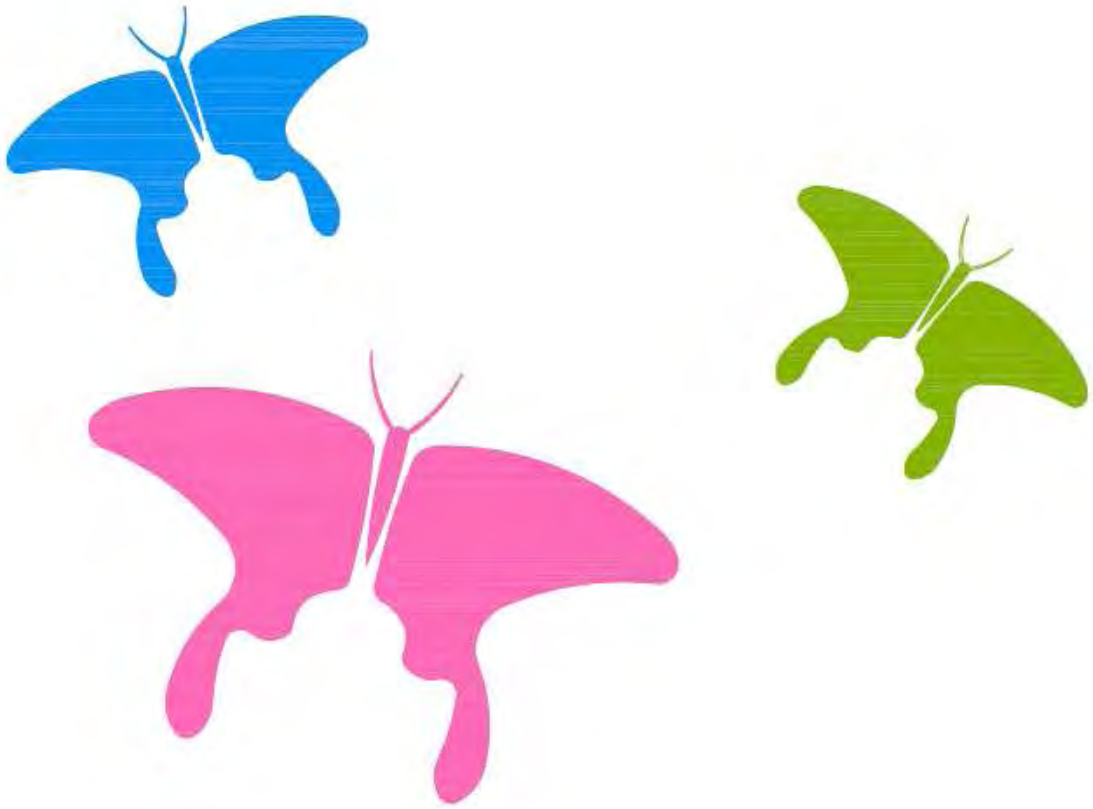
APPLICATION FOR

The First Global District Energy Climate Awards



System:	District heating
Location:	The town of Nyborg, Funen Denmark
Owner:	Nyborg Forsyning & Service A/S
Ownership:	Limited company owned by the Council of Nyborg
Managing director:	Mr. Flemming Kjærulf

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Summary

The Danish multi utility company *"Nyborg Forsyning & Service A/S",* colloquially named *"NFS A/S",* has for years supplied the town of Nyborg with CO_2-neutral district heating.

Through a well establish co-operation between *"NFS A/S"* and two chemical plants located in the town, the district heating supply takes off the surplus of waste heat produced on the plants - enough to supply this middlesized provincial town.

This application for "The First Global District Energy Climate Awards" is a description of a district heating system operated with great care for the environment by dedicated employees and co-operators.

Contents

The system facilities

The pipes between the main heating plant and a supplier of surplus heat.

Insulated pipes in a valve well.

Heat exchanges on the main heating plant receives surplus heat steam from a chemical plant next door

The chemical plant "Koppers Denmark A/S" contributes with surplus heat for approximately 10% of the district heating used in the town of Nyborg.

More than 80% of the district heating used in the town of Nyborg is made from surplus heat from the chemical plant "Kommunekemi A/S". →

A new transmission line is under construction.

The primary well for distribution of district heating to the network.

Circulating pump forwarding the district heating on to the distribution network.

The control panels on the main heating plant.

Boilers on one of the heating plants.
The boilers are only used when peak load and as a reserve, when the suppliers of surplus heat can not deliver the required quantity.

The history of district heating in the Council of Nyborg

On the first of October 1964 the heating supply of the town of Nyborg entered a new era, as the first boiler on a brand new district heating plant was lit. More than a decade before innovative citizens had proposed their vision for a district heating supply for the town. In 1956 this group of people managed to establish an association, but unfortunately, they had to see all their efforts fall to the ground after a few months, because of the insufficient support from landowners and the local authorities.

In 1963 the Council of Nyborg set up a committee to review the prospects of district heating. Soon a conclusion was made and within a year district heating was a reality. From that day the council had worked out masterplans for the district heating supply and in this way formed the basis for developing the distribution of district heating.

During the next decade a number of district heating plants were established in the town of Nyborg to keep abreast with the growth of new neighbourhoods. One of these plants was built in combination with a new incineration plant to channel the surplus heat from the burn off energy into district heating. A constructive way to counter the increasing waste problem in the industrialized society.

The global energy crises that characterized the first period of the seventies gave occasion to rethinking, how to supply the heating plants with fuel. An alternative to mineral oil was needed. This alternative was nearby and turned out to be the future main energy source in the district heating supply of the Council of Nyborg.

A year before the energy crises occurred, a new plant for handling chemical waste was established in the outskirts of the town. According to the same principles used when constructing the incineration and heating plants the previous five years, a heating plant was set up at the location of the plant, to purchase the surplus energy produced, when disposing of the chemical waste.

