VESTFORBRÆNDING

Global District Energy Climate Award 2015

Application in the category Expansion

Vestforbrænding, Denmark

Introduction

Why

Vestforbrænding (VF) was founded by municipalities in 1970 with the aim to take care of waste management and replace landfills with energy recycling.

In 2006 VF generated 250 GWh electricity and 1200 GWh heat, of which 300 GWh was sold in own network. The rest was sold to CTR and VEKS in the Greater Copenhagen District Heating system replacing heat form mainly the large CHP plants.

As the energy policy changed from reducing oil to reducing CO2, VF elaborated business plans in 2006 and in 2010, proving that DH to own consumers could expand to 950 GWh replacing larger gas boilers. The CBA analysis showed an IRR of10% for the society and for VF.

How

VF presented the business plans successfully for the seven municipalities, got acceptance and started implementing them in accordance with the Heat Supply Act. Moreover VF agreed to pay the gas company a minor compensation and got in return information on gas consumption. VF offered the consumers a full package of all installations at no connection fee at a competitive price. The plan included interconnection with the two heat transmission systems north of Copenhagen in order to ensure more efficient use of all the efficient base load heat. Along with the connection of consumers, VF advice the consumers on energy efficiency.

What has been achieved

Currently more than 50% of the plans have been implemented successfully in accordance with the budget and with a start connection rate of around 80%. The detailed projects have in general confirmed an internal rate of return of typically 10% for the society including costs of CO2 and harmful emissions. As all profit of the projects reduces heat prices, VF has been able to reduce the heat prices the last 3 years. VF's successful heat planning replacing gas boilers has inspired many other district heating companies to do the same, and thereby contributed to the implementation the newly formulated Danish energy policy. This also includes plans for district cooling.

Vestforbrænding

Vestforbrænding (VF) is owned by 19 municipalities in Greater Copenhagen and Northern Zealand: Albertslund, Ballerup, Brøndby, Egedal, Frederikssund, Furesø, Gentofte, Gladsaxe, Glostrup, Gribskov, Halsnæs, Herlev, Hillerød, Høje-Taastrup, Ishøj, København (NW), Lyngby-Taarbæk, Rødovre,Vallensbæk

