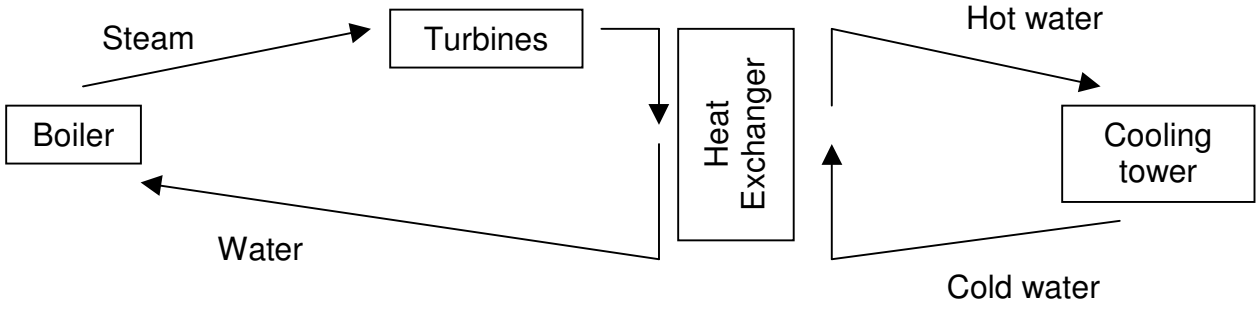
## Cooling Towers

### What are cooling towers?

Cooling towers are used to remove excess heat that is generated in places such as power stations, chemical plants and even domestically in air conditioning units.

In power stations, electricity is generated when steam drives a turbine. This steam must be condensed before it can be returned to the boiler to continue the cycle of steam and electricity generation. The condensation process happens in a heat exchanger.

Cooling water is needed in the heat exchanger and it is this cooling water that is cycled through the cooling tower. In this way the water for the boilers and steam turbine is kept separate from the cooling water. This stops impurities getting into the turbine steam.




In chemical processes excess heat can be generated. This heat is removed using heat exchangers and cooling water which is cycled through a cooling tower.

### Different types of cooling towers

Large cooling towers, like the ones seen in power stations, are called **Natural Draft** towers. Standing at about 130m high, they are huge "chimneys" which create an updraft of air which cools the water as it falls down the inside of the tower. Natural draft towers do not contain any fans to drive the air flow.

Water is pumped up the inside of the tower by electric pumps that can supply 100,000 gallons per minute. The water usually hits metal plates, or baffles, which help to break up the flow and create a larger surface area of contact between the air and water for efficient cooling. For clarity, these have not been shown on the animation.

**Forced draft** cooling towers contain large fans which force air through a smaller tower. The photograph shows four box-like towers that are used to cool water in many industrial sites. These are also the types of cooling towers that may be seen on office blocks where they are part of the air conditioning system.

**Classroom contexts**
These questions may provoke some discussion, or suggest further activities, within the classroom. Scroll down below the curriculum links for some suggested answers.

- Explain why it is not smoke that comes out of the top of a cooling tower.
- Sometimes on a hot day, there does not appear to be any clouds coming out of power station cooling towers. Why would a cold day cause a big cloud to be formed?
- Look on the outside of buildings. Sometimes it is possible to see cooling units for the building's air conditioning.
- Combined Heat and Power stations make electricity and send their waste heat to warm up local houses. Why is this more efficient?

**Links to the Primary Science National Curriculum**

**Key stage 2**

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|---|---|
| Sc3 - 2c (Materials) | Temperature as a measure of how hot or cold things are. |
| Sc3 - 2d (Materials) | Reversible changes including boiling, evaporating and condensing. |
| Sc3 - 2e (Materials) | The part played evaporation and condensation in the water cycle. |

***Explain why it is not smoke that comes out of the top of a cooling tower.***
Although it looks like smoke, it is in fact condensed water vapour from the water inside the tower.

***Sometimes on a hot day, there does not appear to be any clouds coming out of power station cooling towers. Why would a cold day cause a big cloud to be formed?***
On a hot day, the water vapour rising out of the tower may not condense as much as on a cold day.

***Look on the outside of buildings. Sometimes it is possible to see cooling units for the building's air conditioning.***
These units are usually placed on the roof of office blocks and other large buildings that need to remove heat generated by the people inside. Sometimes, smaller units may be seen on the side walls or in places like supermarkets which have refrigerated rooms for food storage.

***Combined Heat and Power stations make electricity and send their waste heat to warm up local houses. Why is this more efficient?***

The heat from a combined heat and power station (CHP) is not wasted. Sending it to heat local houses means that these people do not have to burn more fuel to keep warm. Effectively, more of the energy in the fuel for the power station is turned into useful energy (electricity and heat).

Many chemical plants have CHP plants which they use to generate their own electricity and also the steam that they use for heating chemical processes. This is more efficient, and causes less pollution, that buy in electricity from commercial generators.