The chemical company *"Kommunekemi A/S",* was expanded rapidly and with it a surplus of waste energy. New perspectives appeared and the Council of Nyborg started to negotiate with the company about a long-term solution of providing heating for the entire town.

This proved to be a fruitful co-operation for everyone. Today 98% of the energy used to supply the town of Nyborg with district heating, comes from this and an other chemical company, named *"Koppers Denmark A/S"*. In the early seventies only a few would have imagined, how important these chemical plants were to become for the supply of district heating. A synergy for the local community and the environment was achieved by disposing of environmental hazardous waste in a safe manner.

Another way of making use of waste, appeared in the early nineties, when the purifying plant of the town was changed from being mechanical to biological. The heat from burning off the biogas, produced in the digesting tank on the purifying plant, was channelled into a nearby heating plant and used for district heating.

Until 2001 the district heating supply was managed by the Council of Nyborg. To counter the legislation for distributors of energy the existing departments for district heating, electricity, water and refuse disposal was evolved into a multi utility company and named *"Nyborg Forsyning & Service A/S",* colloquially named *"NFS A/S". "NFS A/S"* was established as a limited company owned by the council.

The structure of the district heating supply in the Council of Nyborg

Since the establishment of the district heating supply in the town of Nyborg the council has worked out masterplans, with the purpose of developing a district heating network. By dividing the council districts into areas for respectively, district heating and natural gas, households as well as businesses are obliged to connect to the energy source prescribed. This has went well and today 99% of the total building stock, within the area of the district heating supply, is warmed up by district heating.

"NFS A/S" is supplying the towns of Nyborg and Ullerslev with district heating from a number of heating plants. Each town has its own separate distribution network, but soon these networks will be connected by a new transmission line.

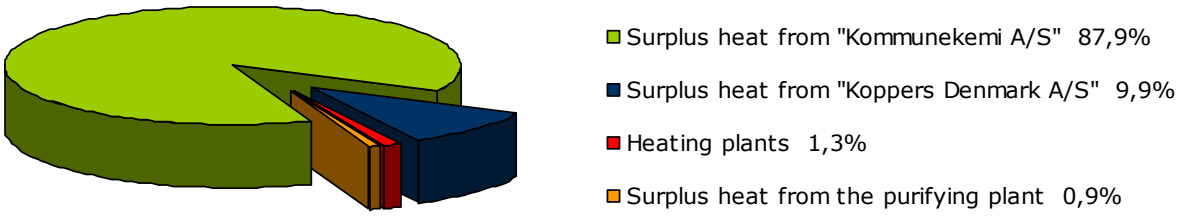
To give an impression of the size of the two towns mentioned, the town of Nyborg, which is a middlesized Danish provincial town, has a population of approximately 17,000. This makes the town of Nyborg more than 6 times larger than the neighbouring town of Ullerslev, which is inhabited by only 3,000.

Describing the district heating supply in the Council of Nyborg is not possible, without mentioning two of the major companies involved, located on the outskirts of Nyborg.

Both the establishments *"Kommunekemi A/S"* and *"Koppers Denmark A/S"* are operating within the chemical industry and produce considerable quantities of surplus heat.

Due to a close co-operation, for several years, by these companies, *"NFS A/S"* has succeeded to channel the surplus heat into the heating plants. This means that 98% of the energy required for supplying the town of Nyborg with district heating, comes from the surplus heat produced by the two plants. *"NFS A/S"* stands out from many of the district heating suppliers in Denmark, in using this amount of surplus heat from industrial companies.

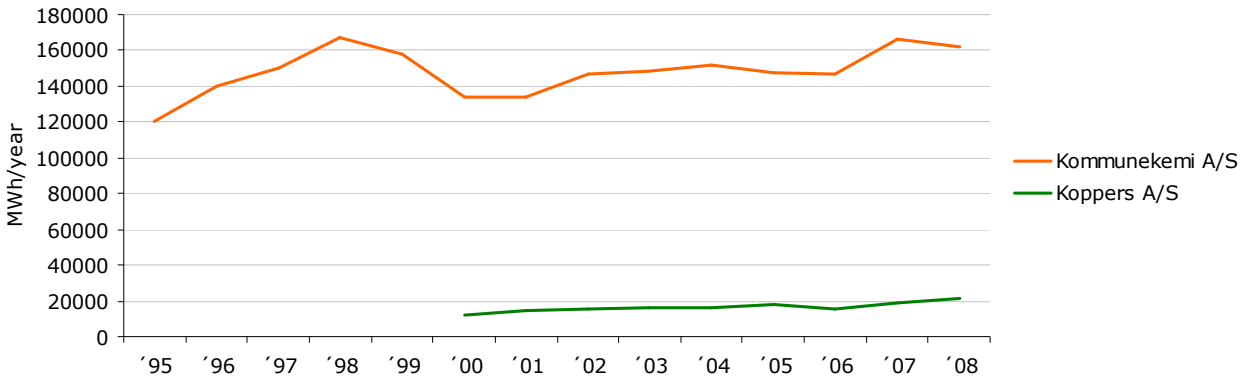
Fig. 1: The share of heat used in the district heating system in 2008.



Only an insignificant quantity of heat is produced by the boilers on the heating plants. Another small percentage of surplus heat comes from the purifying plant of the town of Nyborg, when burning the bio gas produced in the digesting tank.

Being almost fully supplied with surplus heat from industrial companies, the district heating in the town of Nyborg is practically $C0_2$-neutral.

Fig. 2: Surplus heat delivered from the chemical companies.



