

# HEAT GENERATION IN DENMARK

The Danish district heating system supplies almost three-quarters of the population with heating. There are around 360 district heating companies in Denmark, which either generate the heat themselves or buy it from other production companies. The heat is generated in many different ways, using a wide variety of fuels. Most of the production takes place in CHP plants that generate both electricity and heat. They do so by harvesting energy from a number of different fuels such as waste, gas, coal and biomass.

Some district heating companies use only natural gas in their production facilities, while others combine several different

technologies distributed between multiple plants.

The technologies currently available also include CO<sub>2</sub>-free sources of heat such as solar and geothermal heat. In addition, many places also exploit surplus heat from industrial facilities to supply district heating, and other plants likewise use heat pumps and electricity cartridges to utilise the electricity generated by wind turbines.

In practice, the district heating system actually functions like a giant battery with the capacity to assimilate and store production from other energy technologies.

Denmark enjoys a high level of supply reliability, which means that customers

need not worry whether there is heat in their radiators and hot water in their taps. The reason for this is that all plants operate reserve load boilers, typically gas- or oil-fired. These boilers are brought online if the CHP plant fails to deliver, but they are also useful during the winter months when more heat production is required.

## OWNERSHIP

310 district heating companies in Denmark are cooperative societies owned by the users, 50 are municipally owned and only few are in private hand.



### SOLAR HEAT – WITH/WITHOUT PIT STORAGE

A solar heating installation that consists of solar panels, where in many cases the energy is accumulated in giant pit storage facilities – a kind of artificial lake with a cover on top. This makes it possible to store the heat generated until winter, when there is more call for it than in the summer when the weather is typically more sunny – which naturally means less demand for heating. There are currently 86 facilities in use in Denmark – with more to come.



### GEOTHERMAL ENERGY

This involves drawing hot water up from deep underground and then using the heat from this water for district heating.

### HEAT PUMPS – ENERGY FROM WIND TURBINES

Heat pumps provide an efficient way to utilise wind energy in the district heating system as they generate heat from electricity on a ratio of 1:4 (i.e. one part energy = four parts heat). However, they are costly to buy and expensive to run in Denmark on account of high duties.



### ELECTRIC BOILER

A giant electric 'kettle', just like the ones we use in our kitchens. These boilers are excellent at utilising wind energy, but they are not as efficient as heat pumps because they can only generate heat on a ratio of 1:1. On the other hand, they are inexpensive. A total of 400 MW is currently being used for district heating in Denmark.



### DISTRICT HEATING FACILITY

A boiler used exclusively for generating heat. These facilities are also used as reserve capacity to cover extremely cold periods, for example, when the district heating companies need to be able to generate more heat.



### WASTE INCINERATION PLANTS

These plants make it possible to utilise heat generated from the incineration of refuse collected from large areas of Denmark.

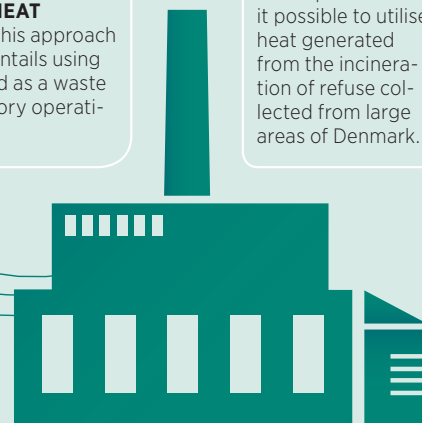
### CHP PLANT

A production facility that generates both electricity and heat, thus making the most efficient use of the energy from fossil fuels. Most CHP plants that were originally coal-fired have now been converted to run on biomass.



### SURPLUS HEAT

This approach entails using the heat generated as a waste product from factory operations, for example.

