further development of district heating.

DEVELOPMENT OF THE NATIONAL DISTRICT HEATING MARKET
According to the statistical office, district heating has a market share of 13.2% of all dwellings. But there is a big difference between West and East Germany with regard to the district heating market share. The market share is around 8 % in West-Germany and around 31 % in East Germany. While the market share leaves a lot of room for growth, Germany is, together with Poland, the biggest market for district heating and cooling (DHC) in the EU.

The fall in the heat demand – as a consequence of energy saving initiatives – is compensated for by the intensification of existing district heating grids in urban areas, opening up development areas with isolated networks and local small-scale district heating and contracting projects. Renewable energy sources (RES) play an increasingly important role in the development of the sector.

FUEL USED FOR DISTRICT HEATING OVER THE LAST 10 YEARS
When looking at the data from the German district heating sector, a gradual shift from coal to natural gas at combined heat and power (CHP) plants can be observed in the last ten years. CHP is the biggest source of energy, with a share of more than 80 %.

This gradual shift can be attributed to a change in political focus. Following the oil crises in the 1970s, indigenous resources such as hard coal and lignite came into focus of the government in order to decrease the country’s dependency on oil and ensure security of supply. This also had an effect on DHC and CHP, which can still be felt today.

Today the political focus lies more on CO2 emissions and more recently on more flexible installations, leading to a shift away from coal.

In 2002, over 50 % of the input energy for CHP in DHC came from coal or coal products and around 35 % from natural gas.

In 2013, the share of coal or coal products was well below 50 % and the share of natural gas was much higher.

NATIONAL LEGISLATIVE FRAMEWORK HAVING AN IMPACT ON DISTRICT HEATING
A lot of the national legislation has an important impact of the development of the German district heating sector:

- **Combined Heat and Power Act (KWKModG)**
The combined heat and power act obliges grid operators to connect CHP plants to their grid and give priority to buying electricity from cogeneration. The act was recently amended as one of the pillars of the new energy policy. The target of ensuring that 25 % of electricity comes from CHP has now been timed for 2020. This means the share has to almost double from the current 13 % within the next seven years!

- **Act on the promotion of renewable energies in the heat sector (EEWärmeg)**
The basic instrument is an obligation to use energy from renewable sources to a certain extent in newly built buildings (or existing buildings if the federal states so desire, see below). District heating is not considered a renewable energy source per se but if the heat is produced by a substantial share of RES, with a share of at least 50% of CHP or waste heat or a combination of these, district heating is considered as an alternative measure and the obligations to use RES are deemed to have been met.

- **Ordinance on general conditions for the supply of district heating (AVB FernwärmeV)**
The ordinance sets a general framework for standard business conditions for the supply of district heating to customers. Customers that are connected to the district heating grid have the right to be supplied according to the general conditions laid out in the ordinance if standard business conditions are being used.

- **Energy saving ordinance (EnEV)**
The ordinance aims to reduce the primary energy demand of buildings to reduce the use of resources and to reduce greenhouse gas emissions. The obligations can be fulfilled by either using more insulation or more efficient systems engineering or primary energy sources. The system in general therefore reflects the efficiency benefits of district heating based on CHP.

I hope you will find the articles concerning the German district heating sector interesting and at the same time we wish you all a nice summer.
New political winds are blowing across Europe. The aim is resource efficiency, but the means to this end are more blurry. In the Energy Tower – a new waste-to-energy facility in Roskilde, Denmark, which will be commissioned this summer – there is no hesitation. Waste is an energy resource, and every possible effort is put into maximising the recovery of the energy resource in the waste.

“Our resources are scarce, and we have to ensure that they are not lost in our waste management.” Similar messages are repeated again and again in political statements and in the media. Explanations as to which resources we are talking about and how we avoid wasting them are, however, in short supply.

THE MOST SIGNIFICANT RESOURCE OF WASTE
Waste may contain many different resources depending on origin and prior use. The resources of waste may be considered a material resource, an energy resource or a nutrient resource, and typically a waste fraction will comprise a mixture of these in varying quantities.

When evaluated from a material’s and nutrient’s point of view, however, many waste fractions do not contain any significant recyclable resources without them first being subjected to thorough sorting and cleaning processes – processes which both economically and in terms of energy are very costly. At modern waste-to-energy facilities with combined heat and power production we can ensure a highly efficient recovery of the most important resource of these waste fractions: energy.

RECOVERY OF THE ENERGY RESOURCE IN THE ENERGY TOWER
The utilisation of the energy resource of waste is precisely the objective of the new waste-to-energy facility in Roskilde called the Energy Tower, which is presently being built by the inter-municipal waste management company KARA/NOVEREN. Focusing on maximum utilisation of the energy resources in the waste it may be carried out with practically no losses.

When materials resources are recycled, an actual environmental benefit only occurs if it results in savings of virgin materials. Similarly, for it to be an environmental benefit, the recovery of the energy resource has to supplement other energy production whereby the consumption of fuels and/or materials is spared.
Despite worldwide efforts to reduce our reliance on fossil fuels by developing alternative renewable energy production, the production of both power and district heating will in the coming 20 years continue to be broadly based on the use of fossil fuels, which is why the utilisation of the energy resource in waste both saves fossil fuels and their emission of greenhouse gases. Even though many European countries are planning a conversion of their energy production from being based on fossil fuels to bio fuels, energy recovery from waste will continue to be an environmental benefit as it will save bio resources, which are expected to become a scarce resource in the future.

So by utilising the energy resources from waste in the Energy Tower it is not only the national consumption of fuels that is saved, but the environment also benefits from lower emissions of greenhouse gases and scarce resources are preserved.

**FOCUS ON ENERGY OPTIMISATION**

In the Energy Tower the waste is utilised through conversion into energy in the form of power and district heating. Focus is on reaching the highest possible efficiency in order to avoid any loss of resources. In the waste treatment process in the Energy Tower, heat is produced in the boiler room and used for the production of steam in a boiler. Through this process, some 85-90% of the energy content of the waste is transformed into steam, and the steam is subsequently converted to electricity and district heating in a turbine.

Earlier generations of waste-to-energy facilities stopped the energy recovery processes at this point, but increased focus on energy efficiency in the Energy Tower has resulted in the installation of flue gas condensation in order to increase the production of district heating. With flue gas condensation the temperature of the district heating water returning from the city is raised, and heat production is further increased by approx. 10%.

KARA/NOVEREN has decided to go even further. In the recovery processes a certain amount of electricity is required to operate pumps and fans etc., and KARA/NOVEREN will reduce the electricity consumption of the Energy Tower by establishing a component cooling system driven by district heating. The component cooling system is a necessary installation in any modern process plant and hence also a necessity in the Energy Tower. However, instead of cooling away the heat with a traditional electrically powered cooling compressor, KARA/NOVEREN has established an absorption cooler driven by district heating water. The need for cooling is at its highest during the summer when the general need for district heating in turn is at its lowest and as such has the lowest recycling value. The total process energy consumption is thus lowered, and the utilisation of the energy resource in the waste is maximised.

With the high utilisation of the energy resource in waste in the Energy Tower – a total energy efficiency rate of almost 100% – KARA/NOVEREN will on the basis of 200,000 tonnes of waste produce electricity corresponding to the consumption of 26,000 households, while the production of district heating will correspond to the consumption of some 26,000 households.
As such, the Energy Tower is not only one of the most modern and energy efficient facilities for the utilisation of the energy resources in waste in Europe; the energy recovery is increased by 35 % as compared to the facility's two old units, which are taken out of operation when the new unit is up and running. Old technology from the 1980s will be replaced by state-of-the-art technology benefitting both climate and environment.

With future alterations of framework conditions for waste-to-energy plants putting even more emphasis on the utilisation of the energy resources in waste, along with a higher valuation of the energy resources recovered, the waste-to-energy facilities of tomorrow will most likely be equipped with heat pumps coupled to the flue gas condensation. This will increase the energy efficiency even further and enable flue gas condensation in systems with relatively high flue gas temperatures.