The production units

The district heating system consists of seven heating plants. Six are located in the town of Nyborg and the seventh in the neighbouring town of Ullerslev. The total boiler capacity is 95.2 MW, which makes each boiler produce an average of 15.9 MW.

The boilers in the town of Nyborg burn on bio-fuel and the boiler in the town of Ullerslev burns on natural gas. As the new transmission line opens between the two towns, the heating plant in the town of Ullerslev will serve only for standby and when peak loading is expericend.

Fig. 3: Key diagram for the capacity of the heating plants. In Denmark the heating season is October to March/April. Central no. 1 is connected to the chemical plant "Kommunekemi A/S" and the purifying plant. Central no. 7 is connected to the other chemical plant "Koppers Denmark A/S" and no. 6 serves the neighbouring town of Ullerslev.

Central	Boiler/MW						Pump/m3					
	Summer 2008						Summer 2008					
	Peak	Average	Peak	Average	Peak	Average	Peak	Average	Peak	Average	Peak	Average
	APR-JUN	APR-JUN	JUL-SEP	JUL-SEP	APR-SEP	APR-SEP	APR-JUN	APR-JUN	JUL-SEP	JUL-SEP	APR-SEP	APR-SEP
No. 1	34.96	12.33	15.19	6.37	25.08	9,35	783	279	381	170	582	225
No. 2	0	0	2.28	0.02	1.14	0.01	0	0	61	0	31	0
No. 3	0	0	0.40	0	0.2	0.00	0	0	32	0.06	16	0
No. 4	0	0	0	0	0.00	0.00	0	0	0	0	0	0
No. 5	0	0	0	0	0.00	0.00	0	0	0	0	0	0
No. 6	3.47	1.42	1.75	0.87	2.61	1.15	75	35	46	26	61	31
No. 7	3.65	2.63	4.07	2.83	3.86	2.73	83	58	102	65	93	62

Central	Boiler/MW						Pump/m3					
	Vinter 2008/2009						Vinter 2008/2009					
	Peak	Average	Peak	Average	Peak	Average	Peak	Average	Peak	Average	Peak	Average
	OCT-DEC	OCT-DEC	JAN-MAR	JAN-MAR	OCT-MAR	OCT-MAR	OCT-DEC	OCT-DEC	JAN-MAR	JAN-MAR	OCT-MAR	OCT-MAR
No. 1	42.69	25.28	46.24	33.6	44.47	29.44	1000	658	1000	772	1000	715
No. 2	7.41	0.05	6.97	0.6	7.19	0.33	239	0.33	202	14	221	7
No. 3	4.33	0.04	11.18	0.49	7.76	0.27	141	1.34	364	16	253	9
No. 4	0	0	4.45	0.22	2.23	0.11	0	0	129	7	65	4
No. 5	0	0	0	0	0.00	0.00	0	0	0	0	0	0
No. 6	4.22	2.56	4.7	3.4	4.46	2.98	96	63	107	78	102	71
No. 7	3.17	2.04	2.8	1.87	2.99	1.96	86	54	59	43	73	49

The district heating system in the town of Nyborg is supervised by a computer system that operates on a basis of reference points placed in the system. Based upon the information coming from these reference points, it is possible to control the heat produced from the heating plants. When regulating the system, it is always the first priority to use the surplus heat from the chemical companies and purifying plant. If needed, boilers can be lit and switched off automatically, so they only are operating when necessary.

The implementing of this computer system in 1988, *"NFS A/S"* was the first district heating supplier in Denmark to try out this new technology. The project by implementing the system was financially supported by the EU with 35% of the total cost. It took 4 years to implement the system and has since been improved to double its capacity.

The distribution network

The total length of the entire conduit system is approximately 143 kilometres of which approximately 96 kilometres are main lines and the remainder are branch lines.

When the new transmission line opens between the two towns that "NFS A/S" is serving, another 9 kilometres will be added to the distribution network.

The temperature of the water led out from the heating plants into the distribution network is 70°-80° Celsius, but can varies, depending on the climatic conditions.

During the fall of 2008 and the spring of 2009 an experiment with adjusting the supply-pipe temperature after the temperature at the consumers residences, has been carried out.

