

HYDROPOWER BASICS



Why Generate with Hydropower?

Basics of Hydropower

Types of Hydropower Projects

Types of Hydropower Turbines

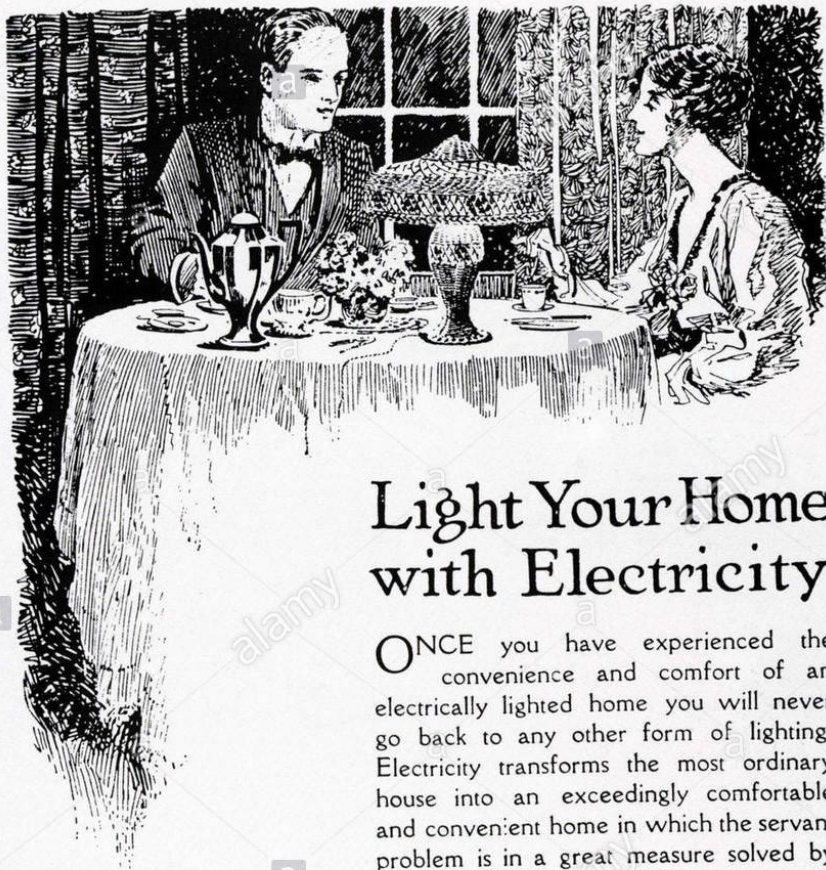
Benefits and Impacts

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Outline

Kleinschmidt

Why Generate with Hydropower?



Light Your Home with Electricity

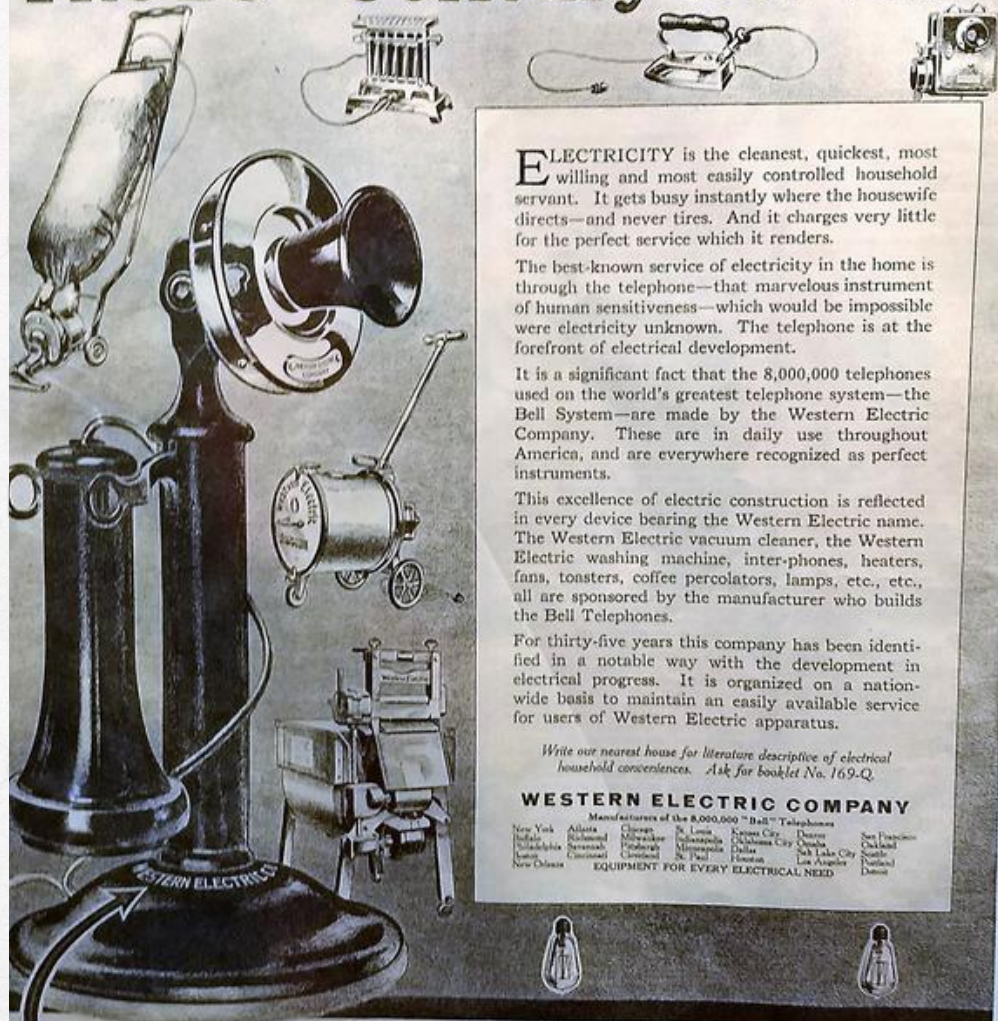
ONCE you have experienced the convenience and comfort of an electrically lighted home you will never go back to any other form of lighting. Electricity transforms the most ordinary house into an exceedingly comfortable and convenient home in which the servant problem is in a great measure solved by a general reduction of housework and a complete elimination of drudgery. Electric Light is the safest, cleanest, healthiest and cheapest of all illuminants.

Issued by the Electric Lamp Manufacturers' Association of Great Britain, Limited.

Electric Light
is a modern necessity

ELECTRICITY

The 20th Century Servant



ELECTRICITY is the cleanest, quickest, most willing and most easily controlled household servant. It gets busy instantly where the housewife directs—and never tires. And it charges very little for the perfect service which it renders.

The best-known service of electricity in the home is through the telephone—that marvelous instrument of human sensitiveness—which would be impossible were electricity unknown. The telephone is at the forefront of electrical development.

