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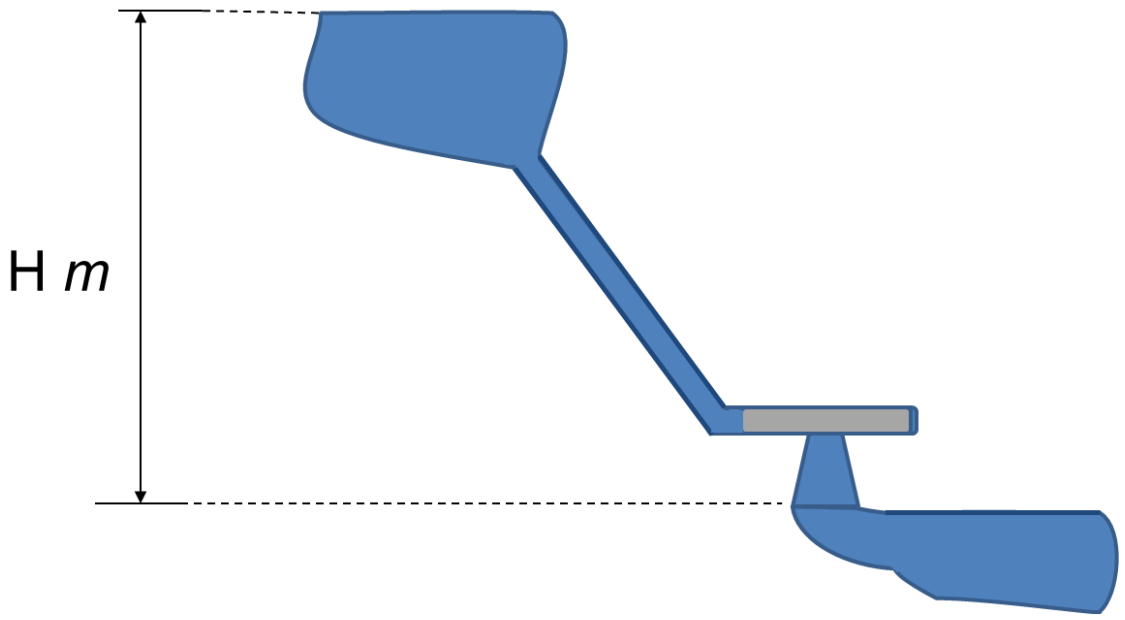
Hydropower

Hydropower is the electricity, generated by using the potential and kinetic energy of Water. Hydropower, or hydroelectric power, is one of the oldest and largest sources of renewable energy, which uses the natural flow of moving water to generate electricity. Hydropower, also known as water power, is the use of falling or fast-running water to produce electricity or to power machines. This is achieved by converting the gravitational potential or kinetic energy of a water source to produce power. Hydropower is a method of sustainable energy production.

How do we get Hydropower?

- Barrage or Dam based Hydropower plant – It's the conversion of potential to kinetic energy.
- Mass of stored water m kg (source of stored energy)
- Acceleration due to gravity g=9.81 m·s-2



Hydroelectric power plants are usually located in dams that impound rivers, thereby raising the level of the water behind the dam and creating as high a head as is feasible. The potential power that can be derived from a volume of water is directly proportional to the working head, so that a high-head installation requires a

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smaller volume of water than a low-head installation to produce an equal amount of power.