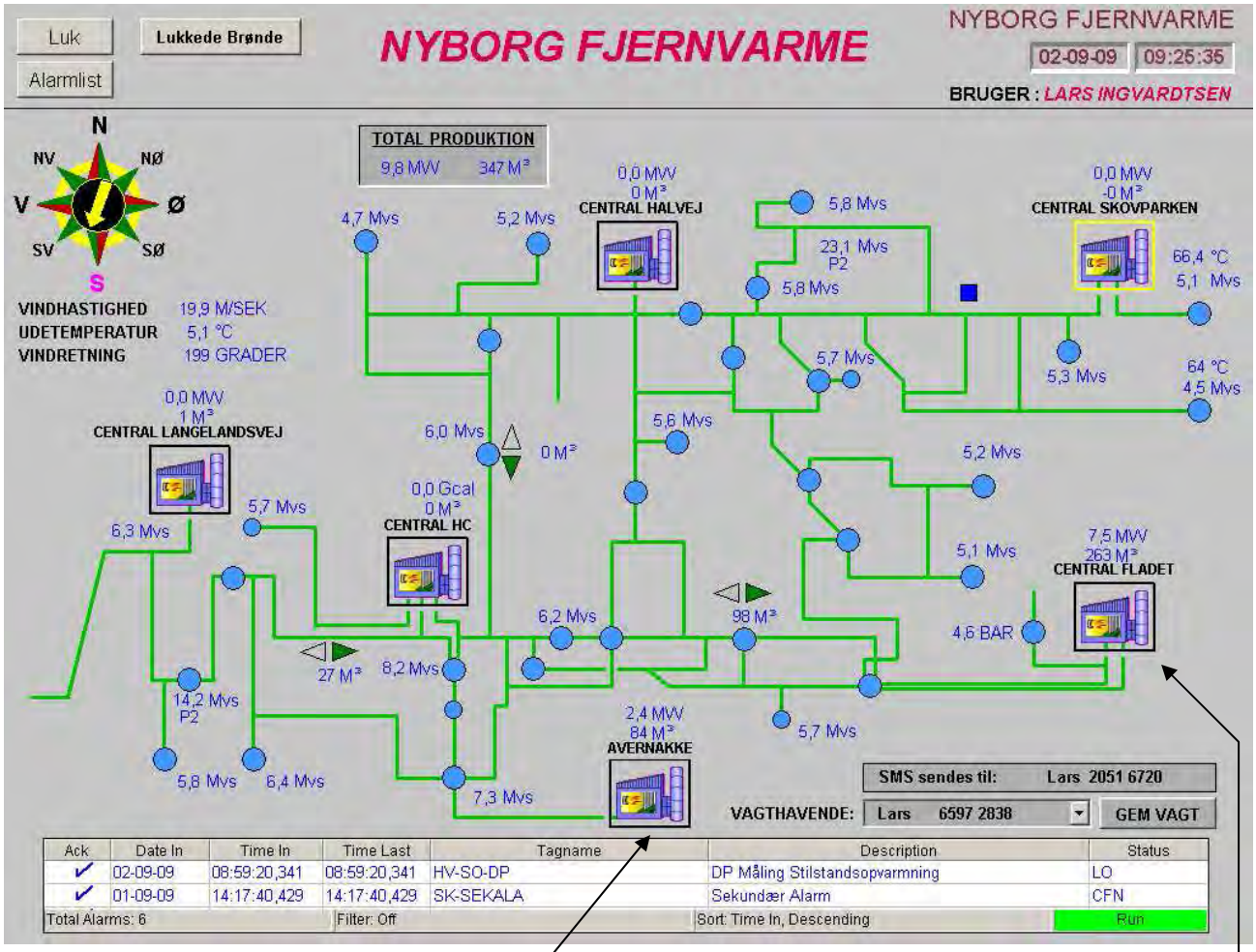
The intention with the experiment was to minimize the variation of temperature of the water and to save energy. By reducing the temperature of the water led out from 80° down to 70° Celsius good results has been achieved.

The pressure in the distribution network can rise up to 6.6 bar and the differential pressure is minimum 3.5 meters.

In the network a number of valve wells are placed in the system in order to keep the required static pressure and to help regulating the differential pressure. The number of wells furthermore makes the distribution system more flexible. This is an advantage when, for instance, a leak on a pipe arises, it is then easy to identify the damaged area.

Within the near future the process of insulation on all the valve wells will be finished. An improvement that will give a lower thermal loss.

Fig.4: A screen dump from the operation system, that supervises the district heating system, illustrates the distribution network. The blue spots on the pipes are valve wells.



The heating plant connected to *"Koppers DenmarkA/S"*

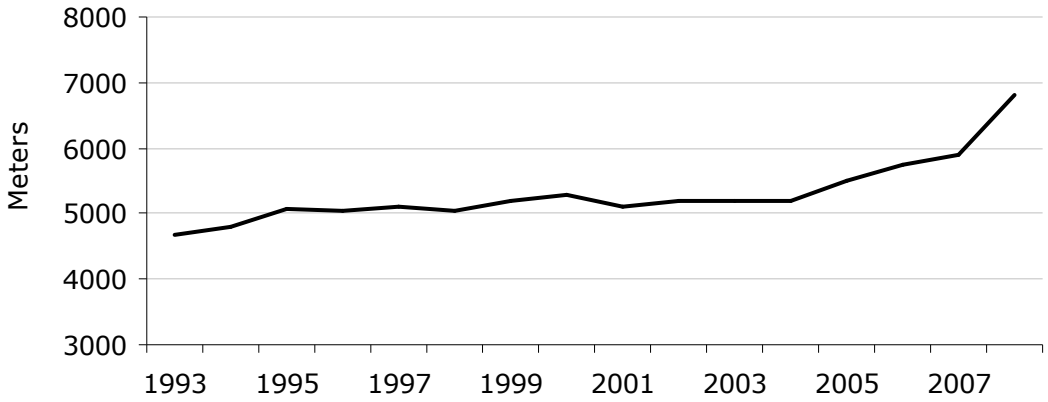
The heating plant connected to the purifying plant and *"Kommunekemi A/S"*

The capacity

"NFS A/S" have approximately 6,000 meters installed in the area that is served with district heating. As many blocks of flats only have one meter serving several flats, the total amount of households and businesses is approximately 16,000.

The total annual production of the seven heating plants is approximately 186.000 MWh At peak loads the heating plants can make a total of 86 MW.

Fig. 5: The numbers of meters installed in the period 1993-2008. The rise in the latest 4 years is caused by growth of the town of Nyborg, as new neighbourhoods has been built.



The average age of the production & distribution system facilities

During the 45 years the district heating supply has existed in the Council of Nyborg, there has been an ongoing process of maintaining and modernizing the whole system.

All of the heating plants date back from the mid sixties to the mid seventies, except for one, this was built in 2000 as a heat exchanger for the chemical work *"Koppers Denmark A/S".*

To minimize the transmission loss in the conduit system the majority of the original fitted concrete pipes have been replaced by pre-insulated pipes. Since 2006 all new the pipes used, have been twin-pipes.

During the 1980´s a great work on moving and upgrading the pipes was going on in a considerable part of the town of Nyborg. The occasion was the political decision on starting the construction work of the third longest suspension bridge in the world. This was the connection between Funen and Zeeland. As finishing the digging in the areas affected by the bridge, the distribution network has been secured for the future developing of the town and the distribution network as well.