It is a significant fact that the 8,000,000 telephones used on the world's greatest telephone system—the Bell System—are made by the Western Electric Company. These are in daily use throughout America, and are everywhere recognized as perfect instruments.

This excellence of electric construction is reflected in every device bearing the Western Electric name. The Western Electric vacuum cleaner, the Western Electric washing machine, inter-phones, heaters, fans, toasters, coffee percolators, lamps, etc., etc., all are sponsored by the manufacturer who builds the Bell Telephones.

For thirty-five years this company has been identified in a notable way with the development in electrical progress. It is organized on a nationwide basis to maintain an easily available service for users of Western Electric apparatus.

Write our nearest house for literature descriptive of electrical household conveniences. Ask for booklet No. 169-Q.

WESTERN ELECTRIC COMPANY

Manufacturers of the 8,000,000 "Bell" Telephones

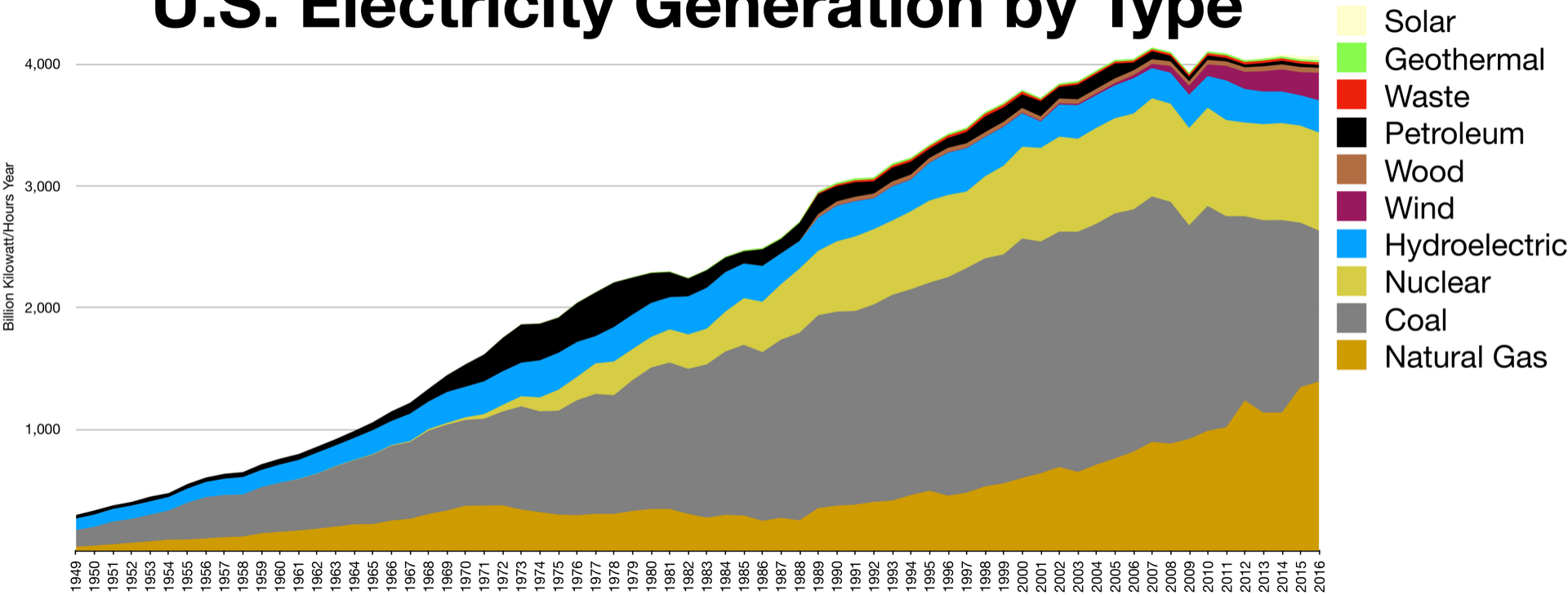
New York	Atlanta	Chicago	St. Louis	Kansas City	Denver	San Francisco
Buffalo	Baltimore	Milwaukee	Pittsburgh	St. Paul	Chicago	Oakland
Philadelphia	Savannah	Cincinnati	St. Paul	Houston	Salt Lake City	Seattle
Louisville	Cincinnati	St. Paul	Houston	Los Angeles	Portland	Detroit

