

The Orsted logo, featuring a stylized blue circle with a vertical line through it, followed by the word "Orsted" in a blue sans-serif font.

# Avedøre Power Station

Green power and heat



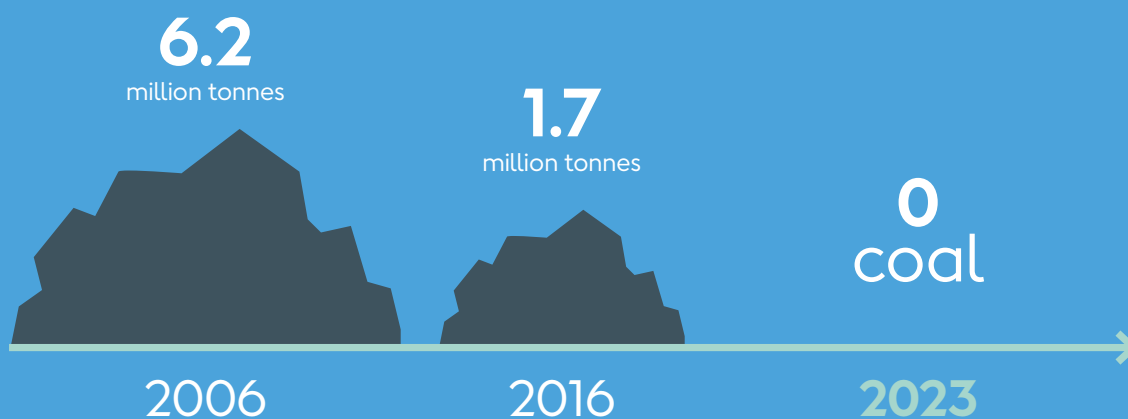


**Climate change is one of the biggest challenges for life on Earth. Today, the world mainly runs on fossil fuels. We need to transform the way we power the world; from black to green energy.**

At Ørsted, our vision is a world that runs entirely on green energy. We want to revolutionise the way we power people by developing green, independent and economically viable energy systems. By doing so, we create value for the societies that we are a part of and for all our stakeholders.

We've taken our name after Hans Christian Ørsted, one of Denmark's best known scientists and innovators. Through his curiosity, dedication and interest in nature, he discovered electromagnetism in 1820, helping to lay the scientific foundation for how power is generated today. These qualities of Hans Christian Ørsted are just what we need to truly revolutionise the way we power people.

We say goodbye to coal in Ørsted



# The green power stations

When the sun is not shining and the wind turbines are not spinning, we at the power stations ensure reliable power and heat generation for the Danes. In addition to ensuring a reliable energy supply, we work every day to reduce CO<sub>2</sub> emissions in the energy production. We do this by operating some of the world's most flexible and efficient power stations, while converting our power and heat generation from fossil fuels to sustainable biomass.

In Denmark, we have seen an increase in the number of wind turbines and solar cells that generate power in recent years, but the power stations still play an important role in the energy supply.

The power stations work as a flexible backup for the wind turbines and solar cells, ensuring that power is available at all times – even on windless days.

In addition, the power stations supply green district heating to a large number of households in Denmark. You could say that the power stations' role has changed from primarily being suppliers of power to now primarily being suppliers of green district heating.

## Coal-free future

Coal is one of the world's biggest CO<sub>2</sub> offenders, and we have therefore decided to completely stop using coal from 2023. We are already well on the way to phasing out coal, and since 2002, we have used sustainable biomass in the form of wood pellets, wood chips and straw to fuel several of our power stations. We have continuously converted most of our remaining power stations to also using biomass as fuel.

Our primary biomass fuels are wood pellets and wood chips. Both wood pellets and wood chips are green fuels, which are mainly based on wood waste from forestry and sawmills – either in the form of sawdust or the parts of the wood that cannot be used for houses, furniture and floors. In the past, wood waste would typically be left in the woods where it would decompose and emit CO<sub>2</sub>. Instead, we now use it to generate green power and heat at our power stations.

The wood pellets and wood chips we use come from sustainable forestry. This means that when trees are felled, the forest owners plant new ones. This way, we ensure that there are always new trees to absorb the CO<sub>2</sub> we emit when we burn the wood pellets and wood chips.