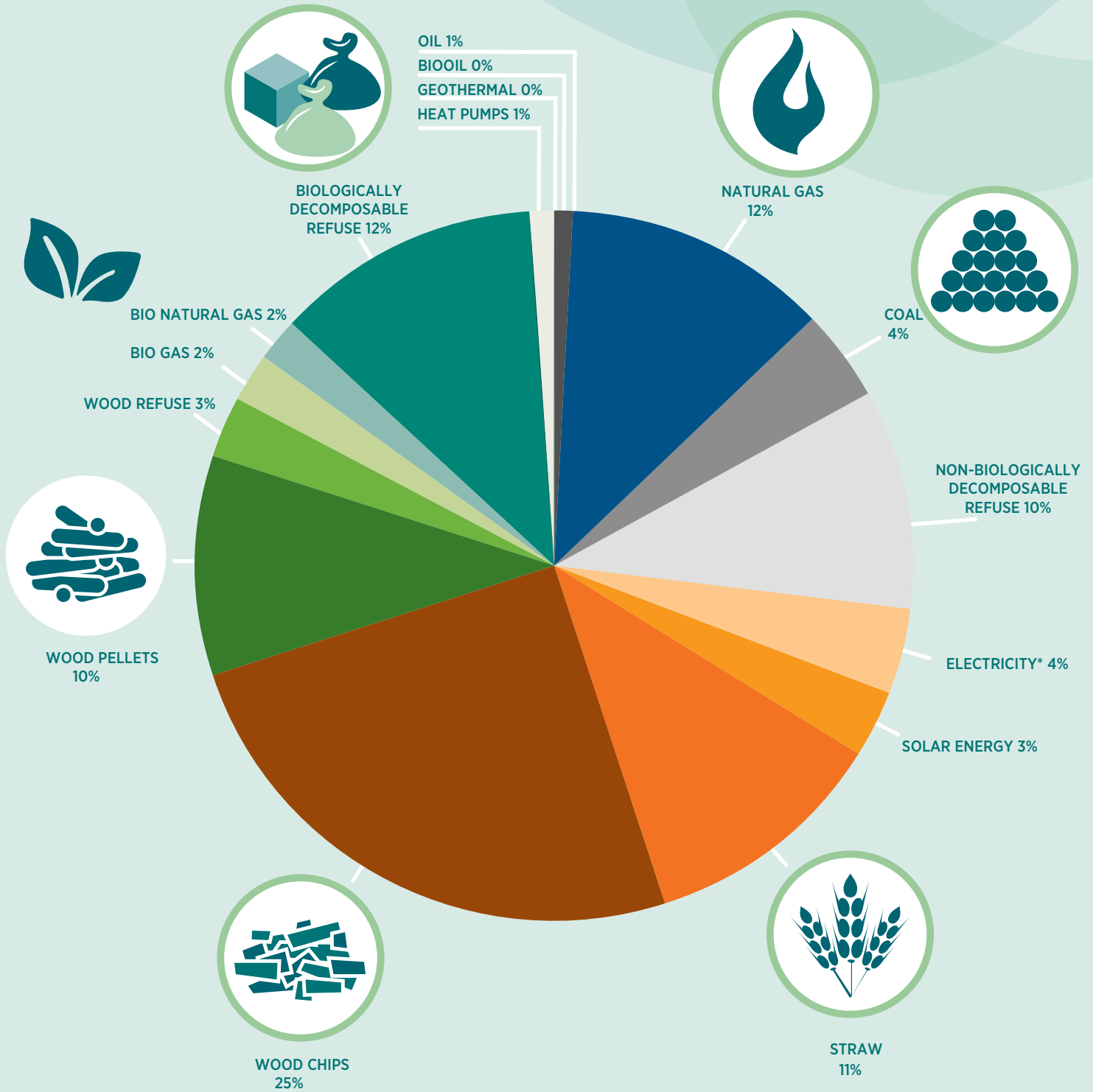




## FUELS:

Many different types of fuel are used to generate heat. The most common fuels include natural gas, waste and biomass. Coal is still used in a number of plants, but its use is being phased out in favour of more eco-friendly fuels and technologies. Oil is only used to a limited extent, firing a few boilers as reserve capacity for when Denmark is in the grip of a particularly

harsh winter. Denmark has been utilising heat from waste incineration for more than 100 years. Biogas is another green fuel that is becoming increasingly prevalent in district heating production in Denmark. The Danish district heating system is 72% green today.