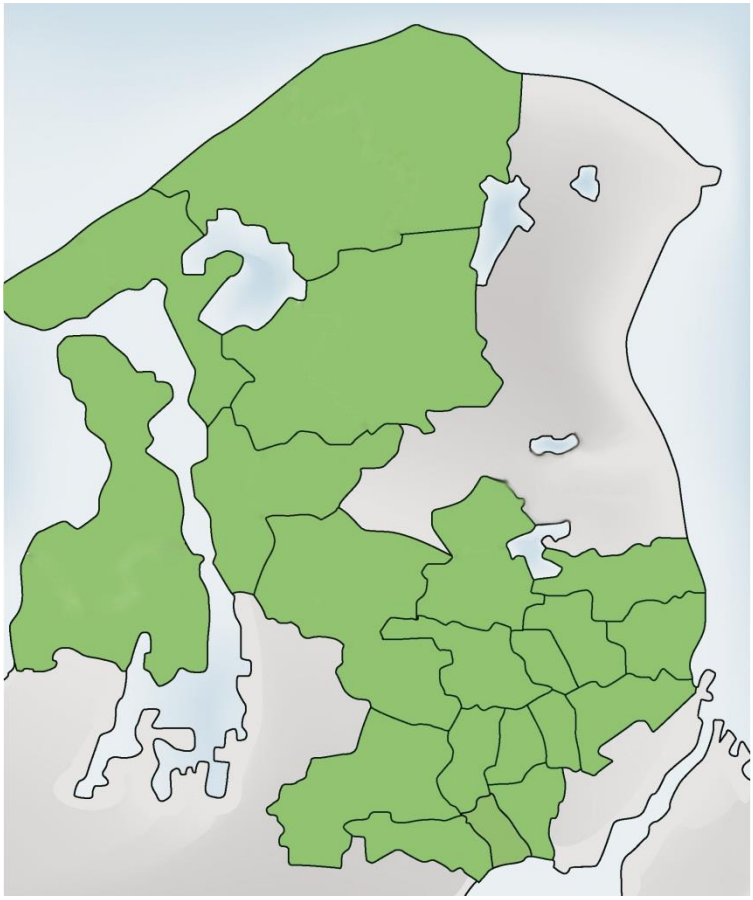

Figure 1 The 19 Owner-municipalities of Vestforbrændin

VF is organized as a municipal partnership company. Each owner municipality has one representative in the board.

The aim of the company is to offer waste management services to all 19 owner-municipalities and to supply district heating. There are 875.000 inhabitants and 60.000 industries in the municipalities, generating more than 1 million tonnes of waste. The first priority of waste management is recycling and second priority is incineration. In total 550,000 tonnes of waste is incinerated at the VF's facility in Glostrup, generating 250 GWh electricity and 1,200 GWh heat.

As VF is a non-profit company, all benefits of operating the company is used to reduce waste collection fee, gate fee at the waste incinerator and heat prices at consumers. The accounting of the waste and the heat is separated and the heat is priced in accordance with the Heat Supply Act, stating that all profit of the heating business shall be to the benefit of the heat consumers.

The 19 owner municipalities guarantee for all loans necessary for the waste and the heat sector and accordingly, VF can finance 100% of all long-term investments at the lowest interest rate on the market.

Figure 2 Vestforbrænding, head office and Waste-for-energy plant in Glostrup

How has the project improved energy efficiency and cost effectiveness

The positive impact of expanding the DH owned by VF can be assessed in several steps, from the original base-line in 1970 to the long-term vision.

Baseline 1970

- Before VF was established in 1970 all waste was dumped at landfills and almost nothing was recycled.
- All heat consumers in the region used oil for heating

Baseline 2006

Compared to baseline 1970, VF has expanded the DH up to 2006 in the following way:

- VF started to invest in DH network in 1970 to supply a new hospital with heat, process energy and cooling (absorption chiller) at a temperature of 160 dgr.C. Shortly after a hot water network was developed to supply mainly new apartment buildings.
- The national heat planning started in 1980 and the Ministry decided that natural gas should have highest priority north of VF in order to give natural gas a market share and to increase replacement of oil.

- It was also decided that VF should be connected to the integrated DH system in Greater Copenhagen (to VEKS) in order to ensure that all waste heat was utilized.
- As the heat from waste increased, a second connection to the integrated system (to CTR) and a new peak boiler plant was established
- In 2006, all combustable waste, which could-not be recycled, in total 550,000 tons was used for energy recycling at the plant in Glostrup at two efficient CHP units (one with flue gas condensation) with a total capacity of 70 t/a generating:
  - 250 GWh electricity to the grid and
  - 1200 GWh heat of which
    - 300 GWh heat was supplied to VF's own network in two municipalities replacing oil boilers
    - 900 GWh heat was sold to CTR and VEKS in the Greater Copenhagen DH system, replacing:
      - 850 GWh from CHP extraction plants: 0,3 MWh coal and gas per MWh heat
      - 50 GWh from gas and oil boilers: 1,1 MWh fuel/MWh heat
- The absorption chiller was closed, and the maximal supply temperature could be reduced as much as possible to around 130 dgr.C. in order to increase the CHP efficiency and still serve all consumers