The heating plant in the same area has also been undergoing changes. Among several improvements made here two new 12 MW heat exchangers were installed in the late eighties, to meet the increased quantity of surplus heat from the neighbouring work of *"Kommunekemi A/S".*

Later, in 1996, new heat exchangers were built with the double effect, a new large transfer pump with an effect of 200 KW/1,000 m^2/h was fitted in and the general size of the pipes were increased. This was necessary as *"Kommunekemi A/S"* was planning a new gas turbine for providing the heating plant with more steam energy. At the same time the computer system, used to control the district heating system, was updated to be able to exchange data with *"Kommunekemi A/S"* for optimizing the flow.

The systems´s success

Lowering primary energy use and CO_2 emissions

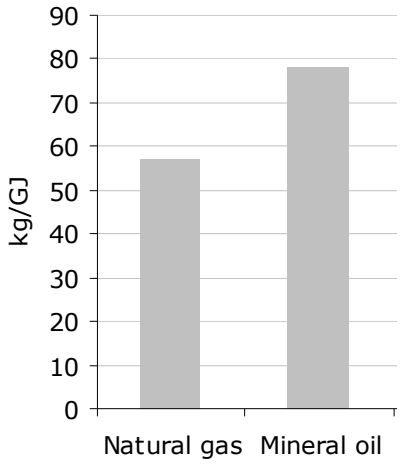
One of the greatest success within lowering the use of primary energy and reducing the CO_2 emissions, in comparison to other available energy options, was achieved in 1999. A co-operation between the chemical plant *"Koppers Denmark A/S"* and *"NFS A/S"* was established on the same principle as the co-operation with *"Kommunekemi A/S".*

The initiative for the co-operation came from *"NFS A/S"*, which had spotted a potential in using the surplus heat from the production at *"Koppers Denmark A/S"*. Until then, the hot water from the production has been cooled in a large cooling tower, a process that required major quantities of both water and electricity. By shutting down the cooling tower and building a new heating plant to use the surplus heat, the consumption of water and electricity was eliminated, to the benefit of everybody, but mostly the environment.

A great advantage when establishing the co-operation with *"Koppers Denmark A/S"* was the positive experiences through many years of collaborating with *"Kommunekemi A/S"*. In 2010 *"NFS A/S"* and *"Kommunekemi A/S"* can celebrate their 35th anniversary. Thanks to this synergy the environment has been spared, loads of CO_2 emissions during the years.

In the aim to become fully CO_2 neutral, *"NFS A/S"* opens a new transmission line between the two towns that *"NFS A/S"* serves during the fall of 2009. This initiative will cause a further reduction in the CO_2 emissions, as 90% of the heat consumption of the neighbouring town, will come from the distribution network in the town of Nyborg. Of the 90%, approximately 60% will come form the surplus heat made in an increased production at *"Kommunekemi A/S"*. The remaining 30% will be produced on bio-fuel, which is consider to be CO_2-neutral. At present the district heating supplied to this town is produced by its own gas-fired district heating plant. This plant is driven by an engine, which produces electricity and heat. The surplus heat produced is used for district heating.

Fig.6: The CO_2 emissions led out when burning natural gas and mineral oil.



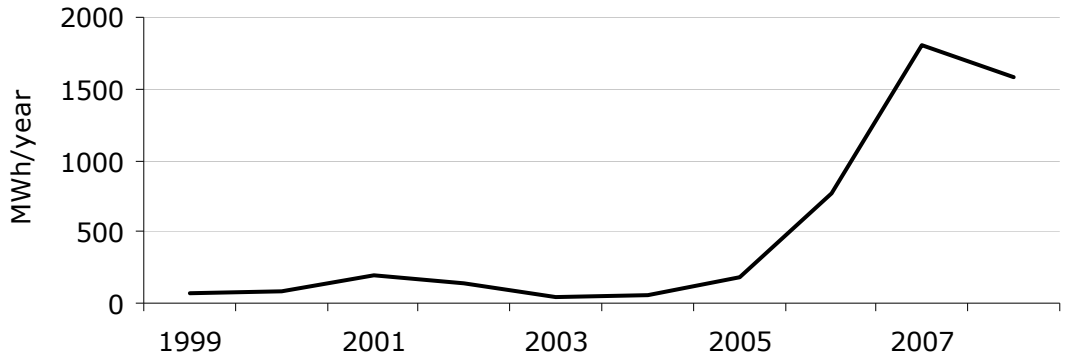
Every effort counts in the strive for becoming *"greener"*. Since 2001 all heating plants in the town of Nyborg have used bio-fuel for the boilers instead of mineral oil. The computer system supervising the district heating system, which was implemented in 1988, has also contributed to a reduction in the CO_2 emissions, by optimizing the use of energy.

Successfully implemented environmental compliance strategies

Since 2001 it has been compulsory in Denmark, to advise all district heating customers on energy savings. In 2006 the government requested suppliers of district heating, to report the achieved energy savings. This task was easy to manage for *"NFS A/S"*, as the company already, in 1993, voluntary started advising their customers on how to save heat. This service proved to be important for the company and, in 1996, an employee was engaged to attend this area.

Today *"NFS A/S"* is assisted in achieving the compulsory energy savings by a consulting engineering company, which is specialized in energy and environment. *"NFS A/S"* is co-owner of this company. An insulation company, which produces insulation solutions for pipe systems, carry out the practical work in the process of achieving the energy savings.

Fig. 7: The achieved savings in the period 1999-2008



Increasing energy performance of existing and new building stock

The advising activities on energy savings made by *"NFS A/S",* have during the years resulted in an improvement of the energy performance of a lot of the existing building stock within the Council of Nyborg.

Many of the businesses in the town of Nyborg have made use of having a check up on potential energy savings. This is a free service that *"NFS A/S"* is offering to all professional customers.