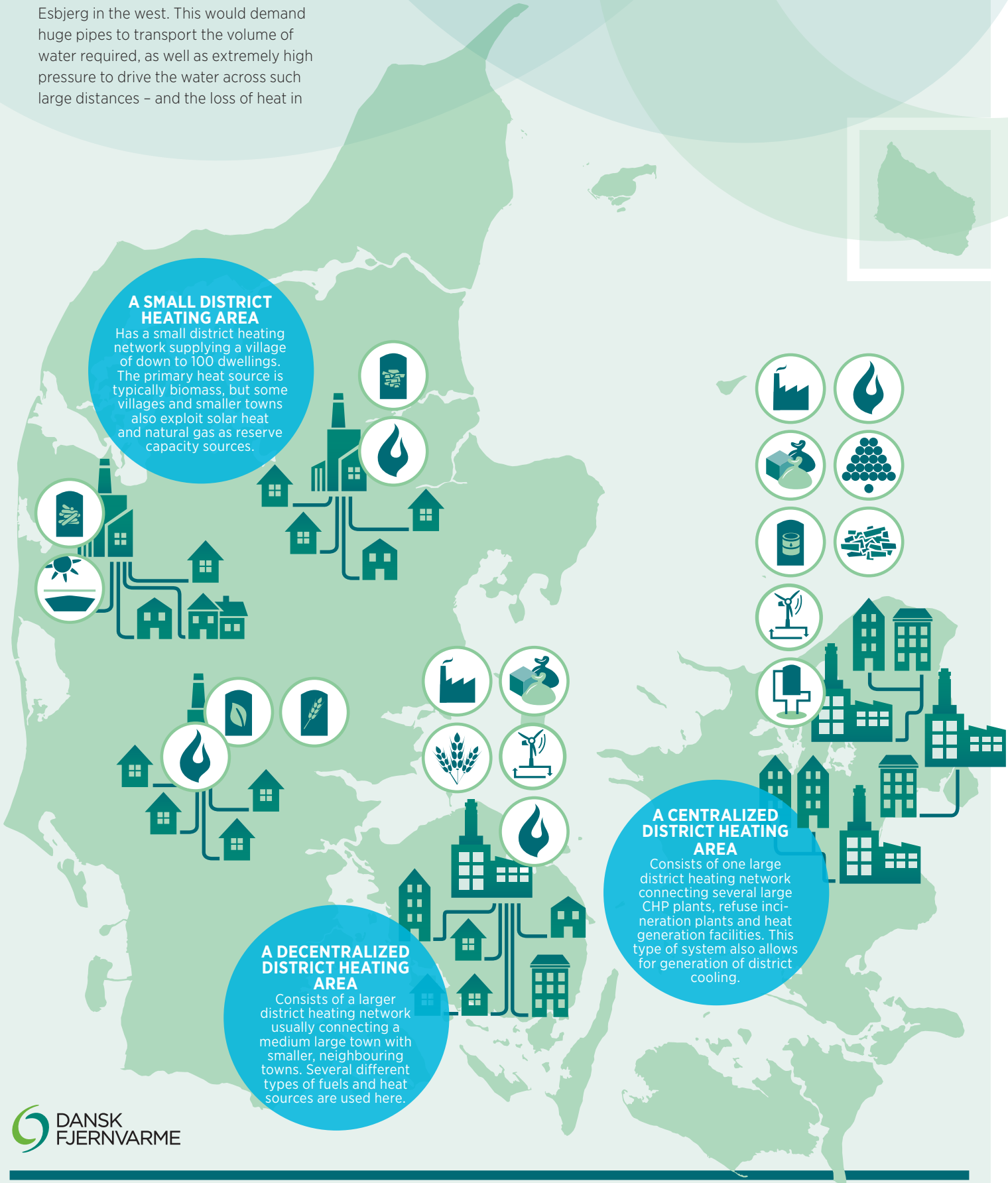




## THE DISTRICT HEATING NETWORK

District heating in Denmark comprises numerous independent district heating grids that are not interconnected. This means that unlike electricity, it is not possible to send hot water from Skagen in the north of the country to Tønder in the south, or from Amager in the east to Esbjerg in the west. This would demand huge pipes to transport the volume of water required, as well as extremely high pressure to drive the water across such large distances – and the loss of heat in

the network would be disproportionately high. However, there are large, wide-spread district heating grids in the biggest cities: Copenhagen, Aarhus, Odense and Aalborg – and in South Jutland.



## AARHUS AS AN EXAMPLE

To provide an example of a major district heating system, let us take a look at Aarhus – one of the biggest cities in Denmark with a total of 350,000 customers.

Kredsløb operates a giant waste incineration plant and one of the biggest straw-fired CHP plants in Denmark. The facility uses 670 tonnes of straw per day, which translates into 240,000 tonnes of straw every year.

In addition, the company receives heat from the CHP

plant in Studstrup, which has been converted from coal to wood pellets. An 80 MW electric boiler has also been installed as an extension to the Studstrup plant. This is equivalent to adding 55,000 electric kettles to the kitchen, lined up next to each other. The electricity is brought online when electricity prices are at their lowest, thus providing a supplement to the other production facilities.

In the future geothermal energy will provide 20% of the district heating in Aarhus.