Expansion 2006-2014

- In 2005 the Danish Energy policy started to change, it was not any longer necessary to give preference to the gas company and Denmark would soon be short of natural gas. The overall aim was now to be independent of fossil fuels in the long run in the most cost effective way.
- VF elaborated in 2005 a business plan, Heat Plan 2010, proving that the DH supply to own consumers could be extended by around 350 GWh in a profitable way for the society, for VF and the consumers in 3 municipalities
- The municipalities accepted the business plan as a good contribution to their heat planning in accordance with the Heat Supply Act.
- VF elaborated several individual projects I accordance with the plan and extended own network based on hot water (max. 110 dgr.C in all new grids) increasing heat sale to own consumers by 373 GWh (from 300 to 673 GWh) replacing mainly gas boilers.
- VF offered the new consumers to establish the connection and consumer sub-station free of any connection fee for consumers larger than 40 MWh/a if they connected the first year
- One of the projects included interconnection with another heat transmission system to Hillerød to transfer efficient heat in the summer period 20 km north to Hillerød.
- The heat sale to CTR and VEKS was reduced and the production from mainly CHP plants was increased accordingly
- The typical IRR of the projects for the society taking into account cost of CO2 and harmful emissions was around 10%, which is far more than the required 4%.
- The typical IRR of the projects for VF as a company was also around 10%, allowing VF to reduce the heat price to all consumers
- The projects were implemented successfully; large connection rate around 80% the first year and according to the budget
- The analysis of the projects including CBA and hydraulic analysis with automatic GIS data transfer was based on data from the building register, the land owners register, GIS database and data for sale of gas to each consumer from the gas company

Expansion 2014-2020

- VF has elaborated an additional business plan, Heat Plan 2015, for increasing the sale to own consumers by 280 GWh from 673 to 953 GWh in 7 municipalities in co-operation with the municipalities
- A project document in accordance with the Heat Supply Act has been approved for the first 150 GWh of this extension and the construction work has started in continuation of the previous projects
- The remaining projects documents will be submitted for approval in 2015 including interconnection with a second heat transmission system north of Copenhagen and a 30 MW gas fuelled CC CHP plant

Long-term strategy

VF continues the work with strategies in order to meet the expectations of the municipalities in accordance with the national energy policy. That includes the following considerations:

- VF considers to intensify the ongoing support to consumers with energy efficiency measures to cover both heating and cooling as well as necessary supply temperature and return temperature
- VF considers to establish several District Cooling grids, including chilled water storages, ground source cooling and heat pumps which generates both cooling and heating as soon as the legal framework is in place.
- VF considers to offer all owner-municipalities the heating services and e.g. operate new DH system in island operation and interconnect district heating systems whenever it is profitable.