# Avedøre Power Station – one of the future green power stations

Avedøre Power Station is one of the future green power stations. The large power station is situated south of Copenhagen, and you can see the iconic buildings from afar – both from land, from the sea and from the air.

There was a major focus in the design of the two Avedøre Power Station units on matching the buildings to the flat, reclaimed landscape at Køge Bay. The unconventional architecture has won Avedøre Power Station several international awards.

Avedøre Power Station is one of several power stations in Ørsted which supplies both power and heat to the Danes.





# How do we generate green power and heat?

Try to imagine 48 hours without power and heat. What would be the first thing you would miss? Is it power for the refrigerator or for your computer? Perhaps you have not thought about how many things in your daily life depend on power, or how often you would actually take a shower if the water was cold.

We all take power and heat for granted in our daily lives, and we expect that there is always power in the socket and warm water on tap and in the radiator. Therefore, we also do not think much about how power and heat are actually generated. We have made a simple illustration to explain the process taking place at the power station during the generation.

In order to understand the power station process, it is first and foremost important to understand that we do not generate energy at the power stations. At the power stations, we convert energy into the forms of energy we can use as power in our sockets and as heat in our homes.

## 1. Fuel

The power station process starts with our fuel. There are various fuels with different properties, but common to all the fuels is that they contain energy. The energy bound in the fuel is called chemical energy and constitutes the input for the power station process which is ultimately converted to power and heat.

Avedøre Power Station is a multi-fuel plant. The plant's main fuels are wood pellets and straw. The wood pellets arrive at Avedøre Power Station by ship from the Baltic countries. The straw comes from local farmers on Zealand and Lolland-Falster and is another by-product which farmers previously burned in the fields.

We can also use fuels such as coal, natural gas and oil at Avedøre Power Station. The fossil fuels are used exclusively as start-up and reserve fuels. It is important to have reserve fuels, so that we can ensure the supply of the necessary power and heat at all times. From 2023, we will stop using coal at Avedøre Power Station.

## 2. Boiler

The chemical energy which is bound in the fuel is released by burning the fuels in a large combustion chamber. The combustion chamber is inside our giant boiler, which consists of miles of piping. The pipes contain water which is heated through the combustion taking place inside the boiler – the chemical energy is converted to thermal energy.

At Avedøre Power Station, we first crush wood pellets and coal, so it becomes dust. Then we blow the dust into the huge fireball in the heart of the boiler. The straw is led into a separate boiler where it burns on a grate in the bottom. The tallest boiler at Avedøre Power Station is 70 metres high – twice as tall as the Round Tower in Copenhagen. The temperature inside the combustion chamber is between 1,200 and 1,500 degrees Celsius. The high temperatures are very important for the power station process, and serve a clear purpose: Heating the water and producing high-pressure steam.

## 3. Turbine

The thermal energy bound in the high-pressure steam must now be converted to kinetic energy. This takes place inside the turbine. If you could open up the turbine, you would see that it consists of a long iron shaft. The shaft is equipped with thousands of turbine blades – a turbine blade looks like a wind turbine blade, only smaller. When the high-pressure steam hits the turbine blades, the high steam temperature of approx. 600 degrees Celsius and the high pressure of approx. 300 bar will make the turbine blades move. Like wind on a wind turbine blade. The steam contains huge volumes of energy and makes the turbine shaft rotate at 3,000 revolutions per minute.

#### 4. Generator

The kinetic energy from the rotation of the turbine is now going to be converted into electrical energy – more specifically alternating current (AC). This takes place in the generator, which is connected to the turbine via the iron shaft. The iron shaft in the generator is not equipped with turbine blades – rather, a large electromagnet is mounted on the shaft. The magnet thus also rotates at 3,000 revolutions per minute. A rotating or changing magnetic field produces a current. In our generator, the voltage is induced in three coils placed around the magnet.