Hydroelectric Installations

- Water flow transfers energy to the turbine casing it to spin.
- The turbine is connected to a generator
- This can be direct, or through a speed up device

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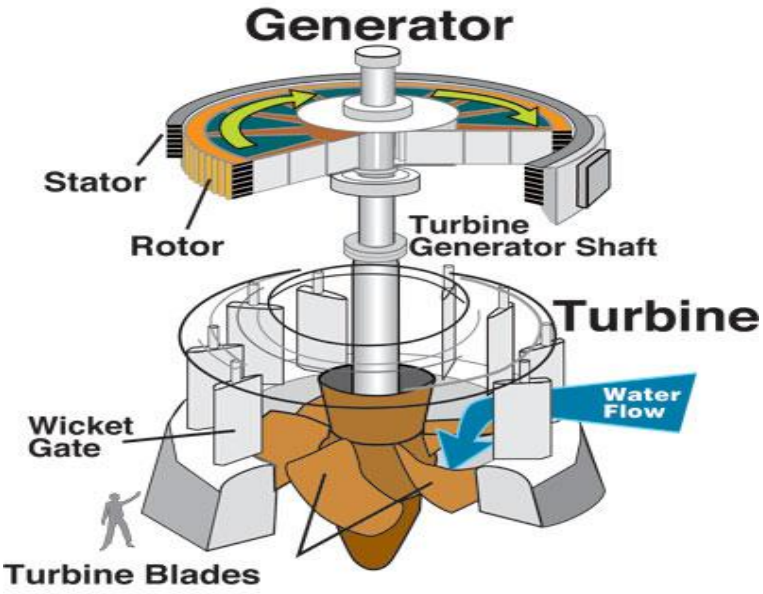
- The rotor of the generator spins and via flux cutting induces a voltage in the stator.
- If a load is connected to the generator then a current is drawn and power produced.



Types of hydroelectric plant

- Barrage or Dam based Hydropower plant.
- Run off River or small scale hydropower plant

Barrage or Dam based Hydropower plant

As per height of water or water head,hydro electric power plant can be divided three categories:
a. Low Head
b. Medium Head
c. High Head
Low head, medium head, high head. Though there is no rule regarding water head height but below 30 meters is considered as low head, above 30 meters to 300 meters is called medium head and above 300 meters is known as high head hydroelectric power plant.

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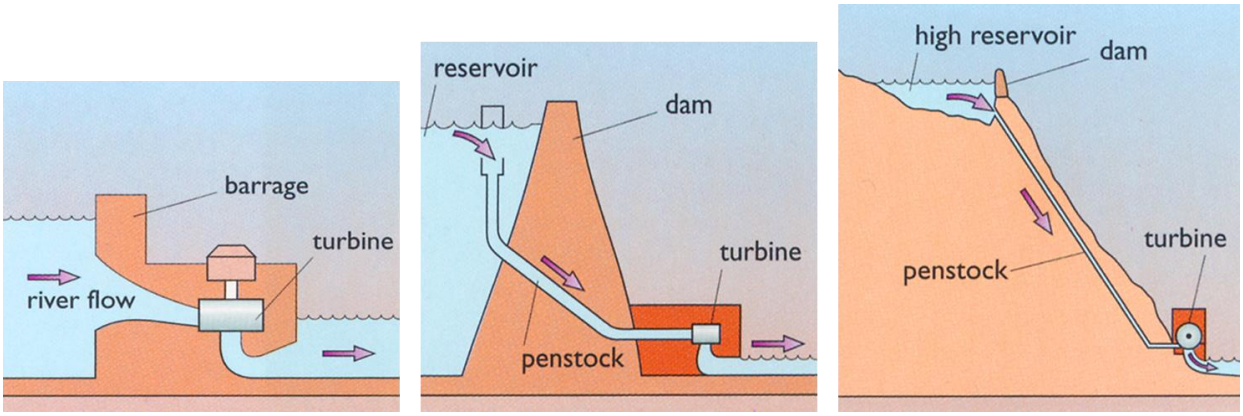

Low Head Plants : Low head plants have water head below 30 m. A low head power plant stores water by the construction of a dam or a barrage across a river and the power plant is installed near the base of the dam on the downstream side. Generally, one half of the barrage has regulating gates so that excess water is allowed to flow in the river from these gates to the river. Depending upon the quantity of water available, Kaplan turbine (in number and size) can be installed.

