FACT SHEET – HYDRO POWER

Hydro power can be used mechanically to drive a mill or in a hydroelectric plant to produce electricity.

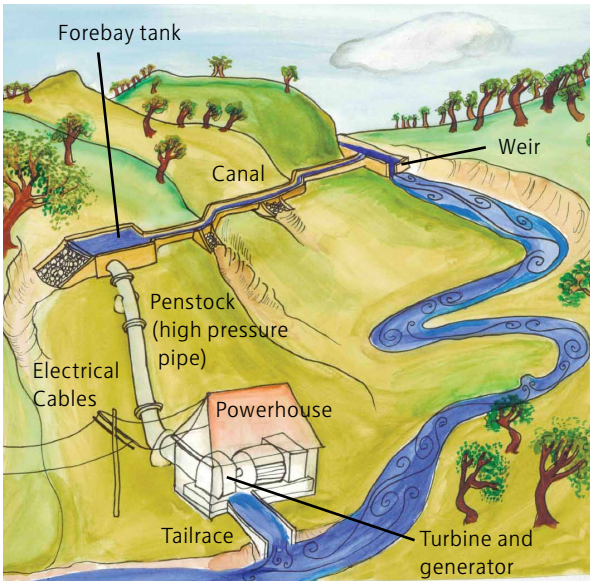
History

People have been using hydro power for thousands of years. More than 2,000 years ago, the ancient Greeks and Romans used water wheels to drive mills to grind grain. By the 19th century, there were 30,000 water mills in Britain. However, as industry grew, most of the water wheels were replaced by engines running on coal. Towards the end of the 19th century, water power started to be used to generate electricity. The first public electricity supply opened in 1881 in Godalming in Surrey, powered by a water wheel. Most of the large hydroelectric power (HEP) plants in the UK were built between the 1920s and 1950s, although a large-scale HEP plant was completed at Glendoe in Scotland in 2008 that can produce 100MW. HEP is now the world's biggest source of renewable energy, and produces almost 16% of the world's electricity. In the UK we produce 1% of our electricity from HEP, 24% of our renewable electricity.

Coedty dam and reservoir, Wales

How it works

HEP, like most energy sources, comes indirectly from solar energy. The sun heats the surface of oceans and lakes making water evaporate, this water then becomes clouds and falls as rain feeding the world's streams and rivers. The gravitational potential energy of the water on high ground can then be converted into electricity by passing it through a turbine that drives an electrical generator.



The amount of power available to a HEP plant depends on two things: the head (the height above the turbine that the water starts) and the flow rate (the amount of water per second that flows through the turbine). As a result, the best places to generate HEP are in mountainous regions with high rainfall. In the UK most of the HEP is generated in Scotland and Wales.

Large-scale HEP plants usually have a dam and a reservoir. The dam increases the head and creates a reservoir. The reservoir is a store of energy, and the power generated can be increased or decreased on demand by controlling the flow of water.
Smaller scale HEP plants do not always need a reservoir. A 'run of river' system uses a weir or small dam to divert some of the water from a river through a pipe or canal that takes the water through a turbine before returning it to the river. This system is much simpler and less expensive, as there is no need for a large dam, but has a disadvantage in that the energy cannot be stored, and relies on there being a large enough flow in the river all the time.

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There is a lot of potential for small-scale hydro power in the UK. Many of our rivers have old weirs that could be reused as low head HEP schemes. One recent technology that is ideal for this kind of system is the Archimedes Screw Turbine. (See picture below).

Photo courtesy of Mann Power Consulting Ltd

Turbines

There are several different types of hydro turbine, the choice of which depends on the available head and flow rate. Most turbines fall into two main categories:

- Impulse turbines – are driven by a high velocity jet of water directed at the turbine. E.g. the Pelton Wheel, which is used where there is a high head.
- Reaction turbines - are enclosed in a pipe and are driven by the drop in pressure from one side of the turbine to the other
- The Francis turbine is the most common turbine in large-scale HEP generation, and is used in low to medium head applications.
- The Kaplan turbine is a form of propeller turbine, which is used in low head applications.

Pumped storage

Pumped storage is not really a renewable energy source, but a way of storing energy. This system uses two reservoirs, one above the turbine and one below. At times of low electricity demand, electricity powers the turbine to pump water from the lower reservoir up to the higher one. This water can then be released when electricity is most needed.

Finding ways to store energy is becoming increasingly important as we get more of our energy from renewable sources, which cannot be switched on and off on demand.

Advantages

- HEP comes from a renewable energy source.
- HEP produces no waste or pollution, and, therefore, does not contribute to climate change.
- Although hydro systems cost a lot to build, they have very low maintenance costs and can last for over 100 years.
- Water can be stored above dams so power can be produced when it is needed.
- HEP turbine-generators can be started up very rapidly to meet sudden fluctuations in demand.

Disadvantages

- Finding a suitable site for large-scale HEP plants can be difficult – in the UK most of the best sites for large-scale hydro are already being used.
- Building large dams to create reservoirs for large HEP plants can flood large areas – this affects the local environment and the people who live in the area. Therefore great care needs to be taken to minimise these potentially, adverse effects.
- Hydro sites are often located in remote areas, so electricity distribution costs can be high.
- Fish can be affected if they cannot swim past HEP plants – fish 'ladders' or 'lifts' are often installed to allow fish to continue on their migration up or down river.

Pelton wheel

Francis turbine

Kaplan turbine