Utilising innovative technological solutions and developing strategies for the future

The board of directors in *"NFS A/S"* has decided, that in the future, the district heating must rely on renewable energy sources.

This means that, if the distribution network in the Council of Nyborg needs to be extended in a large scale, a new plant must be able to produce district heating from renewable energy sources.

To underline this decision, an inquiry has been initiated, to carry on the research of the possibilities of using renewable energy sources. These energy sources are, for instance, geothermal heat, solar energy and the burn off of biomass and biological gas.

The report will be presented by the end of 2009 and will form the basis of the future development of district heating in the Council of Nyborg.

Another decision that has been made, is that all meters, in 2012, will be replaced with a digital unit, that automatically can report in data to *"NFS A/S".*

Customer and communication

Customer relations and satisfaction

Despite that customers are obliged to connect up to the district heating, this policy has never caused any problems, probably due to the competitive price level on district heating in the town of Nyborg.

During the years *"NFS A/S"* has successfully conducted advertising campaigns for connecting to the district heating to increase its number of customers. The message of being able to get a steady, economical heat supply and at the same time avoiding the maintenance of the oil burner and chimney was well received.

A high priority in *"NFS A/S"* has always been to give the customers a good service, regardless which department they make contact with. This policy has led to a good reputation among the customers as well as collaborators.

Communications and marketing efforts

The main communication with the customers takes place via the internet. On the homepage of *"NFS A/S"* (www.nfs.as) it is possible to find an answer to any questions, the customer have.

This for instance, can be how to understand, operate and read the meter. Learn about the importance of cooling the return water in the district heating system and find good advice on how to economise on the use of heat.

The homepage can furthermore be used for a lot of practical purposes such as reporting in your data, notifying change of address, signing up for automatically payment of the invoices, finding former invoices, checking your consumption over a period of five years and see whether you pay too much or too little on account.

Information of terms of payment, explanations of the invoice, terms of delivery and prices on district heating and for establishing district heating to your house/business are also to be found. By subscribing on the free newsletter you can be informed of more of *"NFS A/S"* activities.

To be kept up to date with your energy consumption, it is possible to download an "energy-control- program" from the homepage. By entering your data from the meter every week, you can follow the consumption and take measures against unpleasant surprises. The same programme is available as a booklet, published by *"NFS A/S",* and has for more than twenty years been a popular tool with the customers.

When sending out invoices, the rearside is dedicated to useful information for the customers. You can compare your consumption with an average household, see a chart of your consumption over a period of five years and find good advice on how to save on the heating.

"NFS A/S" aims to meet the community and the customers with dialogue. It is the policy that everybody in the organisation is responsible for a positive dialogue.

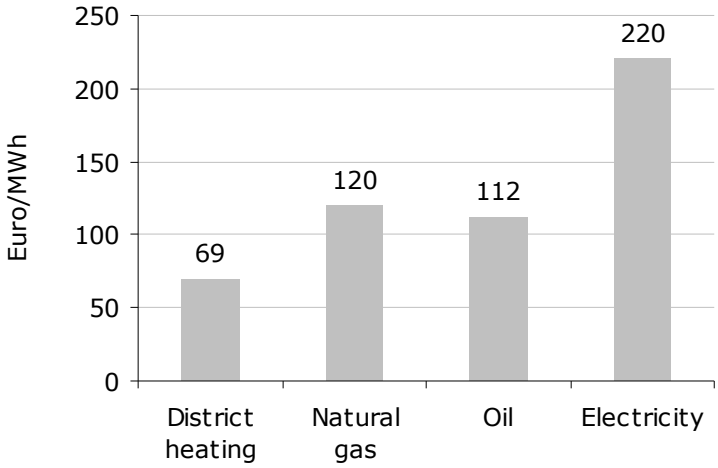
When, for instance, a customer asks for guidance to adjust the temperature of the return water in a household, *"NFS A/S"* will pay the customer a visit, free of charge. When *"NFS A/S"* is in contact with a customer at the customers residence, it is compulsory always to advise the customers of how to optimize use of the district heating and to provide them with the "energy control booklet", to be aware of their consumption.

Another service provided, is arranging information meetings before starting any construction works that affects the citizens. This type of announcements as, well as other relevant information, will also be announced in the daily press.

"NFS A/S" is aware of the technological possibilities of heat supply that the future will offer the customers. To maintain the custommers of the district heating *"NFS A/S"* remains focused on the positive co-operation with the suppliers of surplus heat, the chemical plants *"Kommunekemi A/S"* and *"Koppers Denmark A/S"*, to keep the prices of district heating steady and favourable.

The dialogue between "NFS A/S" and the community causes a continuous process of improving the customers service. When a constructive dialogue is obtained, good ideas come easy.

Fig. 8: Prices on energy sources in the town of Nyborg. The prices are without fixed excises.



The impact on the community

Caring for the environment has for many years been an integrated part of the policy at *"NFS A/S"*. Since 2001 a "green" account has been presented. Outwardly this account gives an impression of how "NFS A/S" cares for the environment. But what is more important it inwardly increases the awareness of the consequences the daily operation of the district heating system has on the environment.

"NFS A/S" engages in the young generation. A "greener" future involves the children. Therefore *"NFS A/S"* is pleased about educating the pupils in the primary and lower secondary schools about district heating and taking them to a heating plant, when an energy subject is on the timetable. Children are curious, quick and it is a good method to reach the adults.

During the energy saving activities *"NFS A/S"* has been in front of a number of energy renovations on schools in the town of Nyborg. As the total cost for the work was beyond that of a single school could afford, a model for returning the costs was set up. Through a close dialogue between *"NFS A/S"* and the schools, the solution turned out in a return through the invoices of the consumption. This means that, what was saved on the consumption went to *"NFS A/S".* The model was a success, as the Council of Nyborg at that time was not able to finance the renovations through the traditional channels.