RECYCLING AND EFFICIENT ENERGY RECOVERY ARE PARALLEL PROCESSES

It is beyond any doubt that part of the European resource efficiency ambition is to maximise recycling. We should do all we can to further increase recycling percentages, without compromising on economic and environmental sustainability. At the same time we have to increase the effort to maximise the recovery of energy in the residual waste, which cannot be recycled in a sustainable manner.

Denmark has for many decades demonstrated that high recycling percentages, even among the highest in the world, are compatible with waste-to-energy and that with innovative thinking and dedicated effort both recycling and energy efficiency can be further increased in parallel. Many other European countries are following suit after having dealt with the stigma of waste incineration and unsuccessfully tried out alternative ways of utilising the resources of their waste. They now know that the Energy Tower in Roskilde is among the places to go if they want to study waste management excellence.

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MAKING MODERN LIVING POSSIBLE
BEAUTIFUL BAMBERG HAS A NEW ATTRACTION

By Jesper With, Journalist

New life is given to an old industrial complex near the city centre of UNESCO protected Bamberg in Germany. The old outer walls have been carefully restored and inside, elegantly designed flats are welcoming the tenants. The flats have been provided with district heating and a DanFlat system, which leads to energy savings of 10-15% and a high degree of comfort.

A couple of years ago, Bamberg's small island ERBA-Insel in the middle of the river Regnitz was consisting of nothing but old industrial buildings in a bad condition after not having been used for its original purpose for several decades. But in a very short time, approx. 400 student flats have been constructed inside the old imposing industrial walls, giving new life to the old 60,000 square metre former textile factory. The outer walls have been refurbished with respect to their history and the original purpose of the impressive 6-storey building is still clearly visible from outside.

A FLAT STATION IN EACH STUDENT FLAT

The students have already moved into their new 1-room flats equipped with state-of-the-art kitchen and bathroom. The rooms are fully furnished and supplied with the newest equipment concerning heating, hot water supply and sanitary appliances. Each flat has its own flat station, delivered by Danfoss, placed in the bathroom. Contractor Valentin Dittrich shows one of the student flats. Dittrich's company is responsible for the installation of the flat stations and having worked with Danfoss for several years, his employees have a deep knowledge of how they function.

HOT WATER ON DEMAND SAVES ENERGY

The 40 KW flat station in each apartment supplies heating and hot water for the tenants. It is equipped with a built-in energy meter that monitors the consumption of heat and water, providing accurate data for billing and trouble shooting. The staff at Stadtwerke Bamberg - the local supplier of district heating - can call the meters through an integral radio link, which enables remote data collection via a hand-held Bluetooth receiver. In this way, they do not need ever to enter the apartment to read it. "It’s a big advantage that the flat station gives you hot water on demand because you don’t need to store any water. Only the water that the resident actually uses by turning on the hot water tap is heated. As a result, an estimated 10-15 % of energy is saved compared to old systems with hot-water tanks", Michael Schumburg, Marketing Manager at Danfoss GmbH explains.

Indirect versions of flat stations feature a heat exchange module, which acts as an interface between the hot water main supply from the heat exchanger in the basement and the circuit within the flat. In this way, heat energy can be taken efficiently from the district heating system, while the heat system within the apartment is sealed.
This means that domestic hot water is prepared from fresh water at any time. This is a legislative requirement in Germany, since the delivery of drinking hot water in buildings with hired flats needs a regular Legionella approval, when storage tanks contain more than 400 liter or the pipework has a content of more than 3 liter.

By experience, Valentin Dittrich knows that the risk of Legionella (pneumophila) is bigger in student homes than in general, since students are sometimes away for longer periods of time, e.g. during holidays or similar. “We avoid that risk, because of the absence of hot-water tanks. Here, the water becomes hot in a few seconds, and therefore the Legionella bacteria have no chance,” he says.

HEAT PIPES SOLVES HUMIDITY PROBLEM

One of the challenges of the project has been to dehumidify the old thick walls and to find a way to keep them dry. This is done by the use of thin heating pipes, which are installed in panels along the 150 years old walls. Since the walls are not plastered the solid stones in the walls are visible in corridors and common areas. This contributes to maintaining the buildings’ character as an industrial building, with respect to its history.

The same heating pipe system is being used in the student apartments, and therefore no radiators are to be found in the complex. Still, the resident can regulate the room temperature by using a thermostat connected to the heat pipe. “Our preliminary measuring of this system shows that heat loss per square metre is actually lower than in new buildings and the old walls stay dry, so we are very satisfied with this solution”, Valentin Dittrich says.

DISTRICT HEATING: THE ENERGY EFFICIENT CHOICE

The entire island is supplied with district heating delivered by Stadtwerke Bamberg. In the basement under the main building, a pipeline containing water with a temperature of 70 to 80 degrees C (depending on time of the year) is entering from the district heating plant. The pipeline is connected to a heat exchanger, where hydraulic separation takes place. After this process, each flat station is able to take exactly the amount of energy that it needs. This is more energy efficient than a traditional boiler, which would be the alternative, since there is no need for a hot water cylinder. Thus, it saves a lot of energy. The pipe that is leading the return water back to the district heating plant is connected to the building in the same basement room.

Danfoss developed the specific design of the heating system together with the engineering company Gaal+Gall and the consultancy engineering company JA Consulting. According to project manager Thomas Frank from JA Consulting, the biggest challenge of the project has been the huge size of it compared to the short time the owner, the University of Bamberg, gave to finish it. It was the wish of the university to let the first students move in only a few months after starting the project, while the company still working on other parts, but they succeeded. The whole 6-storey main building, where the textile production used to take place, is turned into a total of 400 student apartments, common rooms, laundry etc. In a former administration building next door, a restaurant and a café have opened, where students are able to have a comfortable meal with a view to the river Regnitz, which surrounds them.

FACTS

The project of the former textile factory involves 400 student flats and 24 apartments for families. Each apartment is supplied with heating and hot water through a flat station from Danfoss. Moreover, several new exclusive blocks of flats and a new department of the university of Bamberg will be built on the ERBA-island.

300 out of 400 student flats are constructed in the former textile factory, which was built in 1878. It has 6 floors and a total floor space of app. 60,000 square metres.

Student flats and apartments for families are all new and built with a high degree of energy efficiency. The heating system (EvoFlat units connected to the public district heating system) saves at least 10-15% of energy compared to a traditional heating system including hot water tanks.

Bamberg is one of Germany’s most beautiful cities. The city centre is built in baroque style and is in a very good condition. It is on the UNESCO list of World Cultural Heritage.

TECHNICAL DATA

Energy source: District heating
Design temperatures for heating: 70/40°C
Pipe system: double pipe system
Domestic hot water heat exchanger: DHW capacity: 40 kW 70/20°C 10/50°C
Heat emission: in wall pipes
DanFlat units: Termix VMD-F-1 T24 Bamberg

Photos: Christian Alsing

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Quality awareness and energy efficiency are the characteristics of the multi-utility, Stadtwerke Flensburg, the energy and water supplier in the northernmost city of Germany. The utility has since 1894 supplied the city with electricity, but especially since 1969, when the utility began the operation of a Combined Heat and Power plant (CHP), Stadtwerke Flensburg has delivered the live proof of the efficiency and flexibility of district heating technology, today even more so through the integration of renewable energy sources in the district heating distribution system.

The energy efficiency brand of Flensburg is being emphasized by the Climate Pact, which the utility and 15 other companies and institutions in the city have agreed upon in order to reach the ambitious goal of CO2-neutrality in 2050. On the road to this efficiency end, energy metering plays a vital role as the important means of procuring consumption data – data that is needed not only for billing, but even for the documentation of the effect of various climate improving initiatives. Stadtwerke Flensburg is therefore very focused on the quality and the accuracy of the heat metering equipment.

A DISTRICT HEATING EXAMPLE TO FOLLOW

In spite of the modest size of the city with ca. 90,000 inhabitants, Stadtwerke Flensburg nevertheless holds a place among the largest district heating suppliers in Germany due to an amazing 96% district heating coverage. The utility maintains 17,000 metering points, 700 km distribution grid, and it supplies a number of neighbour towns, among which the Danish Padborg Fjernvarme a.m.b.a. with 1,800 customers of their own is the largest single customer for Stadtwerke Flensburg.

