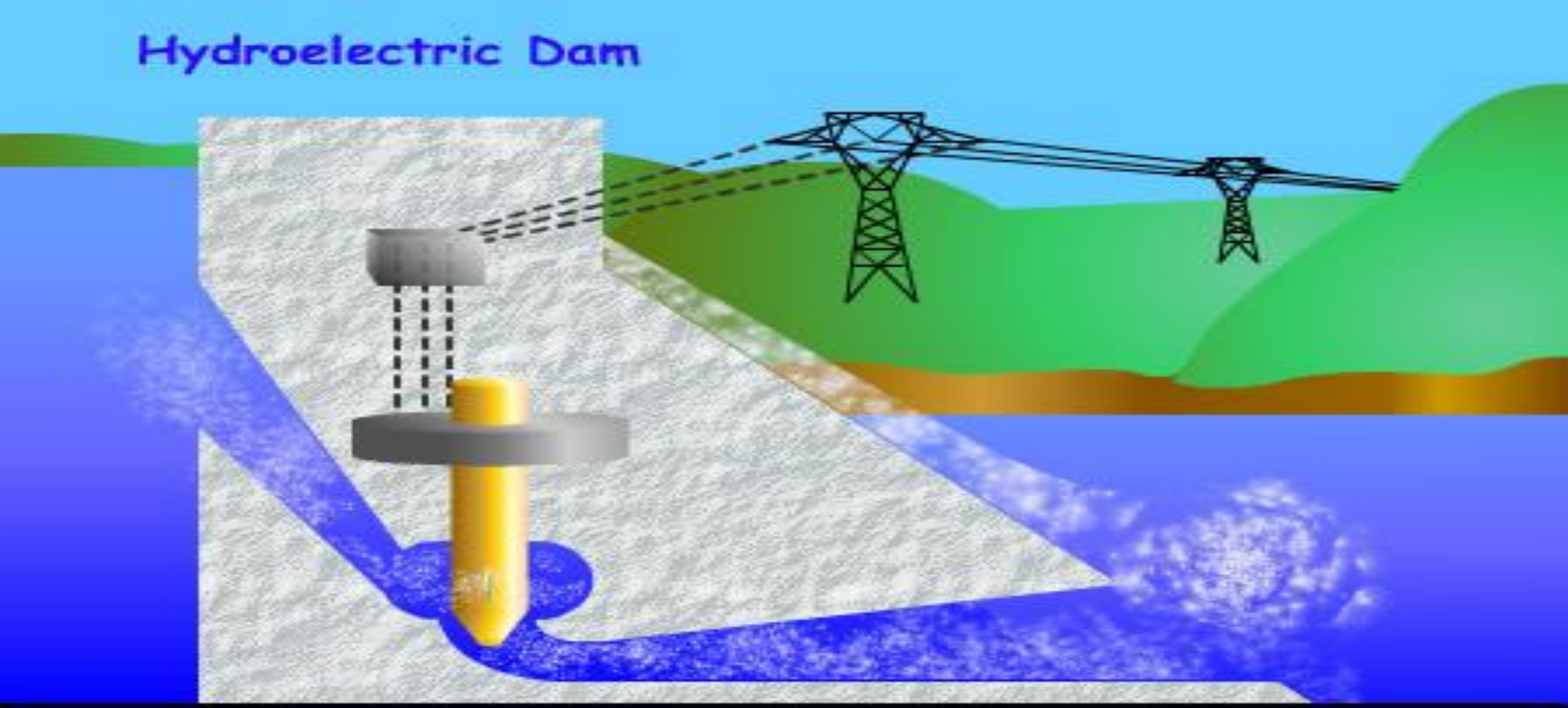
HYDROELECTRIC POWER



HYDROELECTRIC POWER

WHAT IS HYDROELECTRIC POWER?

- Hydro means “water”.So hydro power is water power and hydroelectric power is electricity generated using water power.
- Potential energy converted to kinectic energy which is changed to mechanical energy in a power plant and then turned into electrical energy.
- In an impoundment facility, water is stored in dam.In a dam is a water intake.This is a narrow opening to a tunnel called penstock.

