Basic Knowledge
Hydropower

Traditional hydropower systems have been in use for hundreds of years as a source of energy for a wide variety of mechanical applications. As such, hydropower represents a renewable energy source that has been successfully used for a long time. Since the beginning of hydropower-generated electricity, the percentage of electrical energy generated in this way has grown to around one quarter of all the electricity used worldwide.

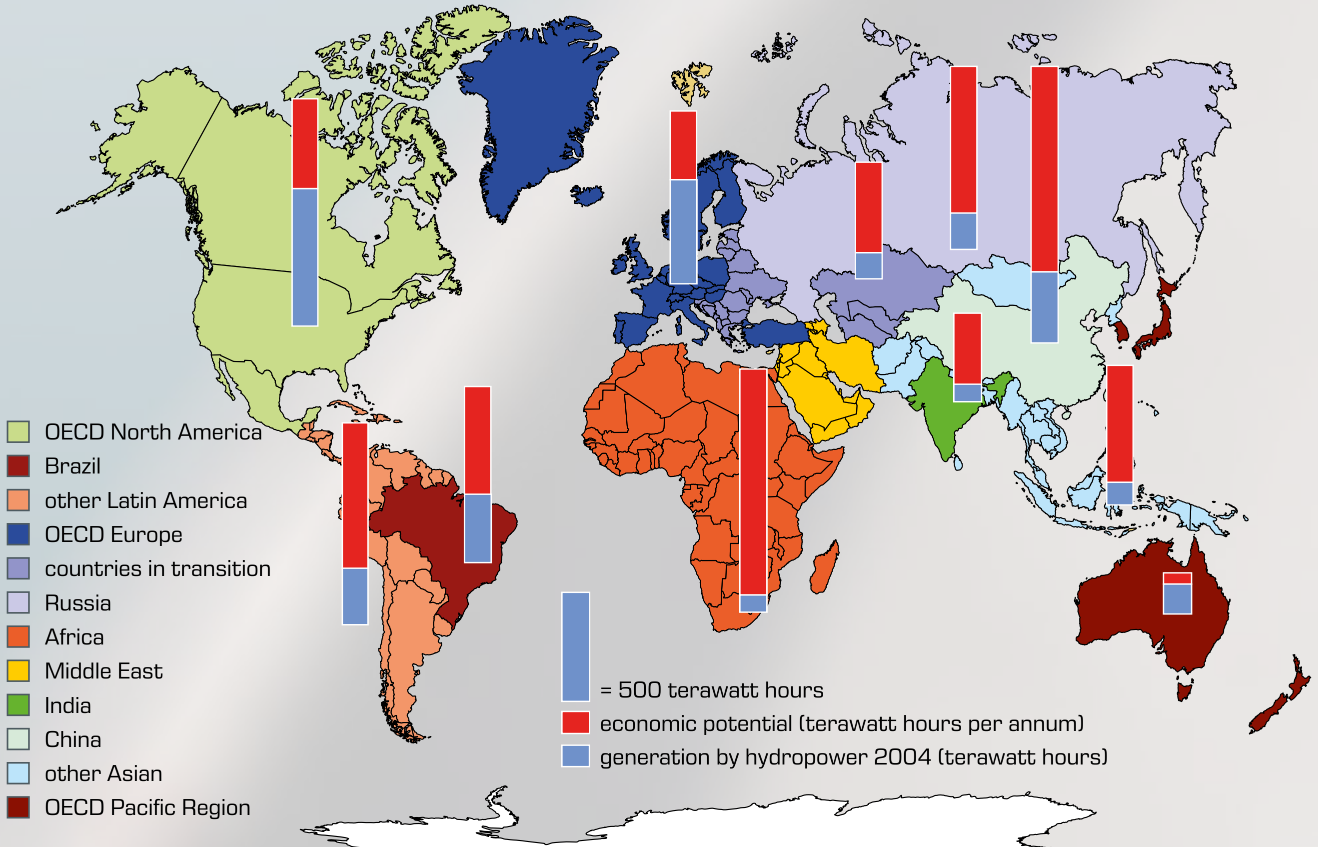
However as the number of turbines in use increases, and with it the necessary retaining dams, the significant drawbacks in the overall ecological balance of this technology has become apparent to some extent. Due to geological conditions, some countries such as Norway (99%), Congo (97%) and Brazil (96%) are able to cover very large proportions of their electrical energy demand with hydropower. By comparison, in Germany only 4% is covered. Brazil is currently home to the world's largest hydroelectric power station, where 18 turbines generate a total output of 12,600 megawatts.