[Note: The customers of Padborg Fjernvarme are being sub-metered. A main meter between Stadtwerke Flensburg and Padborg Fjernvarme is placed directly on the border between Germany and Denmark. This cooperation shows that as well as the European distribution grids for gas and electricity are connected, so are the district heating grids.]

Flensburg is an exemplary city with regards to energy efficiency. Decades before anyone knew about climate change and the Kyoto Protocol, the citizens of Flensburg enjoyed environment friendly heating of their homes. The Combined Heating and Power plant (CHP) has now for well over 40 years been recovering the surplus heat from the power production and channelled it into the district heating system.

The initiator of the Flensburger CHP, former director Wolfgang Prinz, spoke in the German Bundestag in Bonn in 1981 with great verve about the advantages of district heating: “The case is quite obvious,” he said, “The resource, which others use to heat up their air and their rivers, we use to heat up our living rooms in Flensburg.”
stadtwerke flensburg has for more than 40 years been an icon of energy efficiency in germany. [note: wolfgang prinz, director of stadtwere flensburg, 4 february 1981 in bonn. source: der spiegel, no. 16/1981: “fernwärme für die halbe republik.”]

he succeeded in convincing both the lord mayor of saarbrücken, oskar lafontaine, and the then chancellor, helmut schmidt, of the efficiency of the district heating concept. both paid visits to flensburg.

wolfgang prinz was a prophet, who with great success marketed flensburg as a district heating model. but although the benefits seemed obvious, he had to fight hard resistance from the industry. his adversaries claimed that district heating would not be feasible in flensburg because of the undulating land of the city with level differences of up to 90 metres. but wolfgang prinz had made educational trips to the nordic countries, where he had convinced himself of the practicability of the project. the result was that already in 1974 50% of the residences in flensburg were connected to the district heating grid, and by 1985 the percentage had risen to 98%.

combined heating and power is very common in the nordic countries, but relatively rare in germany, where de-central heating sources like gas and oil are much more used. generally for germany only 14% of all residences are being supplied by district heating.

[note: source: agfw branchenreport 2006. for the sake of comparison approx. 60% of all danish residences are supplied by district heating (source: euroheat and power 2013)]

the chp in flensburg is furthermore characterized by a very high efficiency even compared to other chps. by recovering the surplus heat from the power production, stadtwere flensburg is able to exploit 83% of the energy source. power plants without heat recovery use only up to 40% of the energy source because the heat is being dissipated into air or water.

integration of renewables

the german energiewende (the national transition from nuclear power to renewable energy sources) is once more drawing attention to flensburg because of their energy efficient methods. after fukushima eco-power from flensburg has become a commodity in high demand. eco stands for nuclear-free, and stadtwere flensburg is certified provider of nuclear-free electricity. this means the flensburger utility has acquired valuable experiences with the integration of renewables and as a matter of fact provides 120,000 residences outside flensburg with electricity.

as a consequence of the energiewende, there is much more wind and solar power in the system, which must be handled efficiently. in january 2013 stadtwere flensburg commissioned a large electro-boiler. it’s a relatively primitive technology where six large electric immersion heaters can use surplus power from renewable production to heat up the district heating water to 100°c, which is then being fed into an enormous tank containing 29 million litres of water. the hot water can then according to need be circulated in the flensburger district heating grid.

the heavy expansion of solar and wind power plants is causing frequent surpluses of power in the grid – power that cannot be stored. but the district heating system can nevertheless make avail of the power surplus and thus effectively save co2-emissions.

when there is an oversupply on the electricity market, stadtwere flensburg is therefore not only able to purchase electricity at a very favourable price, but is actually also offering a very flexible way of integrating the volatile renewables into the energy system.

stadtwere flensburg is furthermore in the process of partially replacing coal with natural gas, being a much more environmental friendly energy source.
ENERGY AND ENVIRONMENT

**Best Practice in District Heating**

The gas and steam turbine, which is planned to be commissioned in 2016, will with a prospective efficiency of 92% once again exceed the current exploitation of the energy resource. Furthermore, the utility expects a reduction of the CO2-emission by 40%.

**CLIMATE PACT**

The utility plays an important role in the region as a climate model and takes responsibility for the general energy awareness in the population. In a Climate Pact between companies and public institutions in Flensburg, the utility has committed itself to contribute to make the city CO2-neutral by 2050. In order to achieve this ambitious goal, a reduction in energy consumption, as well as an increase in energy efficiency, is required.

A number of initiatives are therefore being launched including the deployment of electric vehicles and building renovations according to climate friendly standards. The project is being supported by the EU.

The City has hired four so-called climate managers who are acting as consultants in energy management for the participating organizations in the Climate Pact. One of their important tasks is to document the heat efficiency and to determine the heat loss so that targeted building renovations and other energy improvements can be initiated.

Under the motto “If you don't measure, you don't know”, the amount of heat energy that is being consumed and the amount that gets lost in the distribution grid must be determined. Thus a vital role is being assigned to the heat meters.

**HEAT METERING FOR HIGHER ENERGY EFFICIENCY**

For several reasons the reliability of the measuring equipment becomes increasingly important.

When optimizing the heating system to reach 100% efficiency, the small margins count. This poses a challenge for the heat meter’s accuracy as even small amounts of energy must be registered. And at the same time the general environmental awareness grows in step with the energy prices, and the consumers demand insight into their consumption patterns and into the details of their energy bill.

New consumer habits and new building technologies require more from the heat meter. An example is the low energy houses that are becoming more and more widespread – here live the very energy conscious consumers, who have an accordingly different consumption pattern. These modern energy efficient houses often have no boiler, but take instead the heat energy directly via a heat exchanger. As an effect, drawing off hot water where the water tap is suddenly being opened and shut off again, will show as a short peak in the consumption pattern from a very low normal heat consumption of maybe 2 kW to suddenly 20 kW and then back to normal. In order to register this kind of consumption and thus to offer the customers a fair and correct bill, the measuring method must be adequate.

As a consequence Stadtwerke Flensburg uses only ultrasonic heat meters with a very high dynamic range, which means that the meter registers the consumption with equal precision in the whole temperature spectre and at both low and high flow rates. Furthermore, the registration of the water temperature is being updated at extremely short intervals so that even small amounts of hot water are being registered and calculated by means of the high resolution volume impulses of the ultrasonic flow sensor.

The integrated data logger stores hourly consumption values for 1392 hours, daily values for 460 days, monthly values for 36 months and yearly values for 15 years. These logger values can be read out electronically and presented as graphic charts to form the basis of a targeted energy counselling.

**APPROVED QUALITY FOR THE FUTURE**

Stadtwerke Flensburg operates its own test lab for quality assurance of incoming meters and for re-verification of meters. Through these in-house inspections and tests, the utility has gathered several years of experience regarding metering accuracy and the reliability of different meter makes. According to German law heat meters must every five years be submitted to re-verification or sample inspection respectively. From a certain meter type a specific percentage of meters are taken down for inspection. A lot of 1,200 meters will still be accepted if it contains one deficient meter, but if just one more meter exceeds the prescribed tolerances, the whole lot of meters must be exchanged. This is of course a costly matter, and meters with long-time stability are therefore preferred.

The overall lesson to learn from Stadtwerke Flensburg is that a high quality standard and a sharp focus on how to optimize the energy efficiency is the most future proof strategy to
The long experiences with district heating and CHP have provided a solid foundation for a sound business case even in the difficult time of a global energy challenge. Stadtwerke Flensburg has adapted itself perfectly to the transitional period of integrating renewable sources and at the same time succeeds in keeping a high supply security at a low cost.

**ABOUT STADTWERKE FLENSBURG GMBH**

Stadtwerke Flensburg supplies as a modern and environment conscious energy supplier in the region of Flensburg approx. 60,000 residences with power, district heating and water. Nationally the corporation has attracted more than 115,000 new private customers so that approx. 175,000 residences are supplied with electricity from the Flensburg supplier. Stadtwerke Flensburg offers individual solutions for industry customers.