EQUIPMENT FOR EVERY ELECTRICAL NEED

Western Electric

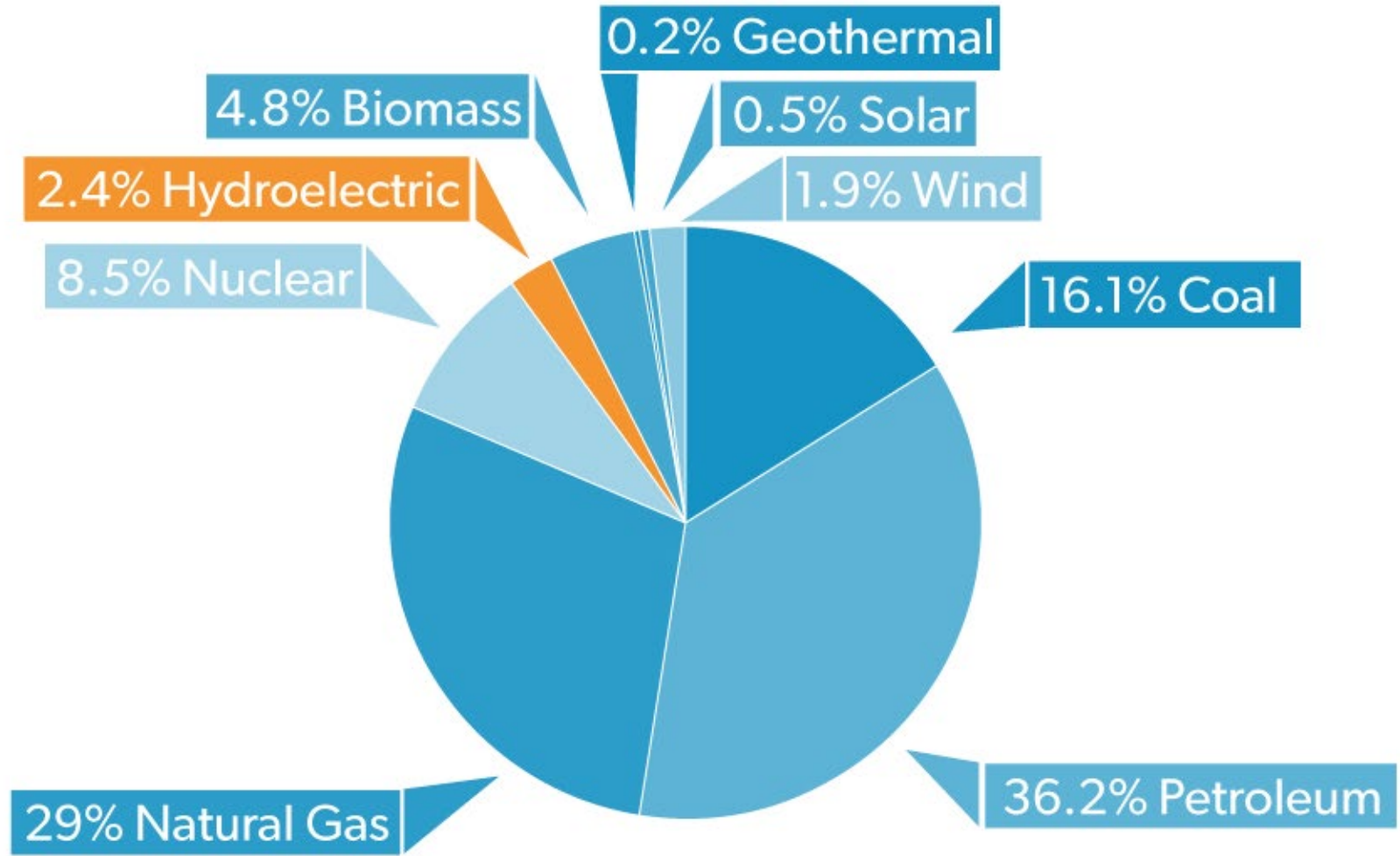
Growth in US Electrical Generation

U.S. Electricity Generation by Type



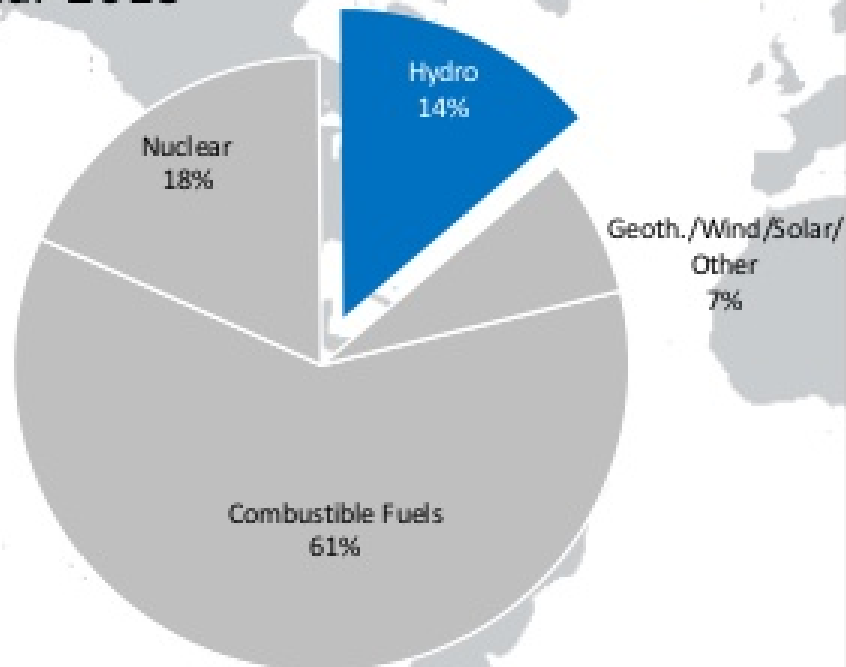
Hydroelectric

Percent of Total U.S. Energy Consumption



Hydroelectric in The World

Hydroelectric accounts for 14% of global electric power production in year 2015



The number of installed capacity is growing and growing

37.4 GW