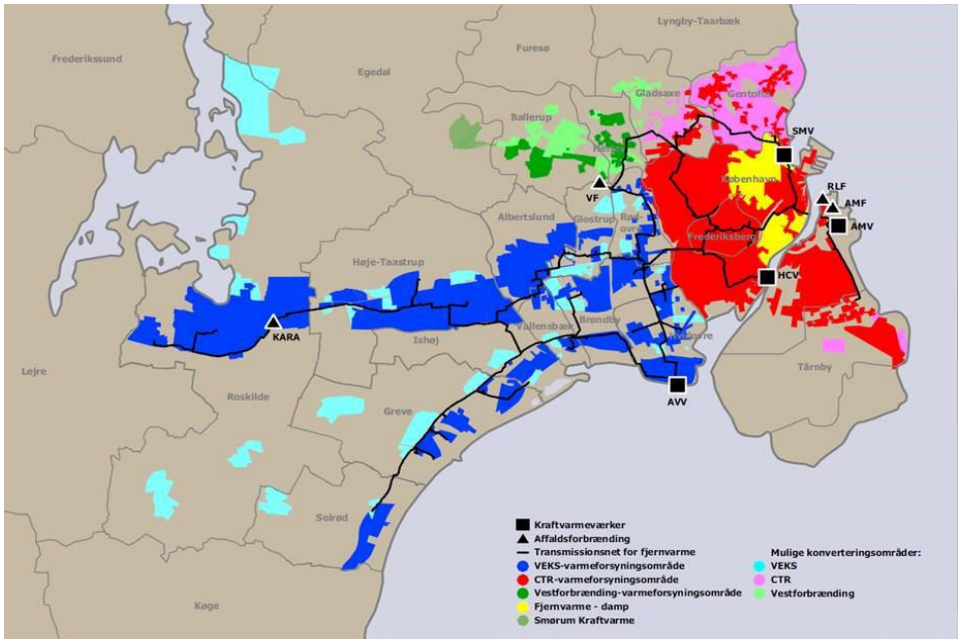

Figure 3 The DH system in Greater Copenhagen

Figure 3 shows the integrated DH system. Dark green is VF as it was around 2006 and the light green is most of the extension up to 2014.

Figure 4 shows the DH system of VF in more detail. The two northern transmission systems from Værløse to Hillerød and from Lyngby to Elsinore is not shown.

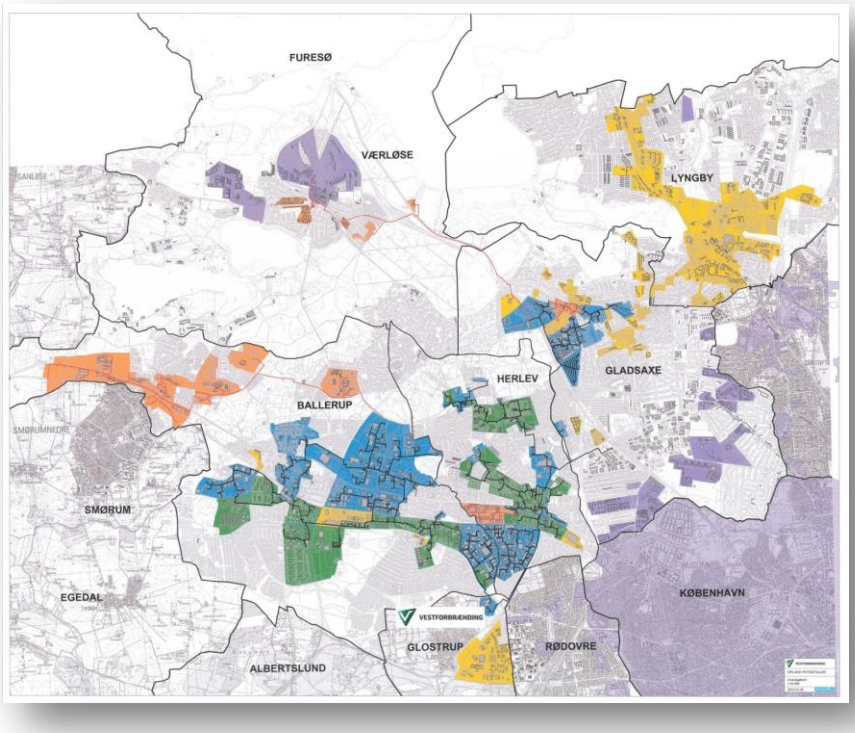

Figure 4 VF's DH network and planned supply area

	300 GWh in 2006
	373 GWh into operation 2007-14
	150 GWh in operation since 2012 or under construction
	130 GWh partly under construction, partly planned