With a turnover exceeding 345 million Euro and about 1,000 employees, Stadtwerke Flensburg has gained a solid position on the energy market. In Schleswig-Holstein the corporation holds a place among the top 50 employers and ranks among the largest and most economic district heating suppliers in Germany. 98% of all residences in Flensburg are district heating customers at the Stadtwerke. Power and heat are produced with respect to the environment in a Combined Heat and Power plant directly at the Flensburger Fjord.

The corporate strategy states that Stadtwerke Flensburg must remain a 100% subsidiary of the City of Flensburg and is obliged to pay respect to the ecological sustainability of its actions and decisions. This includes the compliance with an extensive Eco-Catalogue. Within the greenco2ncept project the energy supplier is achieving CO2-neutral production by 2050. In Flensburg the Stadtwerke supplies their customers with nuclear free power since mid 2012.

**Call 72 44 02 50 for further options**

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Heat meters after incoming inspection ready for installation.
Germany has decided to convert its energy power supply fundamentally.

The goal is by midcentury to provide the energy supply on new foundations. In 40 years, electricity should be generated from renewable sources to 80%. Already in 2022, the last nuclear power plant is to close down and be disconnected from the grid.

This requires new cable networks, new power plants and new energy storage facilities.

Today, nearly a quarter of the German electricity is generated by wind, sun, biomass or hydropower.

The ultimate tool for controlling the expansion of renewable energies in the heat market is the renewable energy heat act. The basic principle is support and challenge: new buildings must obtain at least a portion of their heat from solar or geothermal energy, ambient heat, biomass or biogas. The result is that the new buildings in the years 2009-2011 will save 2.4 TWh per year; less fossil fuel is consumed and thus 640,000 tons of greenhouse gases is spared. The market incentive program has proven itself over many years. Promoted are, for example, solar thermal plants with heating networks.

The energy revolution is a large transformational process. The success depends on the most modern techniques being used. In Lower Saxony, large solar parks, onshore and offshore wind turbines and biogas plants are built. Thus, 39% of the Lower Saxony electricity consumption is already based on renewable energy sources, which is above the national average of 25%.

CHP ON STRAW
Bioenergikraftwerk (bio-energy power plant) Emsland GmbH & Co KG is building a straw-fired combined heat and power (CHP) plant in Emlichheim / Lower Saxony, which is unique in Germany. The power plant is designed for approximately 13 MW of gross power activity and 49.8 MW thermal capacity. Process heat for high temperature steam will be supplied to the neighboring starch plant of the Emsland Group.

Besides France, Germany has the largest straw potential within the EU. A total of 42 million tons of grain gives about 37 million tons of straw. After observance of a variety of different studies the IFEU Institute (Institute for Energy and Environmental Research) proposes to use about one-third of the resulting grain straw as an energetic commercial potential. This results in an annual straw potential of approximately 12 million tons for energy use.

Absolutely dry straw has a heating value of 4.72 kWh/kg. In practice straw has a calorific value of about 4 kWh/kg due to remaining residual moisture of approx. 10–15%. Thus, straw has a slightly higher calorific value than wood (~ 3.3 kWh/kg).

A rectangular bale of straw with the dimensions 2.5 x 1.2 m x 1 m (3 m³) weighs about 500 kg which contains an amount of energy of approximately 2,000 kWh. This is equivalent to 300 kg of coal and 200 liters of gasoil. A conventional straw transport vehicle, loaded with 20 tons of straw on average, is equivalent to 8,000 liters fuel oil. With advanced recovery and compression techniques for square bales it is possible to load up to 24.5 tons per truck today.
Straw is considered to be a CO2-neutral fuel, because the grain absorbs during growth on the field the same amount of CO2 from the atmosphere as it releases during combustion again. So there is no net addition of CO2 to the atmosphere.

Of course, straw consists of more than just carbon. During growth, other substances such as nitrogen, sulfur and chlorine are absorbed from the soil and the environment.

For the energy use especially important elements:
- Corrosion: chlorine, sulfur
- Emissions: nitrogen, sulfur, chlorine
- Slagging: potassium, sodium, calcium, magnesium

These substances require optimal reduction of emissions and advanced burning technology to prevent damage caused by the fuel slagging.

About 75,000 tons of straw are annually required for the operation of the CHP plant in Emlichheim. Straw is supplied from the regional grain cultivation by farmers within an average of 60 km.

The energy use of the residual straw material is in no competition with feed or food production. Farmers thus open up an additional source of income. In addition, the regional livestock industry is supported by the construction of a bioenergy CHP plant by the removal of nutrients, thus creating scope for application of fertilizers. The use of straw improves the overall efficiency of the grain acreage and thus acts in the sense of cross-compliance rules to avoid one-sided cultivation of crops such as canola or corn.

The straw powered plant with its combined heat and power production is based on the classic Rankine principle, which is characterized by the generation of steam in a boiler plant and its expansion in a turbine. Thus, the construction is almost identical to that of a conventional power plant.

From the storage area the straw bales are transported by conveyor belts to the boiler house. At the end of the conveyor belts, a newly developed straw cutter tear up the bales by slowly rotating the blades. After the incineration of the loose straw into the combustion chamber it burns on special water-cooled vibrating grid. The ash is conducted as wet ash from the boiler. The flue gases are cleaned to minimize emissions.

The heat generated during combustion is utilized in the first step in the boiler walls to evaporate water. A separation of the feed water and steam takes place in the steam drum, which is located above the boiler. In a downstream, super heaters heating up of steam to the final temperature of 522°C takes place. This steam is then passed to the steam turbine, which is connected to a generator providing electricity. For the purpose of CHP supply the steam turbine is equipped with

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controlled extraction of process steam (14 bar). This steam is transported through a steam line to the Emsland-Group plant. Another component of this highly efficient CHP concept is a local heating network, supplying public property and private residential buildings in the town Emlichheim with environmentally friendly and climate-friendly heating.

HEATING NETWORK
The district heating system consists of a pre-insulated TwinPipe system. The decision for this underground pipe system was taken due to the extremely low heat loss of these pipes. The heat comes up where it is needed and does not get lost on the way to customers. Two main pipes, dimension 150 TwinPipe, were laid as a ring line to provide a school and the sports hall of the city Vechtetal directly with heat. In addition, substations are placed throughout Emlichheim, to distribute the heat to almost every house in Emlichheim. Therefore the majority of the inhabitants of Emlichheim are supplied with district heating from renewable energy.

Parts of the pipes were placed in the ground by controlled horizontal directional drilling. Horizontal drilling allows environmentally friendly installation of pipes without trenches. Rigs with pull and push force from 6.5 to 200 t. ascend all soil classes using a drilling fluid and means of accurately locating system for a pilot drilling. This drilling is expanded by a backreamer in one or more operations. In the drill hole produced thereby and supported by bentonite suspension, a pipe made of plastic, cast iron or steel is drawn on the withdrawal of the drill string.

Up to now 13.6 km of pre-insulated pipes are put into the ground. The laying of the district heating pipes is carried out by two regional civil engineering and pipeline construction companies, Nusse Kabel- und Rohrleitungsbau GmbH and Jacob GmbH. Based on the latest technology and trained personnel in the district heating technology a very sizable district heating network is growing.

Buried pipes in district heating networks are subject to numerous risks of damage by Public Works in the areas of networks. For this reason, the entire district heating system is equipped with a surveillance system that displays any event of damage to the pipe. As a result errors can be located and possible damages can be repaired. Detectors installed in the power plant provide the appropriate information to a control room.

The plant will not be the only one of this magnitude. BEKW is looking forward to plants on other production sites in Lower Saxony and Brandenburg.