New installed capacity in 2014

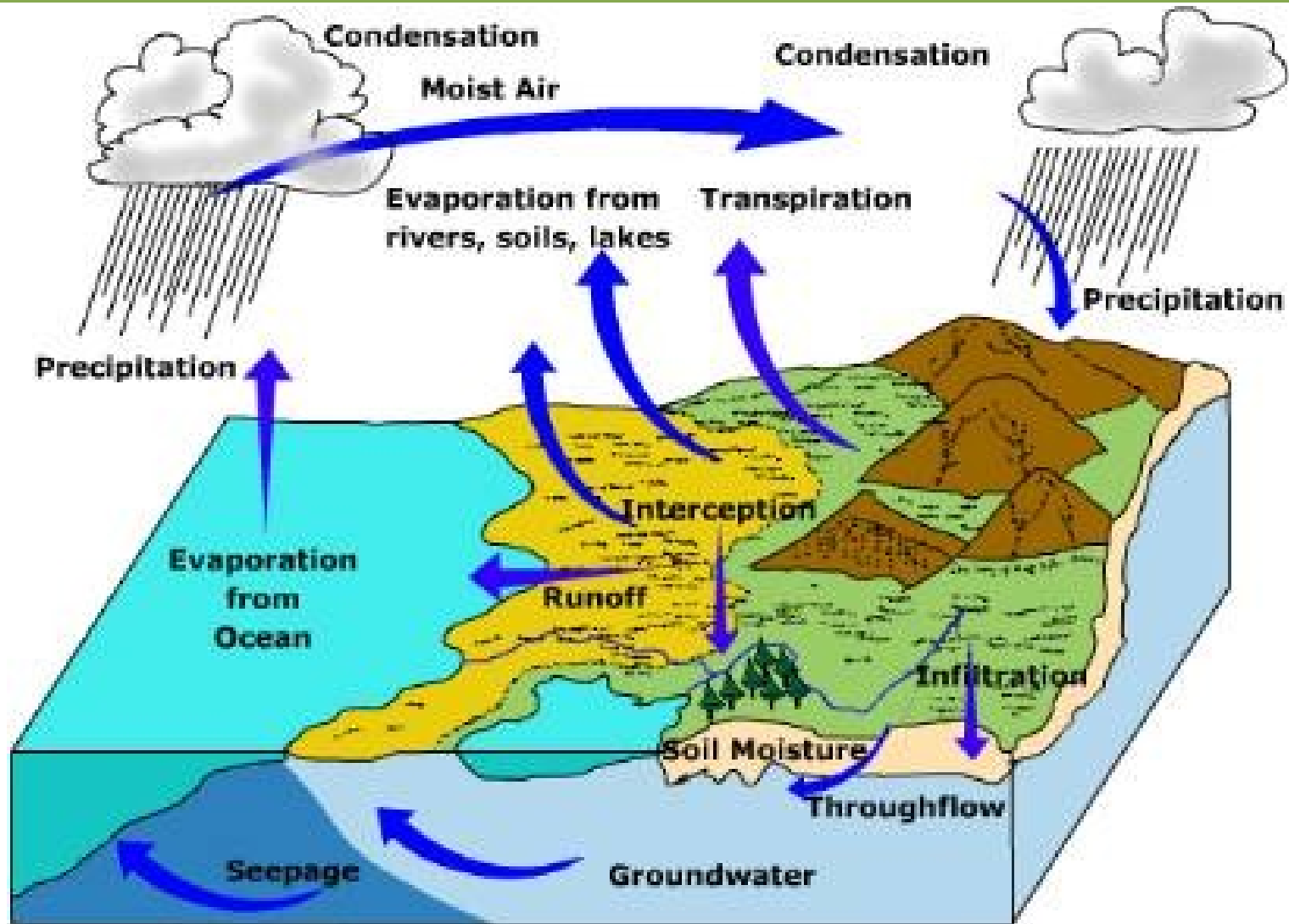
1036 GW

Total global hydropower capacity by 2014

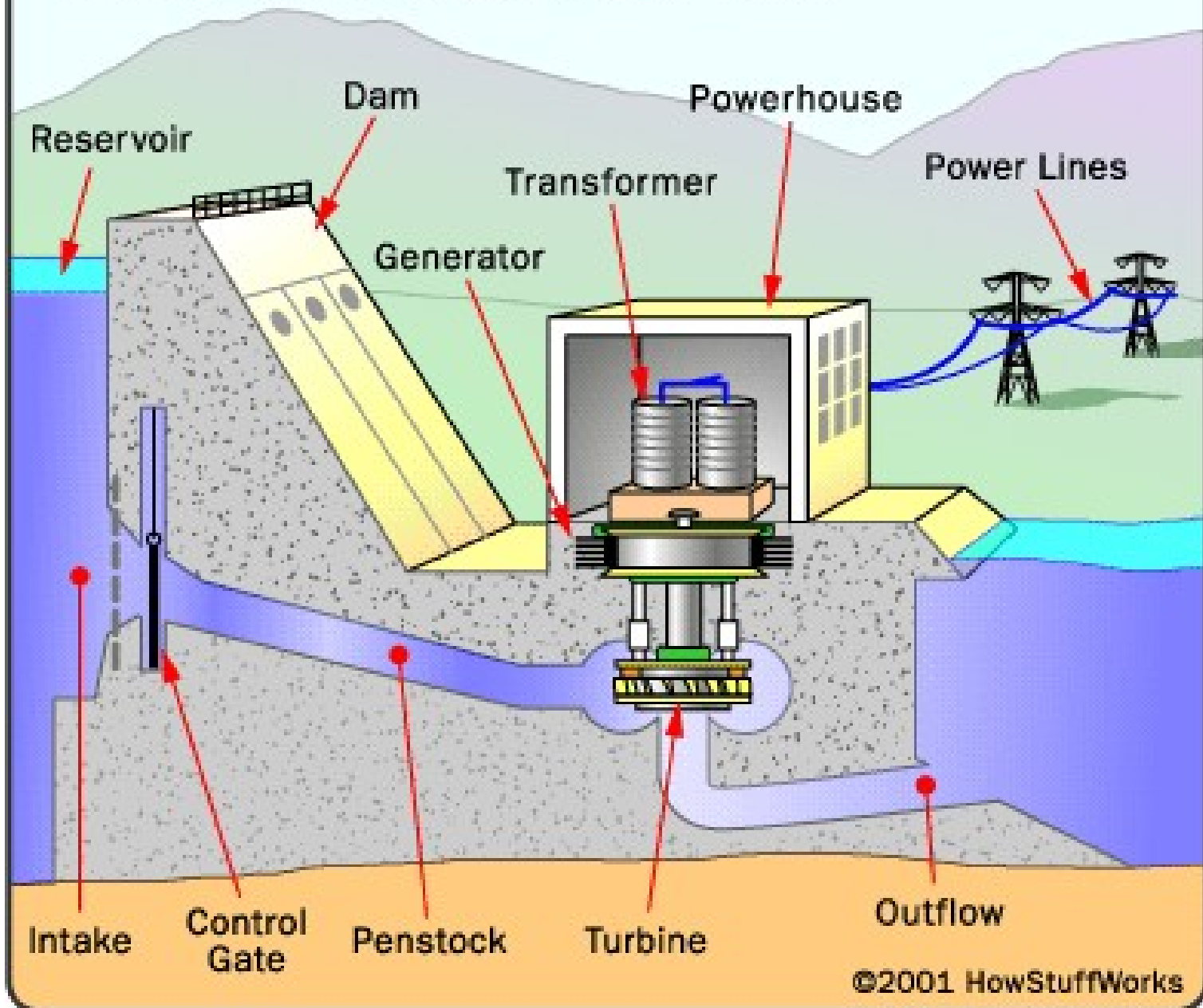
Basics of Hydropower

Hydrologic Cycle

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Inside a Hydropower Plant





HOLTWOOD H.E.S.
Unit #8
POWER HOUSE CROSS SECTION

Dams



Spillways



Penstocks and Canals



OPG Video Tour

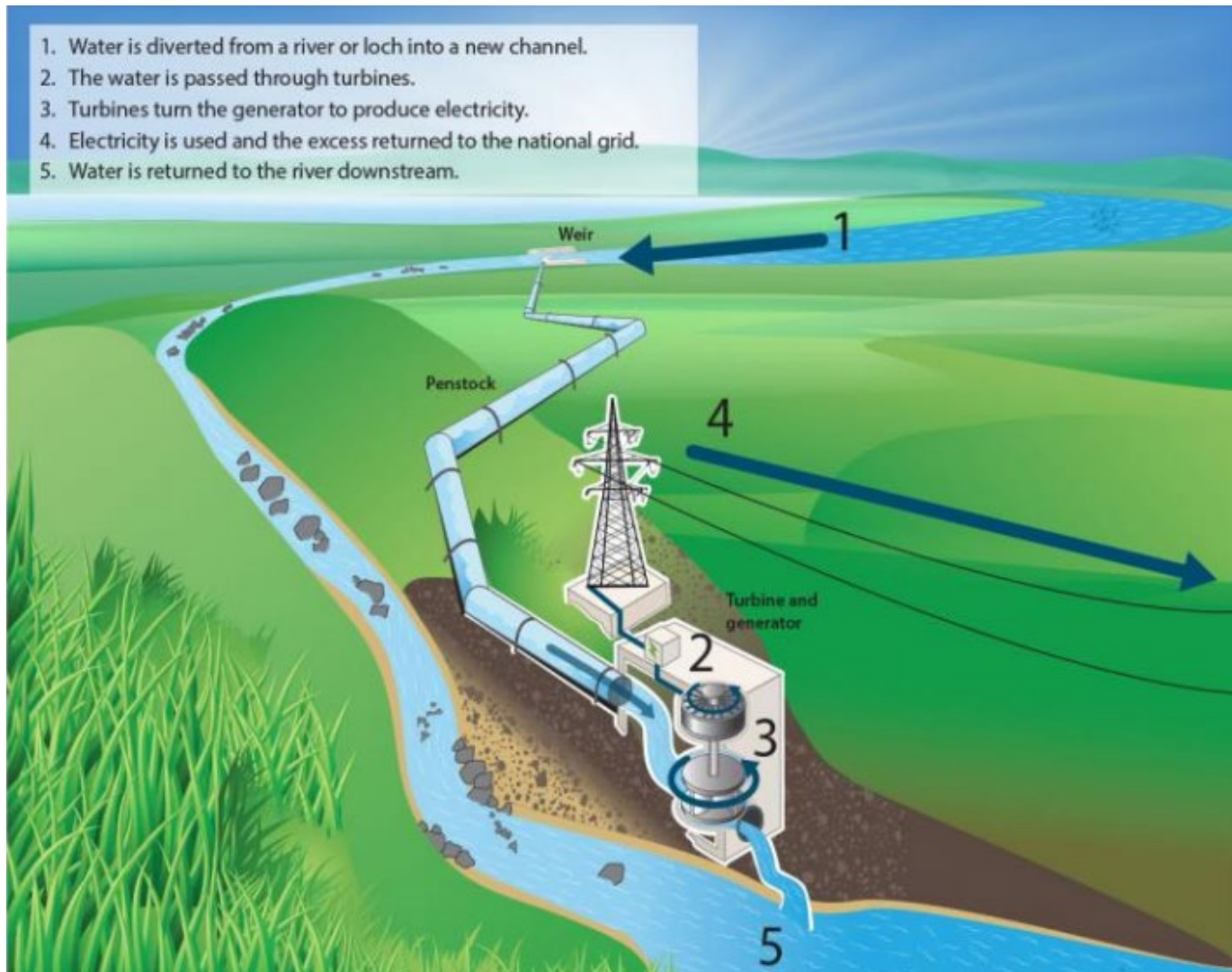