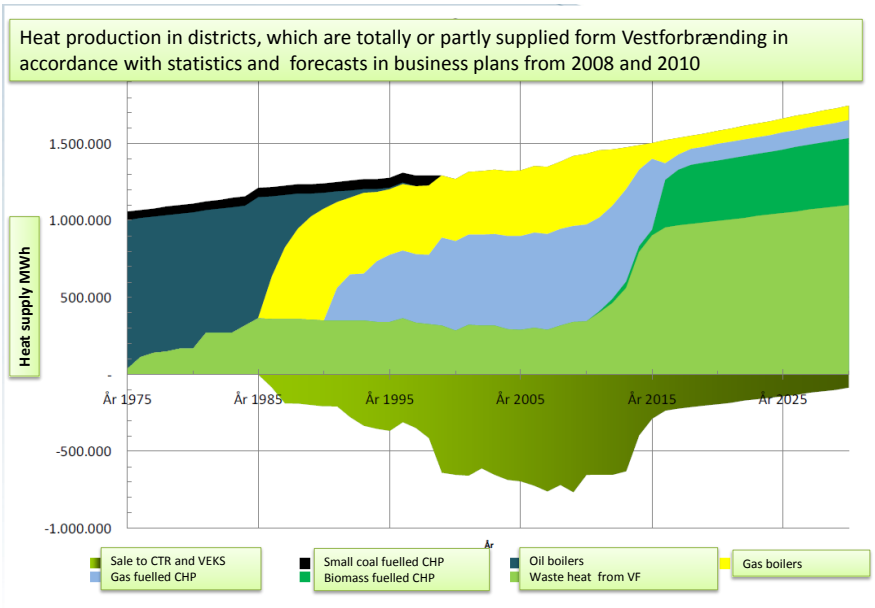

Figure 5 DH production in districts, which totally or partly is supplied from VF

The light green is supply of heat from VF to own consumers and transmission of heat to networks north of VF. Transmission to CTR and VEKS is illustrated as negative values (dark green). It illustrates that gas fuelled boilers and unprofitable gas fuelled CHP plants are replaced with heat from VF, which is compensated for by less sale to CTR and VEKS and thereby more cost effective production at the large CHP plants.

The figure below shows that the heat price, excluding taxes has been reduced during the last three years. The reduction is mainly due to the benefit of the expansion of the DH system, which started in 2006.

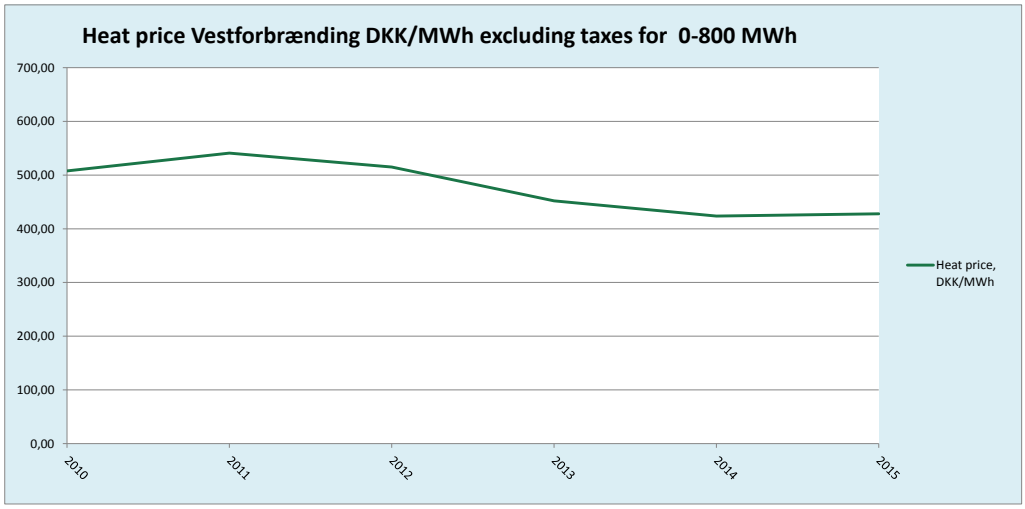

Figure 6 District heating average sale price to consumers

Large project to Gladsaxe approved in 2009

The first large project to be extended into a new third municipality was the project to Gladsaxe in 2009 implementing a major part of the business plan Heat Plan 2010. It was constructed in the period from 2010 to 2012, see figure 7. A substantial part of the heat sale in the project is to the Danish company NOVO, who find the DH supply profitable and fully in accordance with the climate and CSR strategy of the company.