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DISTRICT HEATING IN GERMANY
– INCLUDING THE LEGISLATIVE FRAMEWORK

A gradual shift from coal to natural gas in Combined Heat and Power (CHP) plants can be observed in the last ten years. CHP is the biggest source of energy for District Heating in Germany, with a share of over 80%. This gradual shift can be attributed to a change in political focus. Following the oil crises in the 1970s, indigenous resources such as hard coal and lignite came into focus for the government in order to decrease the country’s dependency on oil and ensure security of supply. This also had an effect on District Heating and Cooling (DHC) and CHP, which can still be felt today. Today the political focus lies more on CO2 emissions and more recently on more flexible installations, leading to a shift away from coal. In 2002, over 50% of the input energy for CHP in DHC came from coal or coal products and around 35% from natural gas. In 2013, the share of coal or coal products was well below 50% and the share of natural gas was much higher. However, the current market situation, heavily influenced by the system of feed-in tariffs for electricity from renewable energy sources, is putting a lot of stress on the economic viability of operating and investing in CHP plants. This has a negative influence especially on natural gas fired CHP plants, which have relatively high marginal costs.

NATIONAL LEGISLATIVE FRAMEWORK HAVING AN IMPACT ON DISTRICT HEATING

COMBINED HEAT AND POWER ACT (KWKMODG)
As a basic instrument, the Combined Heat and Power Act obliges grid operators to connect CHP plants to their grid and give priority to buying electricity from cogeneration. A similar priority exists for electricity from renewable energy sources. The Combined Heat and Power Act therefore clarifies that both these obligations are equal before the law. For electricity from cogeneration, a premium is paid by the grid operator on top of the market price for electricity or the price the CHP plant operator achieved by marketing the electricity from cogeneration himself. By means of a management system, the costs for this premium are shifted towards and shared among all the electricity customers. The premium is granted for a limited time only and serves to offset higher investment costs for CHP plants by comparison with condensing power plants. In order to produce electricity from cogeneration, sufficient heat sinks are needed. In order to reach the target of 25% of electricity from cogeneration, the government realised that incentives had to be granted for opening up new heat sinks. The aforementioned premium therefore applies to new and extended heating networks as well, if they are supplied mainly by heat from cogeneration.

The Combined Heat and Power Act was recently amended as one of the pillars of the new energy policy. The target of ensuring that 25% of electricity comes from cogeneration has now been timed for 2020. This means the share has to almost double from the current 13% within the next seven years. In order to accelerate the development, parts of the framework have been amended. The fixed premium, which is paid on top of the market price, was upped and an additional premium for CHP plants that take part in the EU Emissions Trading System was introduced (+0.3 euro cent / kWh). The threshold for support for District Heating has been raised from 20% of the eligible costs to 30% (average pipe diameter of over 100 mm) and 40% (average pipe diameter below 100 mm). The support now also includes District Cooling grids. Support for thermal storage (heating and/or cooling) used in conjunction with CHP plants for the integration of renewable energy sources in the energy system has been introduced.
The overall cap for support within the Combined Heat and Power category remains at 750 million euro per year (of which 150 million euro are earmarked for DHC grids and thermal storage). The support is very inexpensive compared, for instance, to the support for electricity from RES. The CHP apportionment is set at up to 0.126 ct/kWh (depending on consumption) for 2013. The apportionment for electricity from renewable energy sources is set at up to 5.277 ct/kWh (over 40 times higher). For a household consumer with an electricity demand of 3,500 kWh per annum and an electricity bill of 829 euro per annum this means 4.6 euro per annum of CHP support. For an industrial consumer with an electricity demand of 40,000 MWh per annum and an electricity bill of 4,000,000 euro this means 10,000 euro per year of CHP support.

**ACT ON THE PROMOTION OF RENEWABLE ENERGIES IN THE HEAT SECTOR**

The basic instrument is an obligation to use energy from renewable sources to a certain extent in newly built buildings (or existing buildings if the federal states so desire, see below). District Heating is not considered a renewable energy source per se but if the heat is produced by a substantial share of renewable energy sources, with a share of at least 50% of CHP or waste heat or a combination of these, District Heating is considered as an alternative measure and the obligations to use renewable energy sources are deemed to have been met.

**ORDINANCE ON GENERAL CONDITIONS FOR THE SUPPLY OF DISTRICT HEATING**

The regular framework for the relationship between customers and companies was deemed inappropriate to handle the specific technical and economic features of the supply of District Heating on the one hand and specific customers’ needs on the other. The ordinance therefore sets a general framework for standard business conditions for the supply of District Heating to customers. The supply of industrial customers with District Heating does not fall under the scope of the ordinance. Customers that are connected to the District Heating grid have the right to be supplied according to the general conditions laid out in the ordinance if standard business conditions are being used. The District Heating utilities, on the other hand, can only deviate from these conditions with the explicit consent of the customer.

**ENERGY SAVING ORDINANCE**

Buildings play a major role in combating climate change. In order to raise this potential, the ordinance aims to reduce the primary energy demand of buildings to reduce the use of resources and to reduce greenhouse gas emissions. The aim is to reduce the primary energy demand for heating and warm water consumption in the building sector. The ordinance has a holistic approach and it covers the entire building, the engineering systems and the primary energy sources which are being utilised. Balancing out the different measures is possible. For instance, the obligations can be fulfilled by either using more insulation or more efficient systems engineering or primary energy sources. The system in general therefore reflects the efficiency benefits of District Heating based on CHP.

**ACT ON GRANTING PRIORITY TO RENEWABLE ENERGY SOURCES**

As a basic instrument, the act obliges grid operators to connect power plants producing electricity from renewable energy sources to their grid and to give priority to buying their electricity. For electricity from RES, a feed-in tariff system has been introduced by the act. Grid operators are obliged to buy the electricity from RES at this fixed tariff. Alternatively, the power plant operator can sell his electricity directly on a month-by-month basis. By means of a management system, the costs for these feed-in tariffs are shifted towards and shared among all electricity customers. The tariff depends on the type of renewable energy source and is by far the highest for electricity from photovoltaic sources of energy although it only provides a rather low amount of electricity overall.

**KEY FIGURES**

<table>
<thead>
<tr>
<th></th>
<th>2011</th>
<th>2009</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total installed District Heating capacity – connected load – MWth</td>
<td>49,931</td>
<td>51,506</td>
<td>49,409</td>
</tr>
<tr>
<td>Trench length in km for transport and distribution network (one way)</td>
<td>20,151 km</td>
<td>19,538 km [pipe suppliers’ estimation: 100 000 km]</td>
<td>18,438 km [pipe suppliers’ estimation: 100 000 km]</td>
</tr>
<tr>
<td>Estimation of total investment in District Heating and Cooling (Euro)</td>
<td>There are support mechanisms in place for District Heating networks. Combining data provided the investments for District Heating networks subject to one of the two support schemes amounted to approx. 430 M EUR (source: BMU, kfw). This does not include investments in CHP.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estimation of number of jobs in the District Heating sector</td>
<td>11,335</td>
<td>10,900</td>
<td>10,642</td>
</tr>
<tr>
<td>Number of District Heating utilities</td>
<td>239 (District Heating utilities which are AGFW member companies)</td>
<td>228 (District Heating utilities which are AGFW member companies)</td>
<td></td>
</tr>
<tr>
<td>Number of District Heating systems</td>
<td>3,390 District Heating plants (CHP and heat only) and 81 District Cooling plants (owned by member companies)</td>
<td>2,534 District Heating plants (CHP and heat only) and 81 District Cooling plants [owned by member companies]</td>
<td></td>
</tr>
</tbody>
</table>
Due to barriers within the framework, switching CHP plants from fossil fuels to RES is, in many cases, not economically viable. The ‘exclusivity criterion’ of the act has the effect that only installations that use renewable energy sources exclusively benefit from feed-in tariffs. That is a barrier standing in the way of the most efficient use of biomass in bigger CHP plants. Another criterion that proves to be a barrier for the use of biomass in bigger CHP plants and therefore in DHC as well is the limitation of the feed-in tariff system for the use of biomass up to 20 MW.