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<https://www.opg.com/generating-power/hydro/how-it-works/Pages/how-it-works.aspx>

Types of Hydropower Projects

Run of River

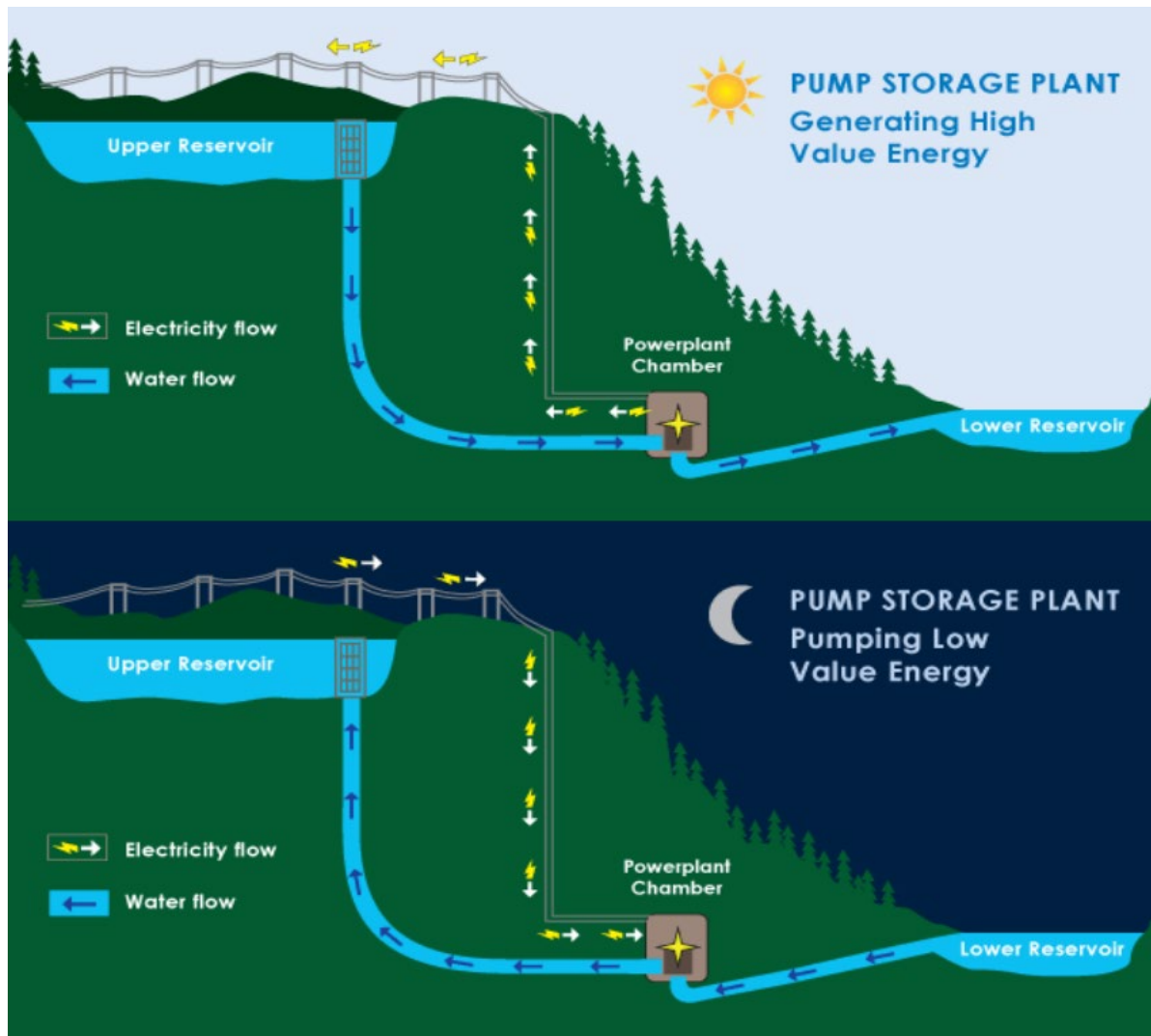
1. Water is diverted from a river or loch into a new channel.
2. The water is passed through turbines.
3. Turbines turn the generator to produce electricity.
4. Electricity is used and the excess returned to the national grid.
5. Water is returned to the river downstream.