The project includes:

District heating expansion to replace gas boilers	118 GWh
Total investment	205 mio. DKK

- Investmens in network 150 mio.DKK
- Investments in peak boilers and pumps 15 mio.DKK
- Investments in consumer installations 40 mio.DKK

IRR for the society based on DEA guideines	11%
NPV for the cociety (6% discount rate)	67 mio.DKK
IRR for Vestforbrænding	13%
NPV for Vestforbrænding (5% discount rate)	122 mio.DKK
NPV for the consumers (5% discount rate)	29 mio.DKK
NPV for the local community	151 mio.DKK

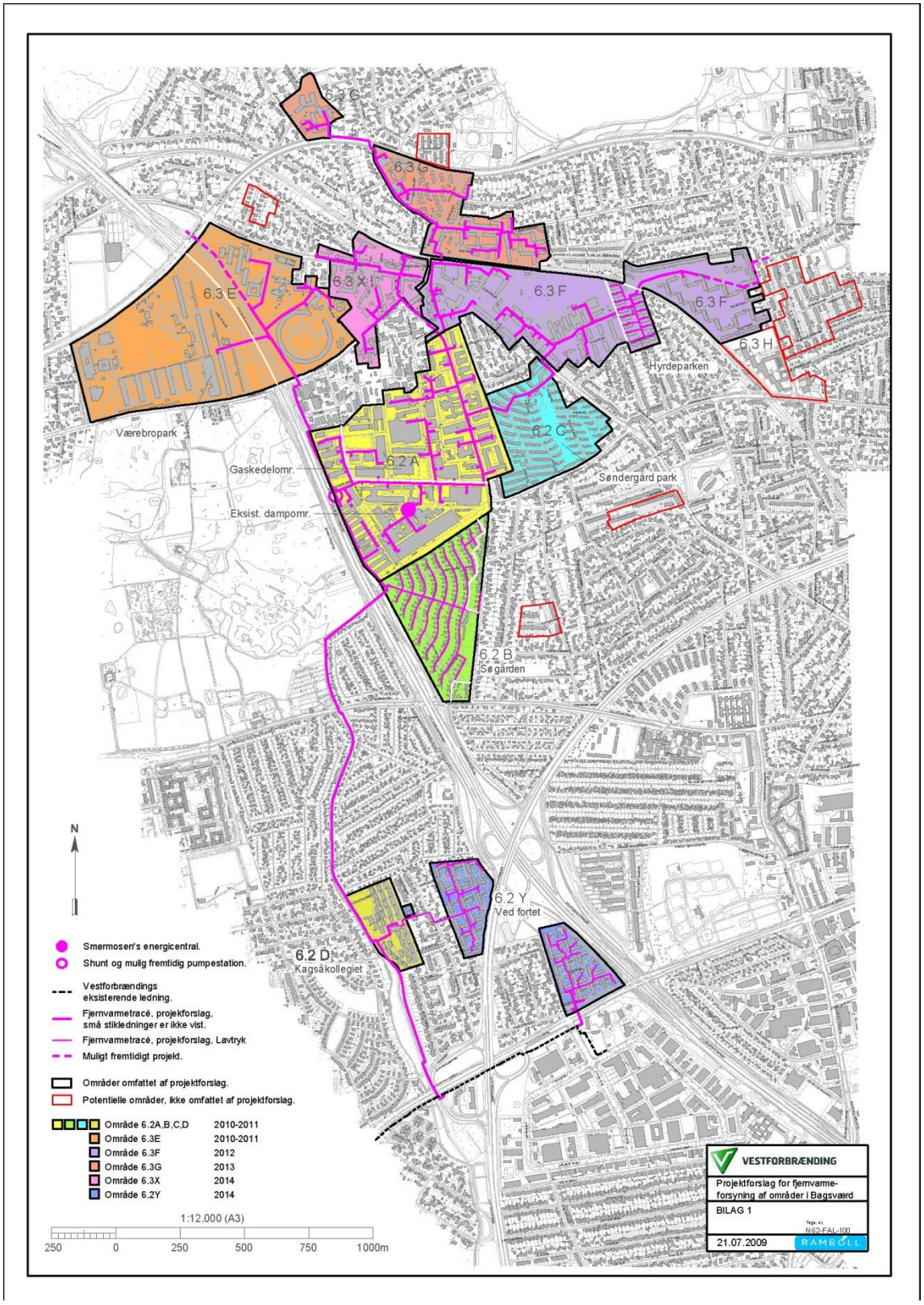

Figure 7 DH project to Gladsaxe in 2009

Large project to Lyngby approved in 2013