With regard to DHC, the act also puts in place barriers towards its accelerated development. Due to the effects that the system has on the electricity market, CHP plants with relatively high marginal costs, such as natural gas fired combined cycle CHP plants, have fewer and fewer operating hours, during which they can run economically. This is explained in more detail in the section on the barriers to the expansion of DHC. Furthermore, while in theory, the costs for the feed-in tariff are shifted towards and shared among all electricity consumers; in practice, there are many exceptions, which skew the market towards on-site production. As explained earlier, the apportionment for electricity from RES is very high at 5.277 ct/kWh. However, if consumers produce electricity themselves and consume it, they do not have to pay the apportionment for this amount of electricity. Due to the high costs of the RES electricity apportionment, this makes on-site electricity production economically favorable, especially for consumers with relatively high electricity consumption, such as hotels or hospitals. This is an incentive to disconnect from DHC and invest in on-site small scale CHP. Since, in Germany, over 80 % of District Heating is produced in CHP, the move from District Heating to on-site small scale CHP is tied to a loss in efficiency, higher primary energy consumption and greenhouse gas emissions. To give even more of an incentive, such CHP plants that displace existing CHP are now even eligible for support within the CHP act. There are even more incentives for on-site CHP in comparison to DHC from CHP such as electricity taxation, electricity grid fees and, in most cases, the EU Emissions Trading Scheme, which does not apply to small installations. Such installations can achieve a very high return on investment, making this a very attractive investment opportunity. According to a survey by the chamber of commerce and industry, every third company is looking into investing in own electricity production to the detriment of efficient DHC and CHP and the regular electricity consumers which have to bear a higher share of the financial burden associated with the feed-in tariff for electricity from RES (the same amount of payments has to be shared between fewer parties).

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EXISTING DRIVING FORCES AND / OR OPPORTUNITIES THAT FAVOR AN EXPANSION OF DISTRICT HEATING

Stakeholders identify companies and the DHC association as the main driving forces behind the development of DHC and CHP.

The legislative framework that became effective as of the beginning of 2009 has been amended recently following the Fukushima incident to reflect the important role that these energy efficiency technologies will have. Whether or not this framework will be enough to deliver the ambitious targets remains to be seen since there are still barriers to overcome for DHC and CHP on both the heating and electricity side.

DHC and CHP as flexible energy efficiency technologies that can deliver systemic benefits have an opportunity to help the integration of electricity from renewable energy sources. Combining CHP plants and DHC grids with thermal storage and power to heat technology such as large-scale heat pumps can help shave off peak demand and provide balancing power to the grid when needed. They also provide the only possibility of integrating renewable energy sources on a larger scale in the existing building stock and lower its primary energy consumption in an economically viable way. However, in order to fulfil this potential, the framework needs to fit the circumstances. This holds especially true for DHC since high investments affect all customers, whether they are subject to new legislation or not.

EXISTING BARRIERS TO THE EXPANSION OF DISTRICT HEATING

There are still barriers towards the accelerated development of CHP and DHC both on the heating and the electricity side. Some of these barriers have already been set out within the national legal framework section of the survey.

Another future barrier for the development of DHC is the recently amended tenancy law. On paper, it should accelerate efficiency gains in rented apartments but the well-intentioned adjustments have a contrary effect with regard to DHC. The system is very complex. With regard to the heating supply, the new amendments regulate the change from own heat production to commercial heat delivery such as District Heating. The idea is that such a change, while benefitting the environment, should not cost more for the tenant. This is a commendable idea but the framework for own heat production and commercial heat delivery is very different. Thus, the amendments will not work as intended but provide a barrier towards the development of District Heating as an energy source.

### Average District Heating price in EUR/GJ

<table>
<thead>
<tr>
<th>Source</th>
<th>2011 EUR/GJ (mixed price for 160 kW and 1,800 h/a, not weighted by delivery)</th>
<th>2009 EUR/GJ (mixed price for 160 kW and 1,800 h/a, not weighted by delivery)</th>
<th>2007 EUR/GJ (mixed price for 160 kW and 1,800 h/a, not weighted by delivery)</th>
</tr>
</thead>
</table>

### Energy supply composition for District Heating generated

<table>
<thead>
<tr>
<th>Source</th>
<th>2011 In TJ</th>
<th>In %</th>
<th>2009 In TJ</th>
<th>In %</th>
<th>2007 In TJ</th>
<th>In %</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>In cogeneration</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Coal and coal products</td>
<td>160725</td>
<td>34.71%</td>
<td>208432</td>
<td>40.29%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Oil and petroleum products</td>
<td>988</td>
<td>0.21%</td>
<td>4631</td>
<td>0.90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Natural gas</td>
<td>171184</td>
<td>36.97%</td>
<td>203800</td>
<td>39.40%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Combustible renewables</td>
<td>8778</td>
<td>1.90%</td>
<td>9264</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>46225</td>
<td>9.98%</td>
<td>0.00%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Waste</td>
<td>21154</td>
<td>4.57%</td>
<td>37055</td>
<td>7.16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Renewables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Combustible renewables</td>
<td>348</td>
<td>0.08%</td>
<td>1082</td>
<td>0.21%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Waste</td>
<td>4355</td>
<td>0.94%</td>
<td>9195</td>
<td>1.78%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial surplus heat</td>
<td>4516</td>
<td>0.98%</td>
<td></td>
<td>0.00%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal and coal products</td>
<td>2708</td>
<td>0.58%</td>
<td>3786</td>
<td>0.73%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural gas</td>
<td>33207</td>
<td>7.17%</td>
<td>36238</td>
<td>7.01%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil and petroleum products</td>
<td>2024</td>
<td>0.44%</td>
<td>3786</td>
<td>0.73%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>6858</td>
<td>1.48%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>463070</td>
<td>100%</td>
<td>517269</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
efficiency technology. Whereas the details of this comparison are very complex and require an in-depth knowledge of German tenancy law, at its core District Heating as a ready-to-use commercial heat delivery has to be benchmarked against operational costs for existing heating systems. This of course is not a fair comparison and will provide a serious barrier towards the change from inefficient heating supply in the building stock to efficient District Heating.

One of these barriers is the effect that the feed-in-tariff for electricity from RES has on the electricity market. Grid operators are obliged to buy electricity from RES at fixed prices, with the spread between what the grid operator had to pay and the income from selling the electricity ultimately being paid by electricity consumers. This is currently at the level of 5.27 ct/kWh (2013). This leads to lower electricity prices, affecting the economies of CHP plants. Since CHP plants do not receive a feed-in-tariff but only a bonus on top of the market price for electricity, the operating hours during which CHP plants can run profitably are decreasing. This especially holds true for CHP plants based on natural gas, which have higher marginal costs. The abovementioned flexibility measures incorporating thermal storage and power-to-heat could help overcome this barrier but it remains to be seen whether the incentives are high enough to generate the necessary investments. On the heating side, District Heating is operating on a very price-sensitive and liberalised heating market, making a competitive price a precondition for further development. The direct competition from District Heating mainly comes from on-site boiler technology based on natural gas or heating oil. In Germany, these installations consist mainly of individual natural gas and oil boilers, i.e. the same systems that District Heating is competing with. Since Germany, unlike other EU-Member States, has no direct tax on CO2, the market equilibrium will be heavily distorted to the detriment of District Heating.
According to the Federal Statistical Office in Germany, District Heating has a market share of 13.2% of all occupied accommodation. For various reasons, there is a big difference between West and East Germany with regard to the District Heating market share. The market share is around 8% in West-Germany and around 31% in East Germany. While the market share leaves a lot of room for growth, Germany is, together with Poland, the biggest market for DHC in the EU in terms of total figures. Various studies demonstrate this high potential for Combined Heat & Power (CHP) and District Heating and Cooling (DHC). Despite the ongoing decline in specific heat demand due to thermal insulation measures, the replacement of old buildings and demographic changes followed by urban restructuring, the District Heating market is steadily growing albeit at a slow pace. The fall in the demand for heat is compensated for by the intensification of existing District Heating grids in urban areas, opening up development areas with isolated networks and local small scale District Heating and contracting projects. As an indicator of this development, the number of substations is steadily increasing while the average connected load of each substation is slowly decreasing. Renewable energy sources (RES) play an increasingly important role in DHC.

