A PROGRESSIVE WAY TO COGENERATE HEAT AND POWER

The widespread use of combined heat and power is one of the most important reasons that Denmark has been able to reduce its carbon emissions, while fuel consumption has remained almost unchanged. Combined heat and power utilise fuel efficiently and the heat is transmitted to consumers as district heating. Today Denmark is one of the most progressive nations in the market for exports of combined heat and power as well as district heating.

COGENERATION OF ELECTRICITY AND HEAT

Cogeneration of electricity and heat (combined heat and power or CHP) is one of the most energy-efficient and environmentally friendly ways to produce electricity and heat. Generating CHP not only makes it possible to use cleaner fuels to the benefit of the environment, but also utilises fuels more efficiently, because the excess heat from the generation of electricity is used as district heating for buildings, rather than merely wasting it, or having to use energy and water to cool it down.

Today, more than 60 pct. of Danish district heating is cogenerated with electricity, saving roughly 30 pct. fuel compared to the traditional approach in which heat and power are produced separately. CHP has developed so extensively in Denmark that it has lowered Denmark's total gross energy consumption by 11 pct. compared to separate productions of district heating and electricity.

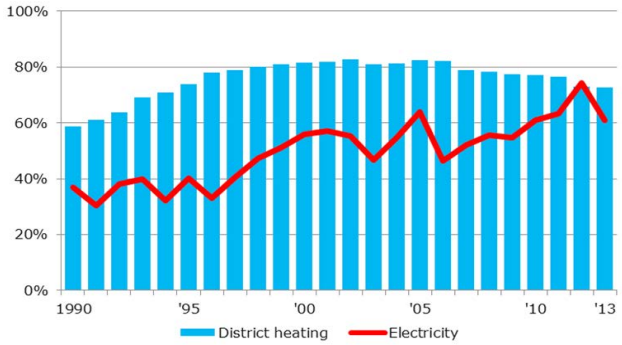

Figure 1: CHP share of thermal power and heat production for district heating

FACT:

In 2021 43 pct. of all energy consumed in Denmark is expected to be from renewable sources. In the district heating sector, renewable energy is expected to contribute with 74 pct. by 2021.

THE SPREAD OF COMBINED HEAT AND POWER SYSTEMS - FROM 1903 TO TODAY

The tradition of combined heat and power in Denmark extends back to the beginning of the 20th century. Scarcity of landfill sites led to the building of a waste incineration facility in 1903 that combined the generation of heat and power, accumulating heat in steam. The facility supplied a large nearby hospital with electricity and heat, later also a poorhouse and public bathing facility.

During the 1920s and 1930s, a collective district heating system was developed using waste heat from local electricity production. During the same period, district heating also supplied urban areas with heat and accounted for around 4 pct. of total Danish heat supply. Later district heating, combining heat and power production, expanded into larger cities and in the 1970s around 30 pct. of all homes were heated using district heating systems.

After the two oil crises in the 1970s, it was decided to expand the fuel-efficient combined heat and power system to medium and small-size cities, and newly found natural

gas in the North Sea was used extensively in decentralized CHP plants throughout most of Denmark.

CENTRALIZED AND DECENTRALIZED CHP PLANTS

The development of the past hundred years has meant that today Denmark has around 670 centralized and decentralized CHP plants. There are various forms of ownership of plants. The largest plants are owned by large energy companies and municipalities, while the smaller plants typically are owned by industries, municipalities or cooperative societies.

The centralized plants initially produced electricity and were located in large Danish cities, whereas the decentralized power plants originally were locally owned heat plants in medium-size and smaller cities. During the 1980s and the 1990s Danish natural gas was utilized to establish a large number of decentralized combined heat and power plants – and today the production of electricity and heat takes place throughout the country. These natural gas plants are now establishing other heat technologies – such as heat pumps, biomass boilers and solar heating panels – so a plant typically has a combination of heat production sources.

The Danish Energy Agency has laid down general conditions for establishing and operating district heating systems. These are to ensure fair prices on heating for consumers, society and economy.

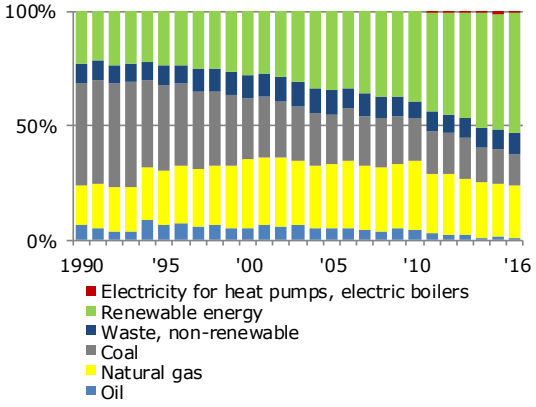

Figure 2: Fuel consumption for district heating production, percentage distribution

SIX OUT OF TEN CONSUMERS RECEIVE DISTRICT HEATING

More than half of the electricity produced in Denmark is produced at CHP plants. Here the excess heat is used for district heating and today, around 1.7 million houses and buildings in Denmark are heated from district heating. This means that 64 pct. of all households in Denmark receive heat from a district heating system which is one of the highest proportions of district heating in the world.

More than half of all district heat produced in Denmark is produced using biomass, signifying that more than 30 pct. of all Danish homes are heated by carbon neutral district heating.

FACILITATES INTEGRATION OF VARIABLE POWER GENERATION

Most CHP plants in Denmark are connected to a heat storage facility which improves the flexibility of the system. With heat storage the CHP plant can produce excess heat during the day, when there is a great need for electricity, and then use the heat at night when the demand for heat is higher than the demand for electricity. The heat storage also facilitates a more efficient use of more fluctuating renewable energy sources like wind or solar power. District heating systems are able to absorb excess electricity and use it to produce heat which could be stored for later usage, or when there is no renewable energy available due to no wind or no sun, then the CHP system can generate the needed electricity.

FINANCIAL BENEFITS FOR CONSUMERS

Before a district heating plant or a CHP plant can be built, it must be documented that the economy is healthy and consumer prices are low. The majority of consumers of district heating pay less for their heating than the alternate cost of an oil burner. According to Danish legislation, district heating is to be sold at a price corresponding to the cost of production and distribution, i.e. according to a 'non-profit principle'. This means that heat consumers benefit from the low costs.

FOR FURTHER INFORMATION, PLEASE CONTACT:

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