Medium Head Plants : Such type of plants can be installed by making use of a localized head or a fall in the stream. In such cases a open channel or conduit may be carried along the side of the valley upto the power house, Figure C or the forebay provided at the beginning of penstock serves as a reservoir for such plants. In such plants, water is carried from main reservoir works in open channel to the forebay. From that to the power house through penstock. The forebay surves as a surge tank.

High Head Plants: Generally, these type of plants are installed by building a dam between the two rows of hills, through which water flows in hilly areas at a high level. This facilitates that large quantity of water at high head to be stored in the catchment area of the dam. A pressure tunnel is taken off from the reservoir and water is brought to the valve house upto the start of penstocks. Penstocks are huge steel pipes Installed to carry large quantity of water from valve house to power house. The valve house contains main sluice valves and Isolating valves, which operate when penstock bursts by cutting-off supply of water through the penstock.

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2. Run off River or small scale hydropower plant

Small hydro schemes account for a significant proportion of the world's hydroelectric capacity, It is basically Run-off river hydropower. No dam is needed, turbine is set into the water.
e.g. China. 30 GW produced in small hydro plants. Aim for 100 GW by 2020-30
Electricity for

- Central or isolated grids
- Remote power supplies

Features:

- Reliability
- Low operating costs
- Stable priced electricity

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Advantages of Hydroelectric Energy

1. Electricity can be produced at a constant rate once the dam is constructed
2. The gates of the dam can be shut down if electricity is not needed, which stops electricity generation. Hence by doing this, we can save water for further use in future when the demand for electricity is high.
3. One of the biggest advantages of hydroelectric power plants is that they are designed to last many decades, and so they can contribute to the generation of electricity for years.
4. Large dams often become tourist attractions because the lake that forms in the reservoir area behind the dam can be used for leisure or water sports.
5. The water from the lake of the dam can be used for irrigation purposes in farming.
6. Since the water is released to produce electricity, the build-up of water in the dam is stored to produce extra energy until needed.
7. Hydroelectric energy generation does not pollute the atmosphere because the hydroelectric power plant does not produce greenhouse gases.
8. Hydropower plants can be considered a reliable energy generation source. Since hydropower totally depends on water present on this planet, this energy source will remain inexhaustible because of the water cycle as it continuously keeps on maintaining balance on the Earth.

Disadvantages of Hydroelectric Energy

1. It is not an easy task to assemble a hydropower plant because the dams are extremely expensive to build, and they require extremely high standards and calculations for their construction.
2. It becomes important that the hydropower plant must serve for many decades because of its high cost of construction, and this totally depends on the availability of water resources.
3. If flooding happens due to natural calamities or the failure of dams, it would impact a large area of land, which means that the natural environment can be destroyed.

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4. People are forcibly removed from the particular area where a hydropower plant is going to be assembled. This affects the day-to-day life of people living in that area.
5. A serious geological damage can be caused due to the construction of large dams.
6. To construct a hydro plant, it is important to block the running water source due to which the fishes can't arrive at their favourable place, and as the water stops streaming, the areas along the riverside start to vanish out which eventually influences the life of creatures that depend on fish for food.

Advantages	Disadvantages
Reduces consumption of fossil fuels for electricity production	Dirt can build up at dams, decreasing their effectiveness
Reduces production of greenhouse gases, such as CO_2	Large-scale wildlife habitat destruction due to river valley flooding
Reduces production of pollution, such as particulate matter	Interferes with natural wildlife migration patterns, such as salmon
Can prevent uncontrolled flooding	Dam construction forces people to leave their homes if they live in or near the flooded river valley
Provides water for irrigation	Very expensive to build
Creates areas for certain types of recreation, such as boating and fishing	Reduces areas for certain types of recreation, such as fishing, camping, hunting, hiking
Is a renewable energy source!	Interferes with natural flow of water through environment
	If natural fisheries are affected, harms the livelihoods of people who rely on those fisheries to make a living
	Requires maintenance
	Can fail catastrophically!