Decentralised power supply through small hydroelectric power stations

In regions without a central power supply, decentralised, small hydroelectric power stations with an output up to about 5 kW offer the possibility of supporting sustainable development in an appropriate manner.

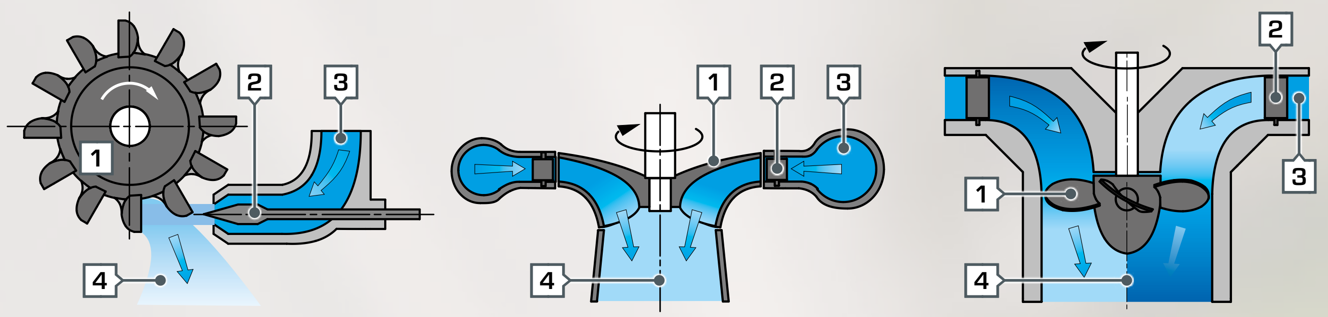
In addition to the typical characteristic variables such as head and flow rate, other aspects such as maintenance issues and accessibility of the installation site are also important to consider when selecting the type of turbine. At heads of 150 m and more Pelton turbines are mostly used. At lower heads on the other hand, Francis or Kaplan turbines are preferred.

Expansion potential for use of hydropower



Source: International Energy Agency, 2006 World Energy Outlook

Turbine types in hydroelectric power stations



Pelton turbine

In the Pelton turbine the water "shoots" out of one or more nozzles onto the vanes of the impeller.

Head: 150 - 2000m
Flow rate: 0,02 - 70 m³/s
Storage power stations

Francis turbine

The Francis turbine operates with positive pressure. The guide vanes can be adjusted.

Head: 20 - 700m
Flow rate: 0,3 - 1000 m³/s
Dams

Kaplan turbine

The Kaplan turbine also operates with positive pressure. In this case, guide vanes and impeller vanes can be adjusted.

Head: 2 - 60m
Flow rate: 4 - 2000 m³/s
Rivers

1 impeller 2 guide vanes 3 water inlet 4 water outlet

Subject Areas
Hydropower and Ocean Energy

Water's natural flowing movements, such as in rivers and reservoirs, can be used in the production of electricity. Furthermore, both the tidal range (the periodic rise and fall of the sea level) and the energy contained in flow and waves can be used in the ocean sector.

Both types of energy conversion are classed as renewable energies. While the typical use of hydropower has been widespread for hundreds of years, using the ocean for energy is in its infancy.

As the table opposite shows, different learning objectives from turbine engineering can be differentiated in the expanded field of hydropower and ocean energy. The corresponding 2E product is listed in the next column.

Additional trainers in the fields of turbines and fluid mechanics in particular can be found in GUNT catalogue 4 "Fluid Mechanics".

Subject Areas	2E Products
Hydropower	
Fundamentals of fluid mechanics: energy conversion in water turbines	**HM 150.19** Operating Principle of a Pelton Turbine **HM 150.20** Operating Principle of a Francis Turbine
Turbomachines: measurements on turbines and pumps	**HM 450.01** Pelton Turbine **HM 450.02** Francis Turbine **HM 450C** Characteristic Variables of Hydraulic Turbomachines
Turbines in run-of-river power stations: river and tidal power stations	**HM 421** Kaplan Turbine Trainer
Comparing turbine types – asynchronous generator drive	**HM 365.31** Pelton and Francis Turbine
How guide vanes affect characteristic turbine curves	**HM 430C** Francis Turbine Trainer
Ocean Energy	
How the guide vanes affect characteristic turbine curves	**ET 270** Wave Energy Converter