One of the largest projects to be approved in accordance with the Heat Supply Act was the first stage project for supply of large consumers in Lyngby-Taarbæk Municipality in accordance with the business plan Heat Plan 2015 and the Strategic Energy Plan for Lyngby-Taarbæk Municipality. The plan was approved by the municipalty in 2013 and the project document in accordance with the Heat supply Act approved a few months later. The project is now being implemented.

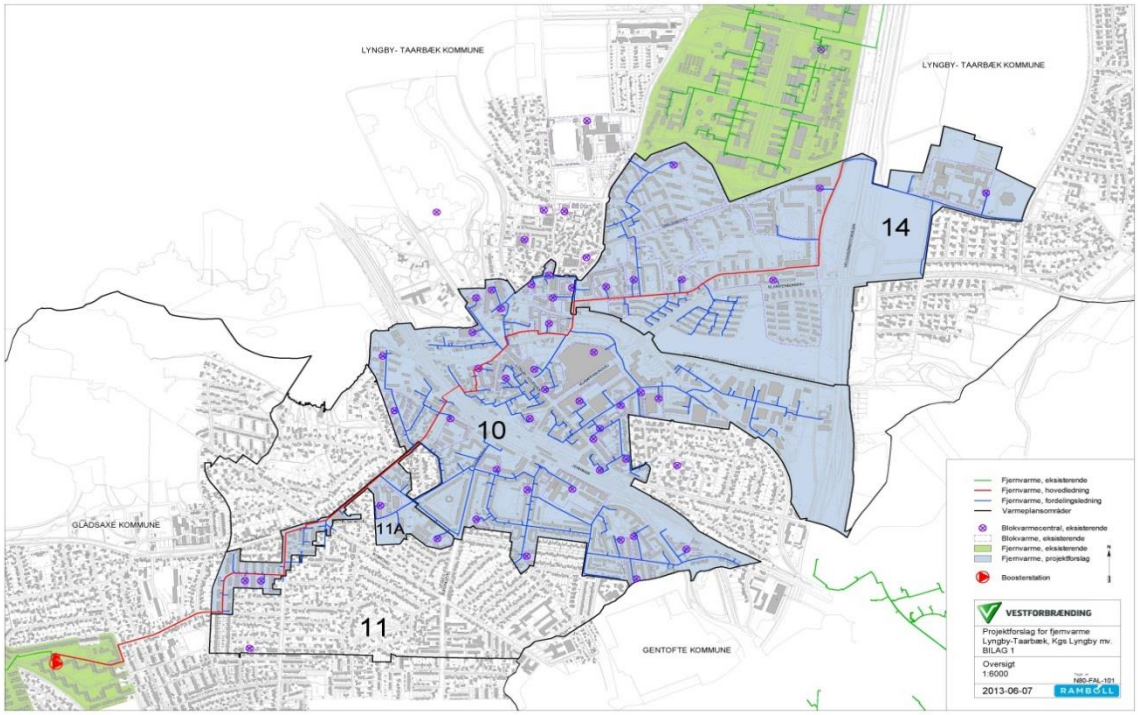

Figure 8 DH project to Lyngby in 2013

The project includes:

District heating expansion to replace gas boilers	150 GWh
Total investment	300 mio. DKK