#### 5. Power and district heating

The power from Avedøre Power Station is distributed to the Nordic power grid. We cannot say with certainty where the power ends up, because the power grid is a large coherent system with connections to both Sweden, Norway, Germany and Western Denmark. The power generated is sold on market terms on the North European power exchange Nord Pool. This means that the power generation at Avedøre Power Station depends on supply and demand. The trick is to maintain balance in the power grid at all times. This means that there must be balance between the power consumption in society and the volume of power supplied to the grid. The power generation at Avedøre Power Station may therefore fluctuate greatly from year to year. If domestic generation of power from wind turbines is high, or if hydropower generation from Norway and Sweden is high, Avedøre Power Station will typically generate less power.

The remaining heat in the steam is used to heat district heating water, so that we produce lovely hot water ready to be sent out to the households. The heat transmission takes place in district heat exchangers. Avedøre Power Station generates heat corresponding to the consumption of approx. 200,000 households.

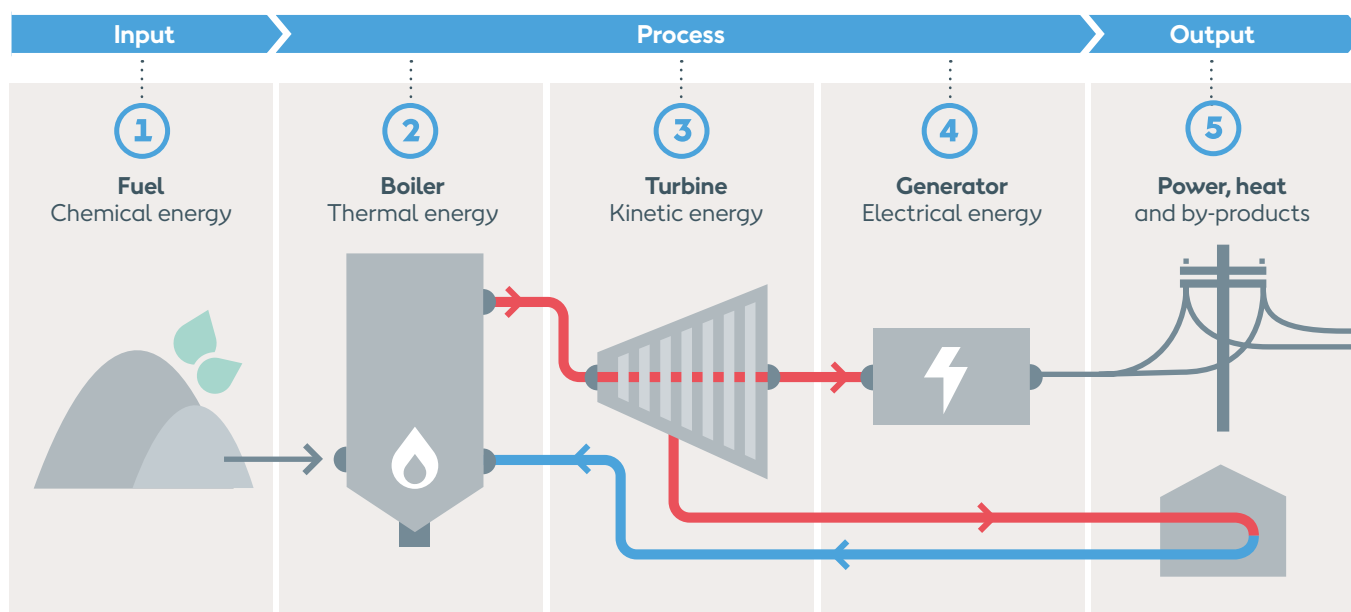
#### Minimal local and global impact

Before the smoke from our CHP plants reaches the outside, it passes through several different filters. When the smoke reaches the stack, water vapour and CO<sub>2</sub> are almost all that is left. By using wood waste from sustainable forestry, we ensure that the CO<sub>2</sub> emitted is absorbed again by the trees which are replanted after felling.

Our flue gas treatment comprises, among other things:

- Collection of bottom ash, which is reused as fertiliser and insulation.
- Removal of nitrogen oxides (NO<sub>x</sub>).
- Removal of fly ash, which is reused in cement and concrete.
- Removal of sulphur dioxide (SO<sub>x</sub>) and heavy metals.

There is a big difference between burning wood in large boilers at CHP plants with extensive flue gas treatment systems and burning wood in small private wood-burning stoves. Small private wood-burning stoves emit approx. 600 times as many particles per produced energy unit than our power stations on biomass.