"NFS A/S" is a member of the organisation, *"Danish District Heating Association",* an organisation with approximately 400 members of Danish district heating suppliers. The membership offers a number of offers, like for instance, seminars on the latest legislation on district heating.

Enclosures

Description of the chemical plant "Koppers Denmark A/S"

The Koppers Group is the world's largest tar distillation company with 8 tar distillation facilities spread over 4 continents and a total distillation capacity of 1,9 million tonnes of tar.

Koppers' core product is coal tar pitch which is used by the aluminium industry for production of anodes, but Koppers also supplies a wide range of carbon oil products to for example the rubber, plastic, concrete and dye industries for further processing.
The Koppers facility in Nyborg has a distillation capacity of 225.000 tonnes of tar, a turnover of 612 million DKK and employs 78 people (2008 figures).

Koppers Denmark's primary motive for joining the co-operation with NFS was that it made good sense:

- It made sense to invest in a heating plant instead of putting more money in the renovation of cooling towers. The outcome is energy conservation both for our company and for the town. We look at it as an investment in the environment.
- It made sense to contribute to the supply of low-cost district heating, since we had no use for the excess heat in our production. A waste product has been put to good use, and we look at it as an investment in the community.
- It made sense seen from a financial point of view. A waste product has been transformed into a productive commodity and our energy costs have been reduced. We look at it as an investment in our company's future.

Description of the chemical plant "Kommunekemi A/S"

"Kommunekemi A/S" was established in the early 70; s to deal with the growing amounts of chemical waste in Denmark. Already in 1975, when the first incineration plant was put in operation, we started the first heat supply in form of steam from waste heat.

The early beginnings resulted in a moderate heat supply at approx. 40,000 MWh to the newly built NFS heat central unit Fladet.

"Kommunekemi A/S" has since the beginning of the 80; s extended and optimized the primary process - the destruction of hazardous waste - and, not least, the development of potentials for additional energy production.

Here in 2009 *"Kommunekemi A/S"* operates an advanced waste two energy plant consisting of 3 incineration lines including several pre-treatment facilities, extended heat recovery installations and 2 steam turbine generators. Beside the self generating process energy for internal use, the annual energy export is about 170,000 MWh of district heating and 60,000 MWh of electricity.

Heat transfer to NFS takes place at 3 points, all with different temperature conditions.

- The first heat transfer takes place through a heat recovery system. The energy here comes from low temperate sub-processes, which normally were chilled away. The requirement for NFS was that the inlet water temperature should be reduced by 10 ° C. NFS succeeded and the first energy from this new system was introduced in 1993. Typical delivery, step 1: 45,000 MWh.
- The second step heat exchange is introduced through condensing after a 3.8 MW back pressure turbine generator. Typical delivery, step 2: 80,000 MWh.
- Finally, there is a heat exchange in the initial and steam-based 3rd step with a typical delivery of 45,000 MWh.

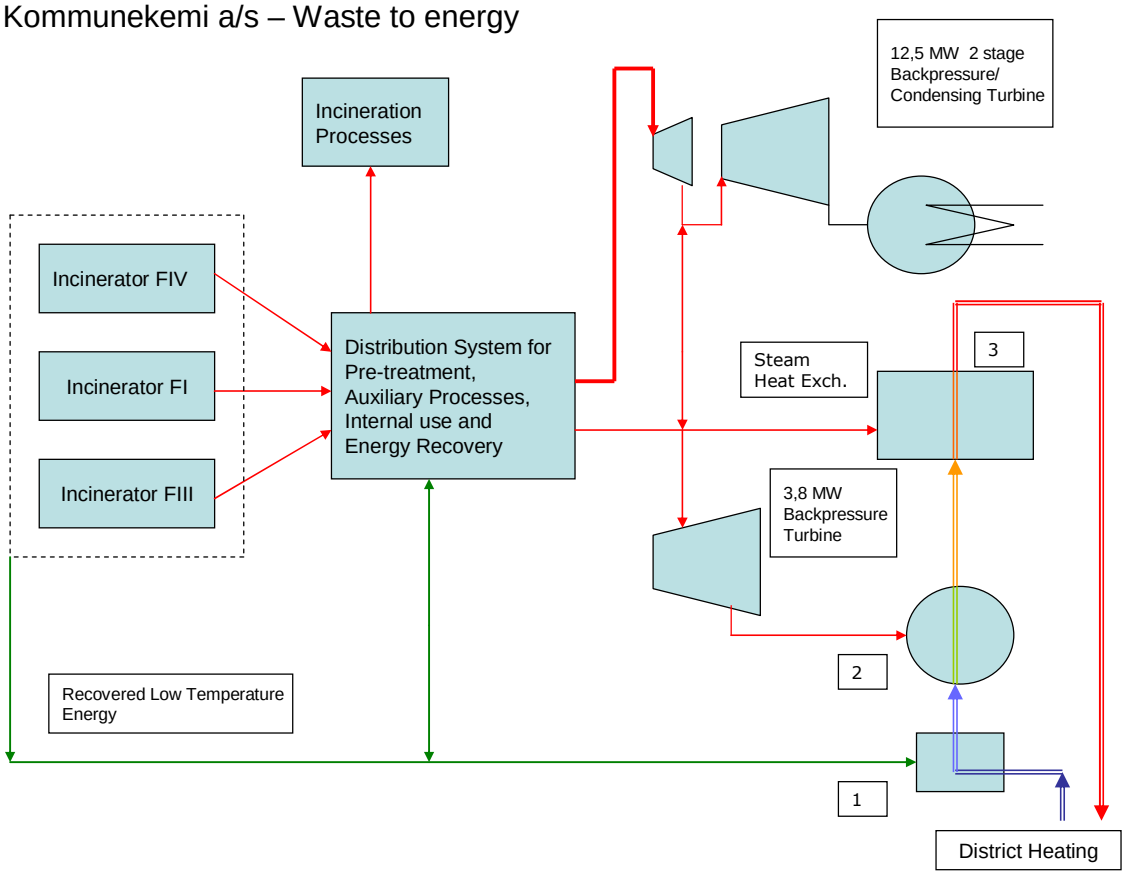
During the summer, when the need for district heating is low, *"Kommunekemi A/S"* produces supplementary electricity through a condensing steam turbine. A conversion in 2006 of this turbine means however that power generation from the first, pressure reducing unit takes place all year round.