After extending the length of time during which nuclear power plants were operated, in 2010 a new exit strategy was decided on following the Fukushima disaster in Japan. According to the current framework, all nuclear power plants are to be decommissioned by 2022 in a phased approach. Since the overall climate change target of reducing greenhouse gas emissions by 40% by 2020, by 55% by 2030, by 70% by 2040 and by 80% to 95% by 2050 (compared to 1990) still remains, an accelerated development towards energy efficiency and the use of renewable energy sources is necessary. CHP and DHC will play a major role in this. CHP installations based on natural gas, connected to a DHC grid and fitted with thermal storage and power-to-heat capabilities (utilising large scale heat pumps for instance) can react quickly to the large volumes of volatile electricity generated by photovoltaic and wind installations. The framework for these energy efficiency technologies was therefore adjusted and incentives were raised in order to reach a 25% share of CHP electricity by 2020, almost doubling the share of 13.20% (2010). This now includes thermal storage, which can support the integration of electricity from RES as explained above. Whether these incentives will be enough to reach the very ambitious goals remains to be seen as there are still barriers remaining, as will be explained subsequently.
CLIMATE CONDITIONS AND ENERGY USE OF BUILDINGS

Number of heating degree days in 2011
For heating degree days, the heating limit is 15°C and the indoor temperature 20°C. There were 3,349 heating degree days in 2011 (the average of the heating degree days of the capital cities), the long-term average being 3,785. These figures are for the German ‘Gradtagzahl’ as the calculation for ‘Heizgradtage’ (building specific) differs from this.

Description of the climate conditions
Germany has warm temperatures and a humid and mid-latitude climate. The oceanic influence from westerly winds is responsible for the relatively mild winters and summers. If the westerly flow is blocked, however, very cold winters and very hot and dry summers are the likely outcome. Apart from the distance to the sea, the temperature is heavily influenced by the topography of the country. It consists mainly of flat landscapes surrounded by uplands. Lowlands have a particularly dry, warm and predominantly sunny climate, whereas higher areas such as mountain ridges are characterised by a wet, cold and cloud-rich climate.

Average energy use of buildings per square meter
According to data collected by co2online.de, average energy use in 2010 was 126 kWh/m² (based on one million building-specific data sets). However, the increase of the average amount of square metres per capita has not been accounted for. According to co2online.de, the data is collected from a group of users with an affinity for energy efficiency, greenhouse gas emissions and environmental topics in general. It is therefore safe to assume that the data collected is much more positive than the real life situation, meaning that average energy use is probably higher than the aforementioned 126 kWh/m².

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www.agfw.de
DREWAG - Stadtwerke GmbH has been developing District Heating in Dresden rapidly between 1990 and 2000. In 1990, Dresden’s District Heating grid was composed of a total pipeline length of 280 km, including the central District Heating grid and island grids. In the time between 1990 and 2000, DREWAG has built nearly 200 km of new pipelines. During that time, DREWAG invested approximately 500 million euro into the District Heating infrastructure.

These investments into District Heating and CHP have more than halved CO2 emissions in Dresden from over 2,000 kt per year in 1991 to less than 1,000 kt per year in 2000. Other emissions, like dust, particulate matter, SO2 and NOx were significantly reduced as well. In the same timeframe electricity production in Dresden tripled from 500 GWh in 1992 to 1,600 GWh in 2000. This rise in electricity production from CHP makes DREWAG the largest contributor to CO2 emission reductions in Dresden. Currently and in comparison with figures from 1993, over 5.0% of the CO2 emission reductions in Dresden can be attributed to DREWAG. Outside Dresden, the production of electricity via CHP reduces CO2 emissions by an additional 1 Mt of CO2 per year, substituting electricity predominantly from condensing power plants.

This development could be regarded as a best practice example for the development of District Heating by itself but DREWAG wants to take District Heating even further with the new energy concept 2020. The starting point was the decrease in District Heating delivery. District Heating delivery fell sharply when industrial consumers faced a fast economic downturn in the period following German reunification. Large-scale refurbishment of the building stock coupled with low spending power led to a further reduction of District Heating delivery. A slower pace of development of District Heating networks is expected in the future. DREWAG therefore developed an energy concept for 2020, analysing the potential for District Heating in Dresden. The analysis revealed that the potential for new connections to District Heating in Dresden amounted to 137 MW, including areas which are being supplied with natural gas at the moment. Due to political will and the climate change debate, Dresden wants to further reduce CO2 emissions and, since District Heating already plays a fundamental role in contributing to climate change and energy policy goals, the city council and DREWAG have in cooperation agreed that the municipality and DREWAG should develop District Heating and CHP in Dresden even further. According to the city council’s decision, the share of District Heating in Dresden’s heating market should be raised by 20% by 2020. DREWAG also analysed the possibilities for mandatory heat planning but decided against encouraging Dresden to make use of this municipal toolset. The market situation and framework in Dresden allow for such an accelerated development under full market conditions. The energy concept 2020 will contribute further to the reduction of CO2 emissions both in and outside Dresden. Realising the full analysed potential of 140 MW would result in a further reduction of CO2 emissions by 70,000 t per year. The development of District Heating also has a positive effect on other social factors such as employment.

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On March 19 DBDH held its general assembly at Christiansborg, home to the Danish Parliament. This year it was time for new members of the board to be chosen. Thus, the board now consists of: Lars Gullev, VEKS (chairman); Peter Heymann Andersen, Rambøll; Henning Lamberts, COWI; Knud Bonde, Kamstrup; Morten Dalum, Desmi; Bent Have Johnsen, Aalborg Engineering; and Martin B. Petersen, ABB.

As is tradition on DBDH’s annual general assembly, the “DBDH person of the year” was elected. This year the title went to Mr. Egon Erlandsen as DBDH highly appreciates his energy and sincere dedication to both district energy and DBDH. Egon is always present at members meetings and is a very active networker. He is very helpful when receiving foreign delegations, and DBDH is very delighted to have Egon as a representative, and as a spokesman for DBDH.

Also “DBDH member of the year” was elected. The honour went to Aalborg Engineering represented by Mr. Bent Have Johnsen. Aalborg Engineering has been an active member of DBDH for many years and has always contributed with a high level of activity both domestically and internationally. The company participates frequently in DBDH members’ meetings and in international conferences. Aalborg Engineering is also a keen and competent contributor to articles in HOT|COOL and also supports the magazine financially with regular advertisements. Aalborg Engineering specializes in the design and supply of steam boiler systems with the objective to design and supply reliable products and act as a reliable and responsible business partner. DBDH is proud to have Aalborg Engineering as a member.

We offer complete heat loss efficient pre-insulated piping systems for district heating, district cooling, steam and pipe systems for industrial use.

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NEW MEMBERS OF DBDH

WICOTEC KIRKEBJERG is one of Denmark’s leading engineering and construction contractors and employ approx. 1,100 employees with offices across the country.

As a pioneer in the field of construction, building and installation Wicotec is always at the forefront of digital development within their disciplines. The company uses the latest knowledge and technology in all technical and vocational skills and is able to bid on any large complex technical contracts in modern construction and building installations.

UNO TRANSPORT was founded by Kim Uno Mogensen in 1999 and specializes in Transport to and from the Baltic Countries, Russia, Belarus, Kazakhstan and other East European countries. The company accepts part- and full loads as tailor made solutions in trailers, containers and Railway wagons to these countries.

Uno Transport still has its core business in this area and uses mainly own trucks and trailers, operating today with 400 own trailers and 110 trucks. Furthermore, Uno Transport works with FIEGE International Freight Forwarders in many countries, especially in the Far East, like China, Hong Kong, Taiwan and whole South East Asia.

Today there are own offices in Mazeikiai and Klaipeda Lithuania, Riga in Latvia, Kiev in Ukraine and Moscow in Russia. The offices work together with the Danish office in Aarhus in coordinating transports to and from the local markets in Eastern Europe.

Since the start in 1999 service has been expanded to include worldwide project transports. This could be oversized cargo, heavy lift cargo or complete relocation of Factories.

Besides this Uno Transport is “house forwarders” to a number of Danish and Foreign manufacturers and takes care of all logistics related to In- & export, whether it is a full or a part load, sent by road, air, sea and rail anywhere around the world.

Today there are 14 employees in Denmark and more than 45 abroad in various offices.