# Key figures



**600,000**

Avedøre Power Station generates green power of approx. 600,000 households.



**200,000**

Avedøre Power Station generates green heat of approx. 200,000 households.



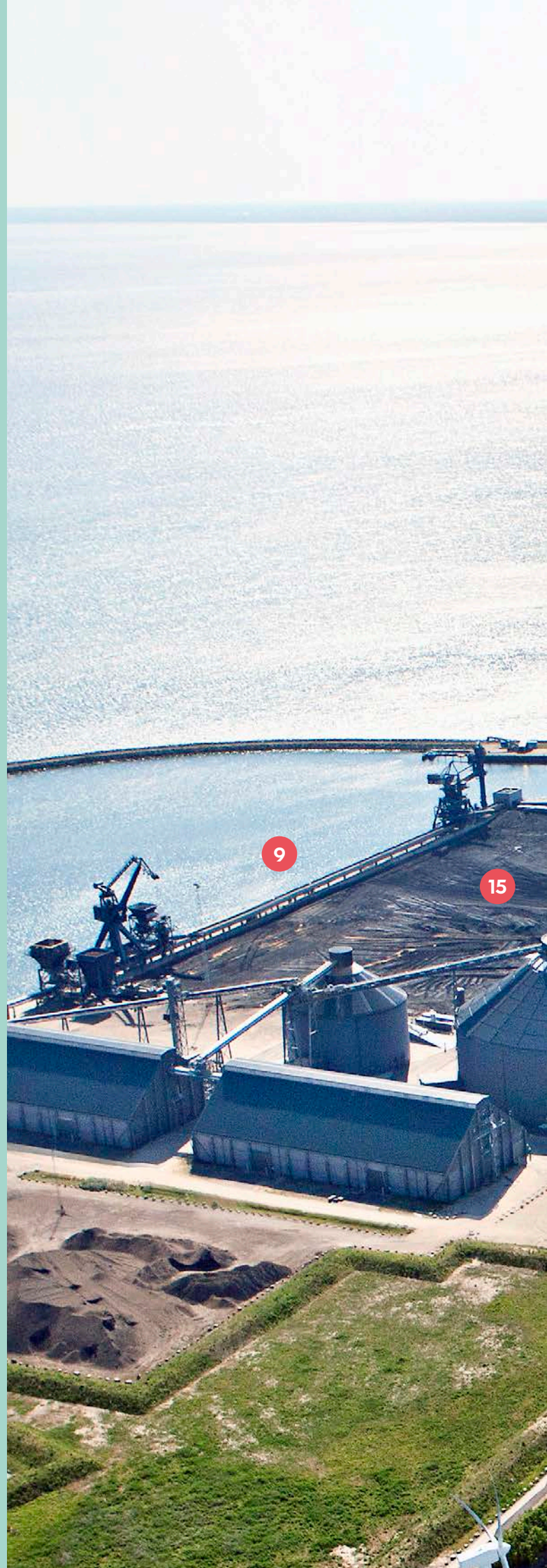
<b>Power generation:</b>	max. <b>757</b> MW
<b>Heat generation:</b>	max. <b>932</b> MJ/s
<b>Steam temperature:</b>	max. <b>600</b> °C
<b>Steam pressure:</b>	max. <b>300</b> bar



**Main fuels:** **Wood pellets and straw**

## Avedøre Power Station

1. Boiler house, Unit 1
2. Boiler house, Unit 2
3. Administration
4. Gas turbines
5. Straw storage facility
6. Flue gas treatment plant, Unit 1
7. Flue gas treatment plant and straw-fired boiler, Unit 2
8. Cooling water channel
9. Harbour
10. Substations
11. District heating pump station
12. Heat storage tanks
13. Oil tanks
14. Water tank
15. Coal yard
16. Wood pellet storage facilities