Control and regulation of energy production, including the vital balance between district heat and electricity production are governed by SRO in a strictly defined and prioritised order.

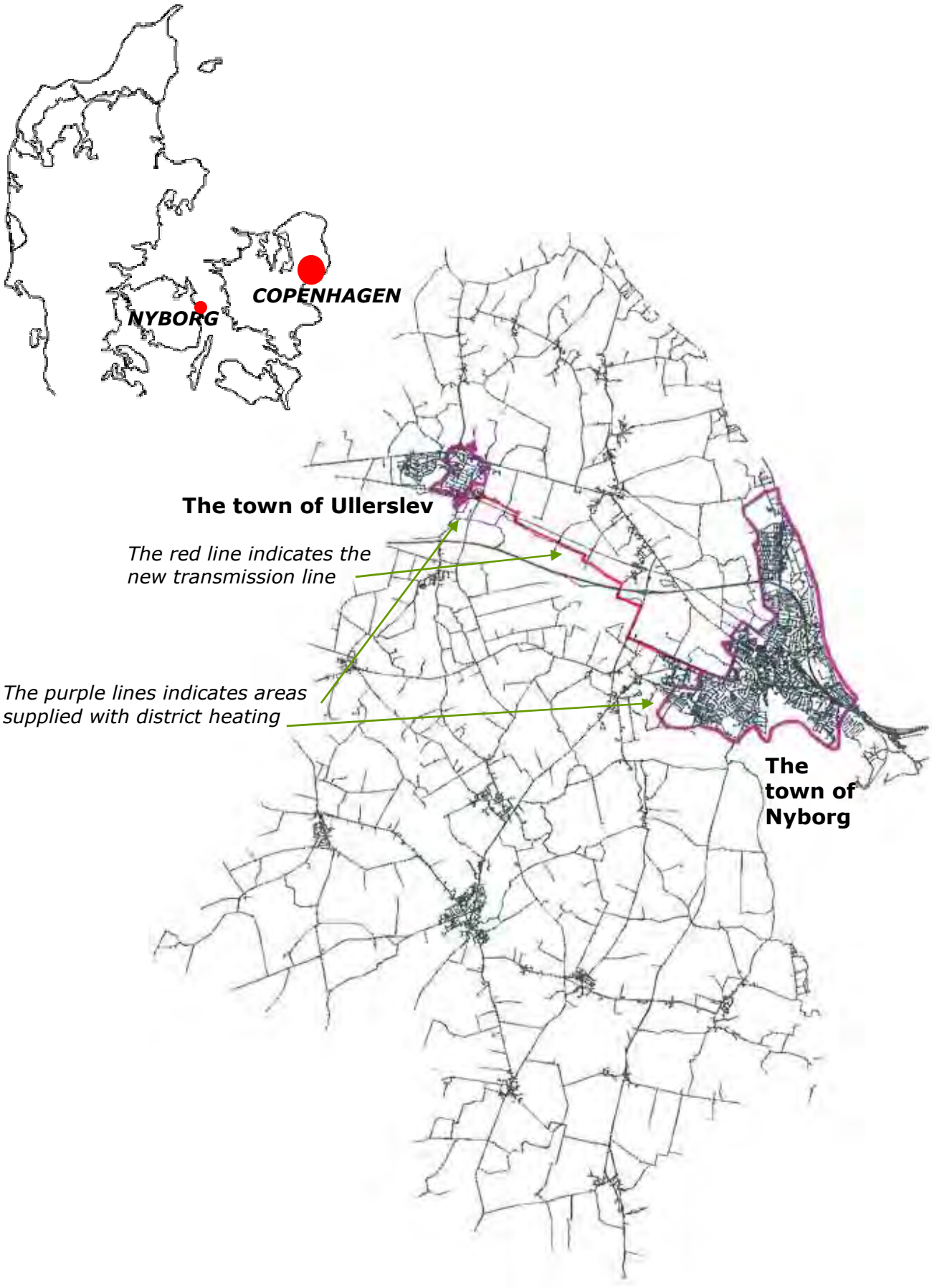
Our plan for late 2009 and afterwards is to supply even more district heating to NFS as the result of the new connection to the small town Ullerslev – *"Kommunekemi A/S"* is looking forward to do so.

Kommunekemi's treatment of hazardous waste creates value for the society. Our deliveries of energy contribute positively to NFS' total CO_2 account.

Kommunekemi a/s – Waste to energy



Map of Denmark and East Funen



Links

www.danskfjernvarme.dk	*"Danish District Heating Association"*
www.enervision.dk	*Consulting engineering company assisting "NFS A/S in achieving the compulsory energy savings.*
www.koppers.com	*"Koppers A/S"*
www.kommunekemi.dk	*"Kommunekemi A/S"*
www.nfs.as	*"Nyborg Forsyning & Service A/S"*
www.nyborg.dk	*The Council of Nyborg*
www.steffca.dk	*Insulating company assisting "NFS A/S" in carrying out the practical work with achieving the compulsory energy savings.*