Uno Transport aims to offer the best service, and works closely with the customers to find the right solution, not only regarding transport, but also packaging, lashing, warehousing, insurance and documentation.

HÔJE TAASTRUP DISTRICT HEATING COMPANY is a consumer-owned district heating company. It is part of the complex CHP system that covers most of Greater Copenhagen.

The company was established on 1 January 1992 by the merger of the consumer-owned Taastrup Heating Plant and the municipal heat supply in Høj Taastrup. The establishment took the form of a cooperative society with limited liability. The company is thus owned by the heat consumers.

The daily management is handled by the managing director. The company’s management is a board of nine members.

Wicotec Kirkebjerg

UNO TRANSPORT

Hóje Taastrup District Heating Company
**SASECO** is a software development company specialising in solutions for personal energy management and Home Control. The company has developed a user-friendly online application designed to combine the advantages of automated meter reading with wireless home automation.

Saseco is dedicated to advancing the synergy between the new technologies in wireless automation and intelligent energy meters, aiming to create savings in energy consumption, both by automating energy consuming devices and through behavioural changes caused by a greater insight into consumption patterns; increased security by monitoring the home for fire, burglary, excessive consumption, pipe leaks etc.; greater comfort by automating lights, heating, cooling, ventilation etc.

The product, eButler, is an online software-as-a-service application for visualisation of energy consumption and controlling wireless home automation devices like switches, dimmers, smoke/movement sensors, thermostats etc. The consumption of water, electricity, gas and heating is registered hourly by so-called 'intelligent' meters, giving the user a unique insight into his/hers consumption patterns. eButler is continuously developed, adding new functions as well as new media like mobile phones and digital-TV.

Most energy management systems are developed for professional users, and as such require a high level of prior knowledge. Versions for private consumers are often just reduced versions of the same, complicated programs. These systems rarely generate the desired results, as they are not developed with the right users' requirements in mind.

Saseco's products, however, are developed specifically for the private consumer. This means feature accessibility over feature profusion, and boiling down complicated calculations to simple charts and sophisticated analysis to plain results.

**ROSS ENGINEERING** is specialized in drilling & well management – planning, design, drilling, completion and work-overs of wells.

The company situated in Copenhagen offers consultancies and in-house design for oil & gas and geothermal industries. The company performs well planning, risk analysis and mitigation, drilling of wells including documentation and reporting in accordance with regulative and legislative requirements.

Ross Engineering comes with years' of unique experience and expertise based on technical knowledge of all of the drilling processes, in terms of site management, drilling equipment and geological conditions. The company understands the complexity of a drilling project and the changes that may occur during such project.

Ross Engineering’s strongest asset, however, is it’s the combination of theoretical knowledge and expertise with hands-on experience worldwide. The company has a widespread network with competences within well engineering, subsurface, production, geology, completions, intervention & work-overs and logistics.

Geothermal energy is an area under scrutiny and development in Europe as countries seek to fulfil the goals of a fossil-free future. As district heating technologies become integrated in Europe’s infrastructure, Ross Engineering will assist in preparing and executing geothermal projects.
coolers in every room is removed, and costs and expenses become significantly removed. “It can also be limited to quite few individual buildings or factories like at the Hanyang University in South Korea, where our NSL centrifugal pumps are installed, or at the Novozymes Biotechnology Plant in Tianjan in China. But the Dubai Metro project shows that District Cooling can be used for many purposes,” Jørn Urup Nielsen says.

PUMPS FOR HEATING PLANTS AND THEIR PIPED NETWORKS
At the headquarters in Nørresundby, just north of the city of Aalborg, DESMI has been developing and producing efficient pumps for more than 150 years. The company has been supplying energy efficient pump solutions to match sustainable energy requirements, since District Heating schemes were first initiated in Denmark back in the 1920’s. Thus, the fundament of the company know-how of today was created during the development of the Danish District Heating system, which today covers a big part of the heat demand of the country. In the big cities District Heating is totally dominating. DESMI is specialised in large/medium-sized pumps for all types of heating plants and their piping networks. For instance DESMI pumps with a capacity of 2,600 m³/h are installed at the local Rærup pumping station, a part of Aalborg District Heating Company, and a number of NSL pumps (i.e. 250-425) are installed at “Vestforbrænding”, an incineration plant near Copenhagen.

“However, today we are supplying pump solutions for DH projects all over the world. For instance we have delivered NSL 300-525 pumps - each with a capacity of 1,250 m³/h - to Zunhua Power and Heating Plant in China, as well as a large number of similar sized pumps to WKC Almere Power Plant (Vattenfall/Nuon Energy) in the Netherlands. Just to mention two high quality projects,” Jørn Urup Nielsen says.

CUSTOMER ADAPTED SOLUTIONS
He emphasizes the importance of being able to deliver customer adapted solutions, since every customer has different needs concerning size, pressure and flow.

COOLING SOLUTIONS FOR THE MIDDLE EAST
One of the projects is in Dubai in the United Arab Emirates, where energy efficient DESMI pumps are an important part of a District Cooling solution that supplies passengers of the new Dubai Metro with comfortable temperatures. The Dubai Metro is the first District Cooling supplied mass transport system in the world. Five District Cooling plants have been built to supply the Metro system with energy efficient cooling. This has let to a reduction in total power consumption by 30 to 50%. At the same time the total carbon footprint of the project is seriously minimized. It also reduces noise and vibration, compared to the “classical” stand-alone solution of having rooftop air-cooled chillers and pumps.

Mostly the pumps that DESMI delivers for District Cooling purposes are placed in urban areas as part of a system that supplies chilled water from a central location to a number of buildings through piped networks. In this way the need for
We can manage a flow of up to 4000 m³/h through our pumps. They have to be adapted to the characteristics of the flows through the pipelines and we are very experienced in doing this with great accuracy. In several projects around the world DESMI is part of energy efficient package solutions. As an example we are cooperating internationally with ABB, where we combine their motors with our pumps,” Jørn Urup Nielsen explains.

The company is constantly working on developing new technology to provide energy efficient solutions. Furthermore the company’s experience in the Marine & Offshore business has given great competences related to pump solutions for seawater applications (i.e. in bronze), which is common for District Cooling water intake. Salty seawater reacts aggressively under high temperatures like in many parts of Asia and in the Gulf States. Here an application in bronze can be an attractive solution - though at first hand a more expensive investment - because it extends the lifetime significantly.

“We are also involved in the “4th Generation District Heating Technologies and Systems” along with Aalborg University and a number of other stakeholders – where the aim is to utilize surplus energy down to 40 degree C for heating purposes,” Jørn Urup Nielsen says.

FACTS
DESMI is a global company and is currently expanding its international involvement within District Heating and District Cooling. This happens through own sales companies as well as local distributors.

It has five regional offices dealing with District Heating and Cooling projects in China. Moreover it has companies in various European countries including UK as well as in Korea and Singapore. They have specialist staff allocated for this type of business. In total, the company has got 27 local companies in 14 countries – and more are on the way.

DESMI pumps are relevant in all kinds of power generation, where water is in the process. So when the company is in contact with energy companies related to District Heating and Cooling it’s obvious also to discuss power plant constructions concerning water intake and cooling processes within: Biomass and Waste-, Coal Fired -, Gas Fired-Geothermic-, Hydro-, Industrial- and Nuclear Power Generation.

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Costs resulting from inefficient district heating pipe systems that lose heat and require a lot of maintenance accumulate steadily over the service life of the system.

You can easily make big reductions in such operating costs by making the right upfront decisions about the type of pipe and the insulation thickness best suited to your particular project. The right decision helps roll back your operating costs as well as your CO₂ emissions.

The LOGSTOR range of pipes and joints ensures versatile, energy-effective and environmentally responsible solutions throughout your district heating networks.

Calculate the savings you will achieve using our web-based calculation tool at www.logstor.com/calculator.

Or contact us now.

Comparing performance in different types of pipe laid in a 1,000-metre length of trench indicates heat loss reductions and CO₂ savings of as much as 52% These calculations were carried out using the LOGSTOR Calculator.

The right pipe pays off

distributing energy efficiency