5

2

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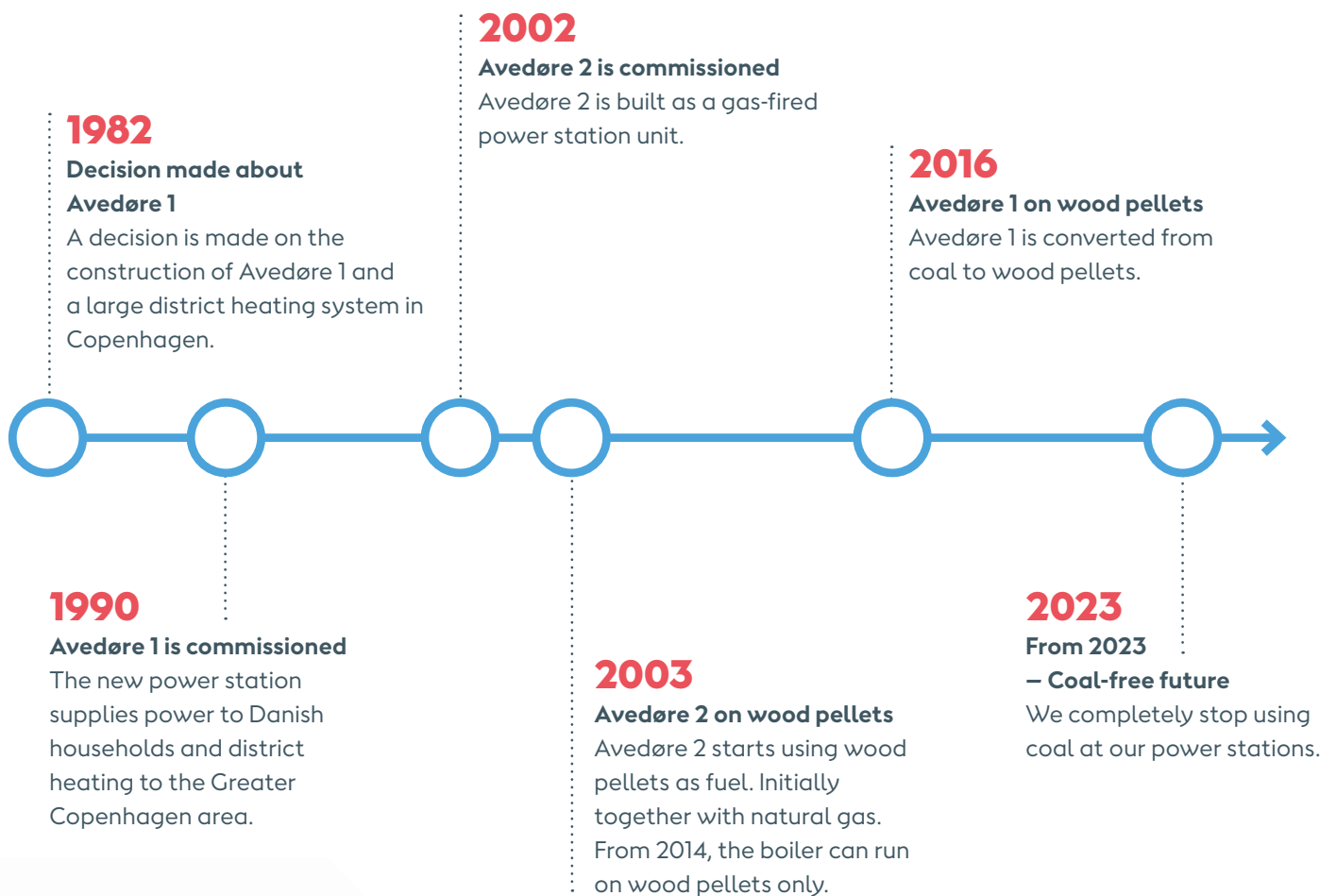
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# Avedøre Power Station over time







**Ørsted A/S**

**Avedøre Power Station**

Hammerholmen 50

DK-2650 Hvidovre

Tel. +45 99 55 11 11

[orsted.com](http://orsted.com)

## Visit Avedøre Power Station

Avedøre Power Station is pleased to arrange visits for groups and schools. We offer guided tours and talk about our generation of power and district heating.

Please contact [besoegetkraftvaerk@orsted.dk](mailto:besoegetkraftvaerk@orsted.dk) if you want to know more about the possibilities.