- Investmens in network 200 mio.DKK
- Investments in peak boilers and pumps 50 mio.DKK
- Investments in consumer installations 50 mio.DKK

IRR for the society based on DEA guideines	10%
NPV for the cociety (4% discount rate)	146 mio.DKK
IRR for Vestforbrænding	8%
NPV for Vestforbrænding (3% discount rate)	135 mio.DKK
NPV for the consumers (3% discount rate)	261 mio.DKK
NPV for the local community	396 mio.DKK

Technologies

VF has since 1970 used high quality standards for the district heating network. The first DN500 concrete duct is now more than 40 years old and still in good shape. All the 30 year old preinsulated pipes, which are equipped with leak detection system and have welded muffs, are also in good shape, and they seem to have even more than 30 years of remaining life-time.

Moreover the consumers have saved heat and reduced the return temperature, leaving more available capacity.

Due to this solid base of existing network it has been to expand the DH system to more than the double.

Taking into account that it is possible to increase the transfer of efficient base load by increasing the flow in bottlenecks, to supplement with local peak boilers and to include various distributed heat sources, and future heat storages, it has been possible to expand the DH supply even more.

All new networks are first of all based on preinsulated pipes with leak detection and welded muffs, but benefits also from new features, such as bended pipes, twin pipes (in small dimensions) and no-dig methods in order to reduce construction costs.

Figure 9 Preinsulated pipes, bended, twin and no-dig

Vestforbrænding, a front runner for expansion of DH

VF has since the first new projects for replacing gas boilers with DH inspired others to follow. VF has e.g.

- Inspired the parliament to include shift from large gas boilers to DH based on efficient heat production to be one of the bullets in the previous national Energy Policy Agreement
- Proved to the Energy Agency, as a respond to the Agreement, that there was a huge potential for cost effective expansion of the DH system in Denmark
- Inspired the Energy Agency to encourage municipalities to look for this potential sending a letter to all local authorities
- Inspired other DH companies to expand the DH successfully based on the same strategy (total solution including consumer installation and no connection fee)
- Provided evidence for prognosis for expanding DH in Heat Plan Denmark
- Inspired many visitors from abroad

Innovation

The DH extension of VF is innovative in many ways:

- The projects are a result of a heat planning including local authorities, VF and utilities and the assessment is based on a CBA for society including costs emissions and for the local society.
- Therefore the project is a frontrunner for implementation of EU directives
- The extension includes a total offer of connection and substation free of charge
- VF has in the planning access to all data, GIS, building and landowners register, sale of natural gas to each consumer in co-operation with the gas company
- All profit of improving the heat supply is to the benefit of consumers, which encourage the politicians in the board to take wise decisions
- VF is in the process to establish district cooling, advice to consumers etc.
- VF use technical solutions for in particular network, which have long life-time
- VF use technical solutions, which lower cost, whenever possible, e.g. reducing number of heat exchangers by using pressure reduction and shunts, using bended pipes, twin pipes and no-dig methods when possible

Strategy

VF is in the process of elaborating an Energy Supply and Climate Strategy.

The aim is to promote an efficient development of the DH supply and related supply in interaction with the energy recycling from waste and other renewable energy sources, including:

- To reduce the CO_2 emission in the most efficient way for the society
- To ensure low prices for waste and heat supply
- To contribute to the strategic energy planning in all owner-municipalities, which can benefit from the DH supply
- To establish and operate DH supply in the municipalities which can benefit from the organization of VF
- To ensure interaction and optimization cross sectors
- To reduce the dependency on fossil fuels in Denmark
- To reduce waste of energy and thereby reduce the primary energy consumption
- To promote energy efficiency and reduce consumption of energy
- To develop district cooling in symbiosis with district heating as soon as the EU directives (as regards district cooling) has fully been implemented in Denmark in a coming new Act for district heating and cooling, which allows the heat consumers and coming cooling consumers of Vestforbrænding to benefit from this synergy.

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