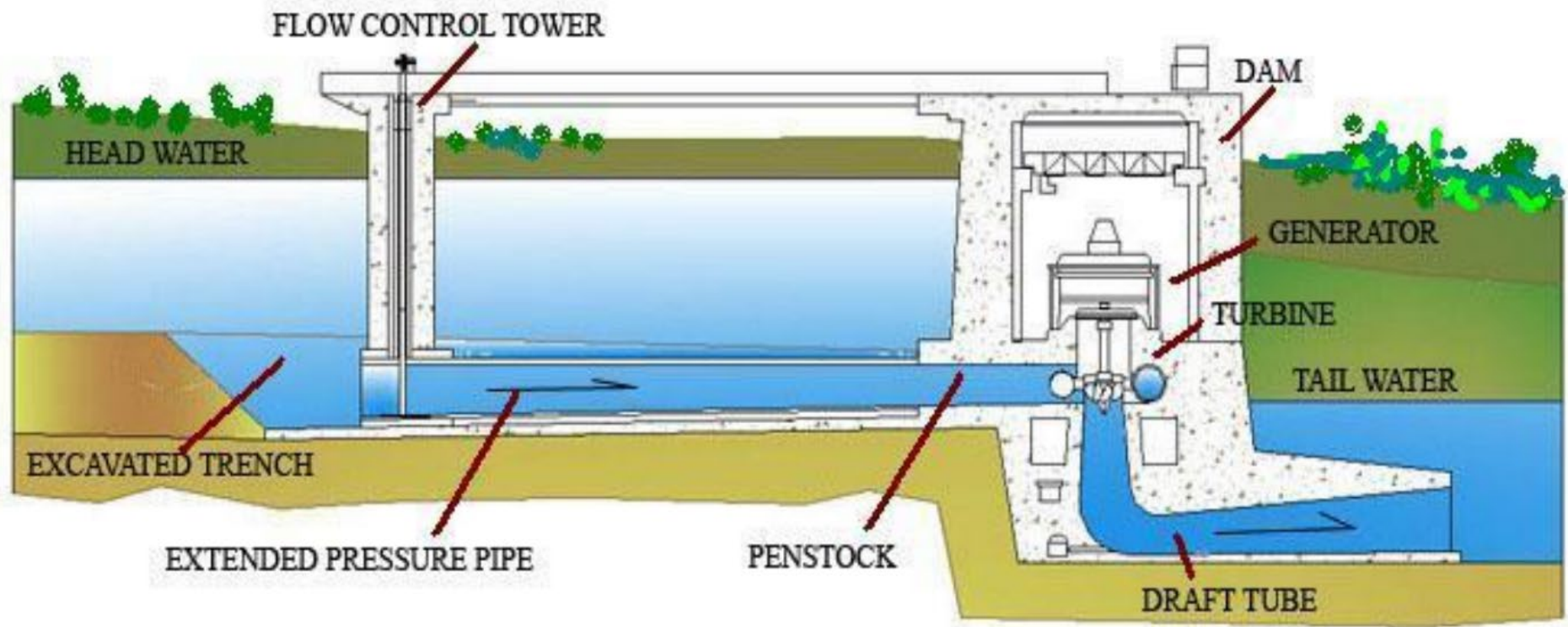
Storage



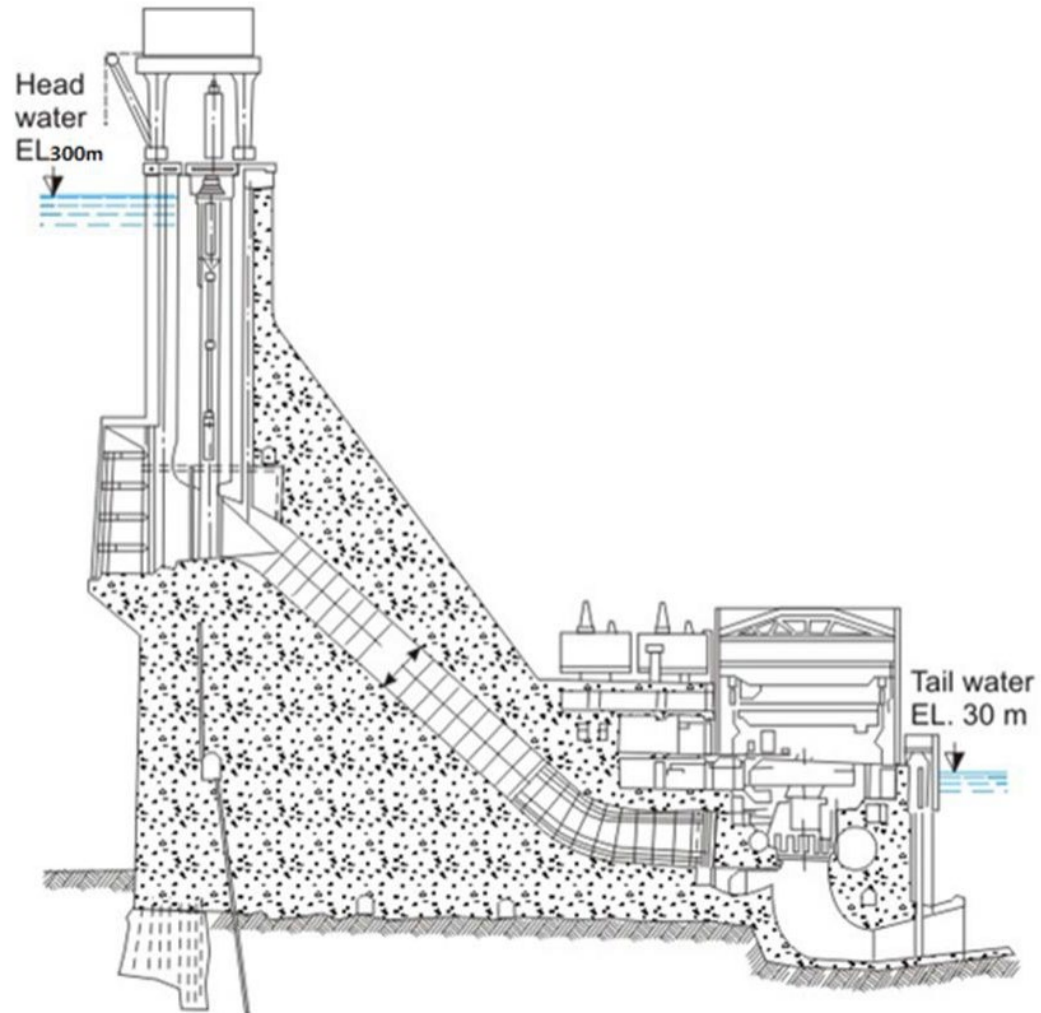
Pumped Storage Hydropower



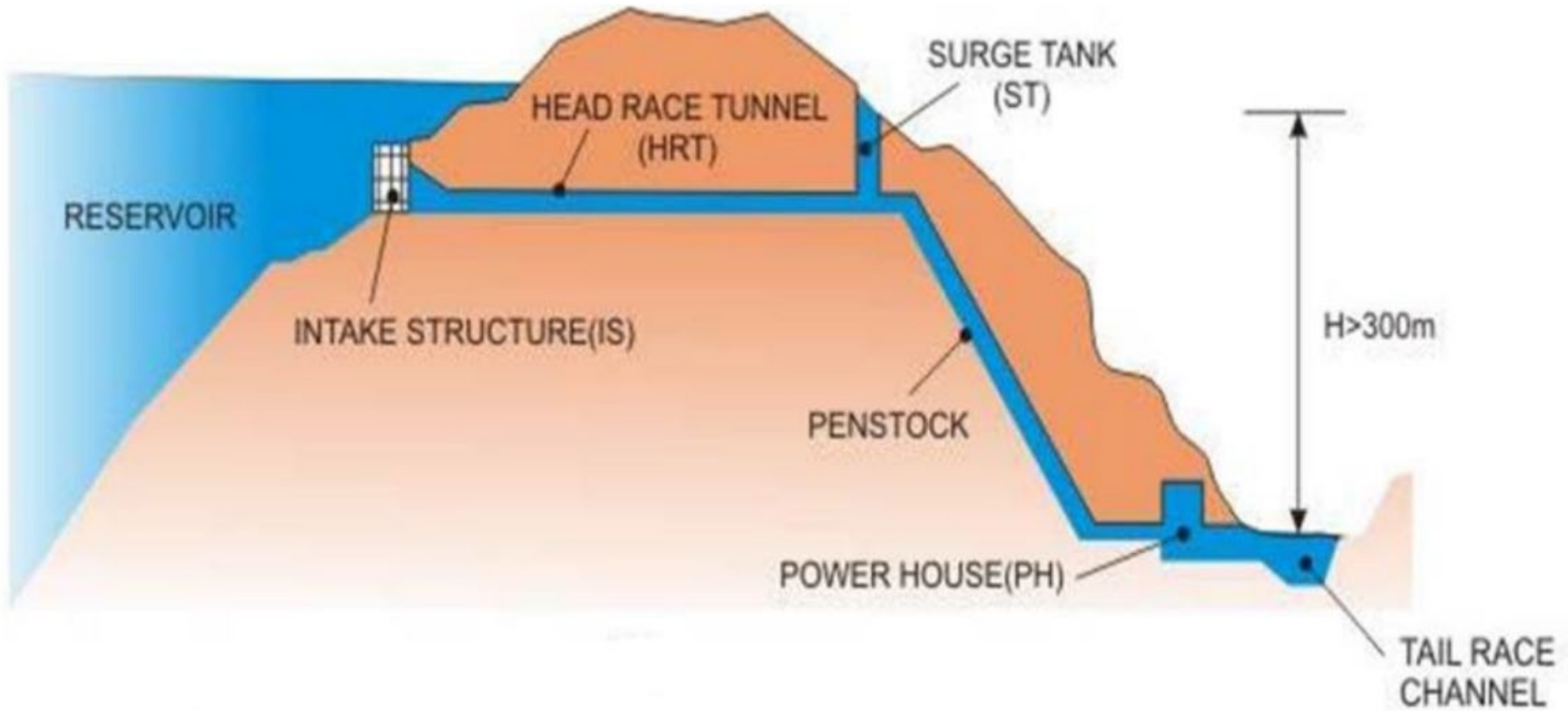
Low Head



Medium Head



High Head



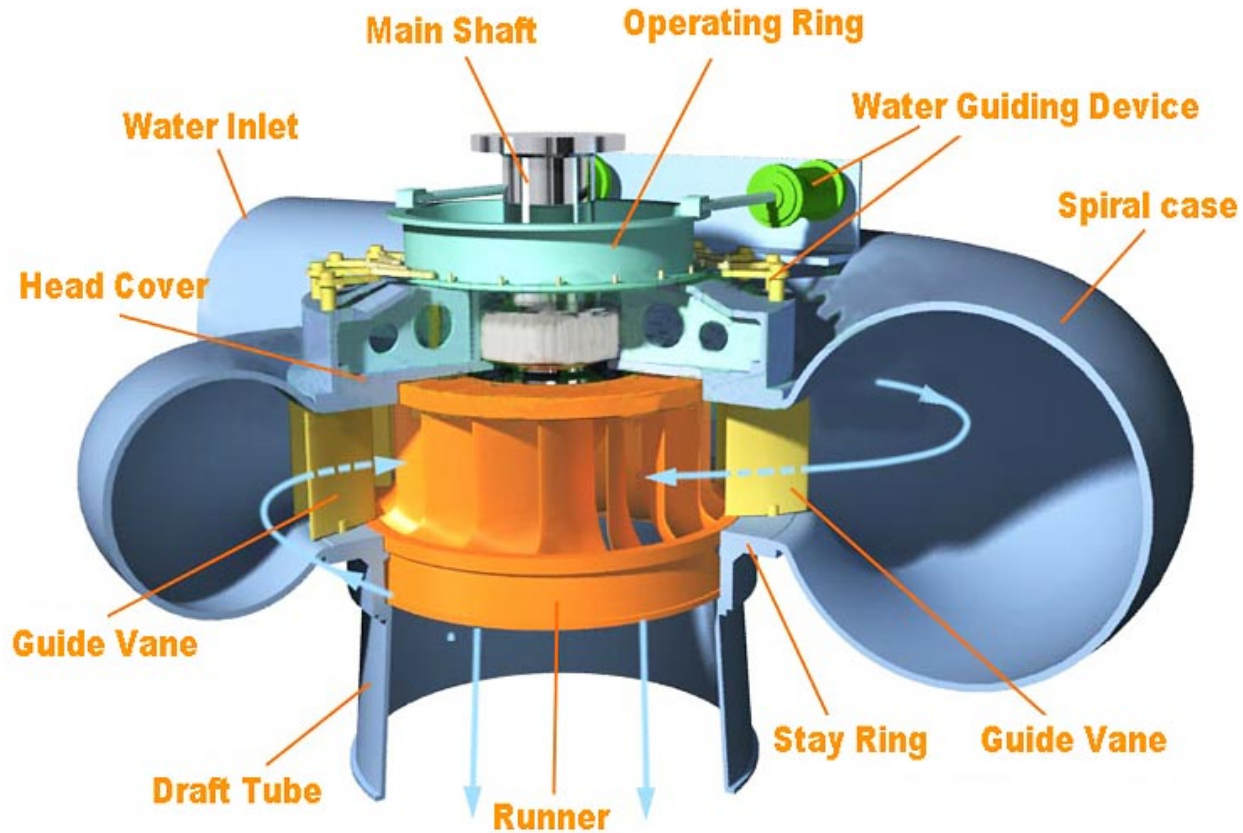
Types of Hydropower Turbines

Pelton



<https://www.youtube.com/watch?v=3PoeMQeHePo>

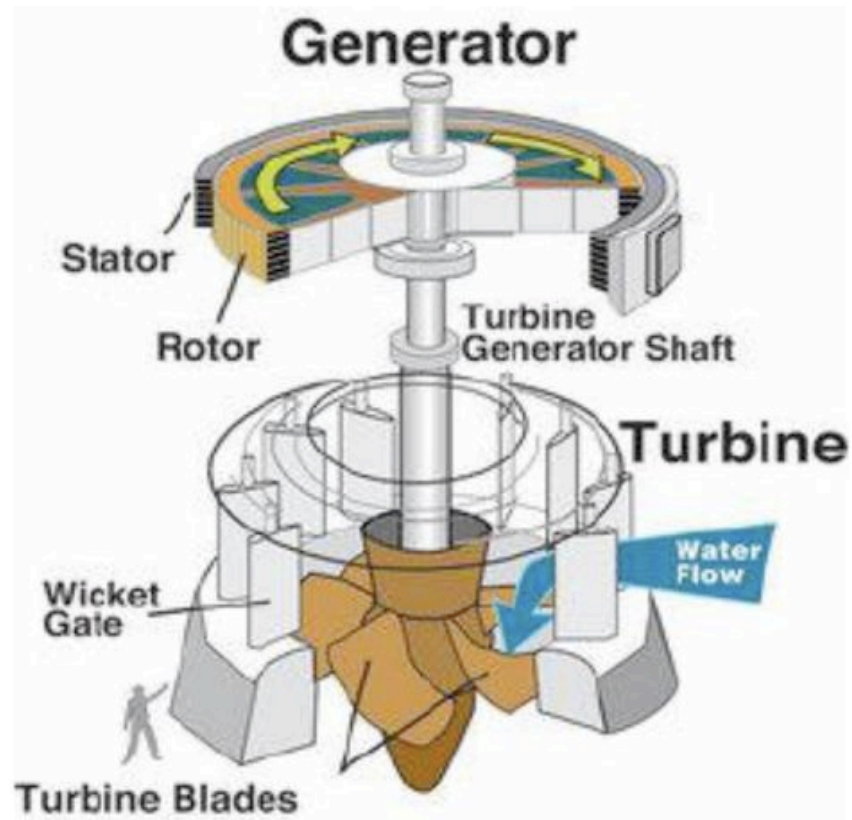
Francis



Francis Turbine

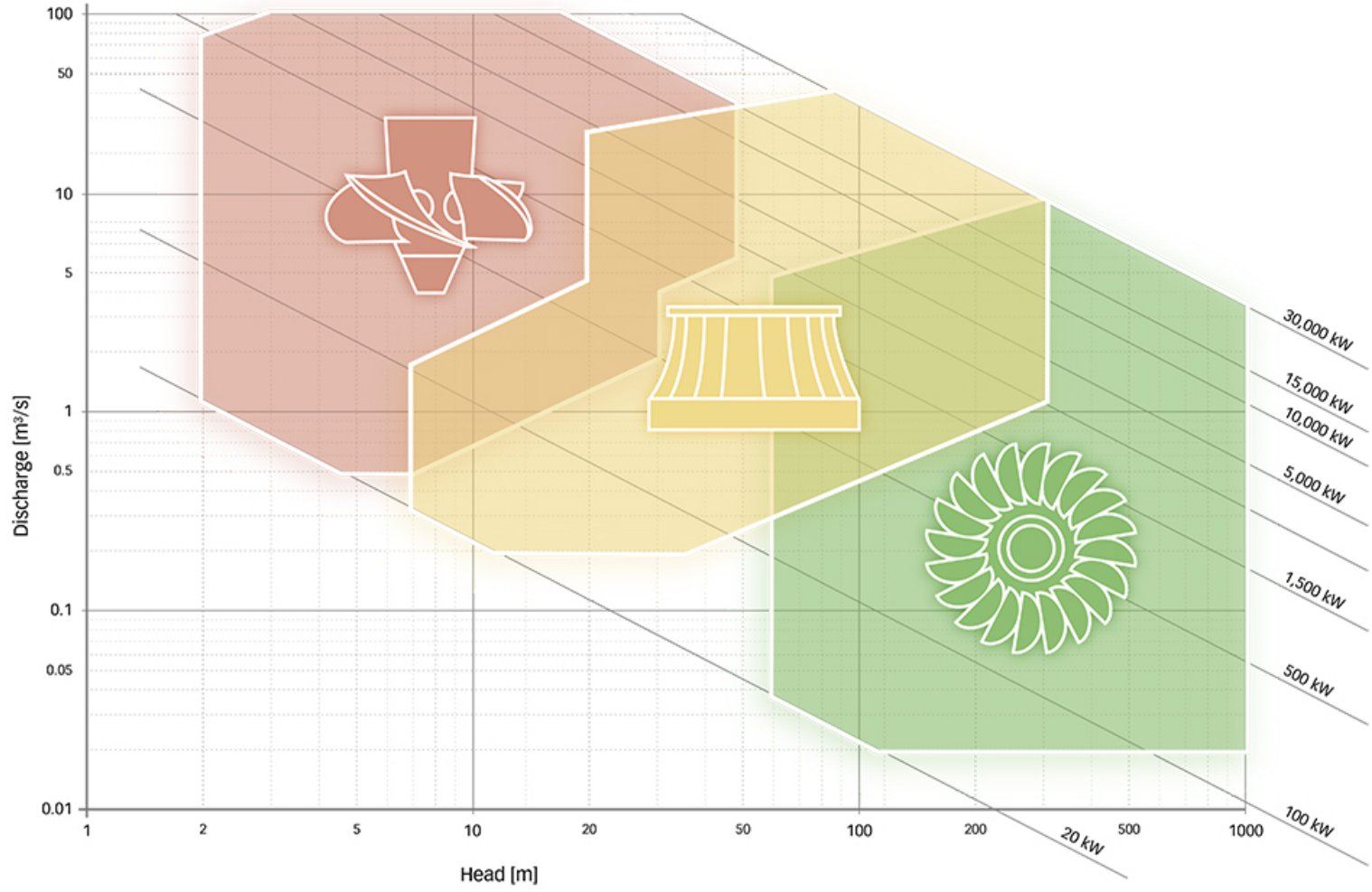
<https://www.youtube.com/watch?v=pNx76qvT9EU>

Kaplan



<https://www.youtube.com/watch?v=pbliwh4-R2I>

Turbine Application Chart



Benefits and Impacts of Hydropower

Benefits

- Baseload generation source
- Long Life - Low Cost of Energy
- Carbon neutral in operation
- Can help integrate other intermittent renewables
- Creates recreational opportunities
- Attenuates floods
- Assists navigation
- Provides 90% of Kleinschmidt's workload

Impacts

- Impacts river ecosystems
- Inundates land
- Impacts river temperature, dissolved oxygen, and sediment movement
- Creates risk by impounding water
- Reduces flows in bypass reaches