HISTORY OF HYDROELECTRIC POWER

- - Nearly 2000 years ago the Greeks used water wheels to grind wheat into flour
- - In the 1700's, hydropower was broadly used for milling of lumber and grain and for pumping irrigation water
- - Appleton, Wisconsin became the first operational hydroelectric generating station in the United States, in 1882, producing 12.5 kilowatts (kW) of power
- - The total electrical capacity generated was equivalent to 250 lights
- - Within the next 20 years roughly 300 hydroelectric plants were operational around the world
- - The invention of the hydraulic reaction turbine created the sudden expansion of hydropower
- - 40% of the United States' electricity was provided by hydroelectric power in the early 1900's

- The largest and last masonry dam built by the U.S. Bureau of Reclamation was the Roosevelt Dam in Arizona between 1905-1911; its power output has increased from 4,500 kW to 36,000 kW

- In 1933, the Tennessee Valley Authority Act was enacted into law

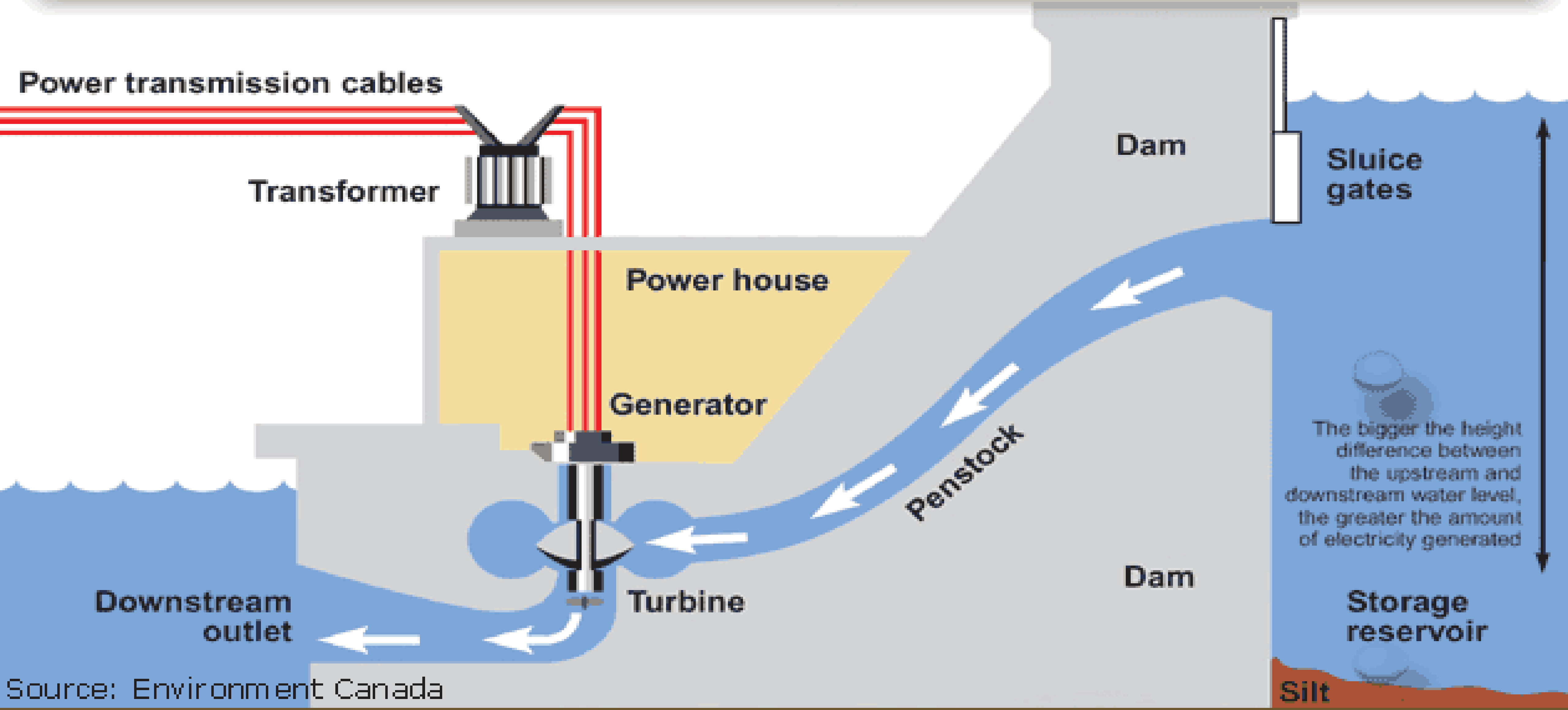
- The Hoover Dam first generated power in 1937, producing 130,000 kW

- By the 1940's, hydroelectric power supplied roughly 75% of the electricity used in the western United States and approximately one-third of the United States' total electric energy

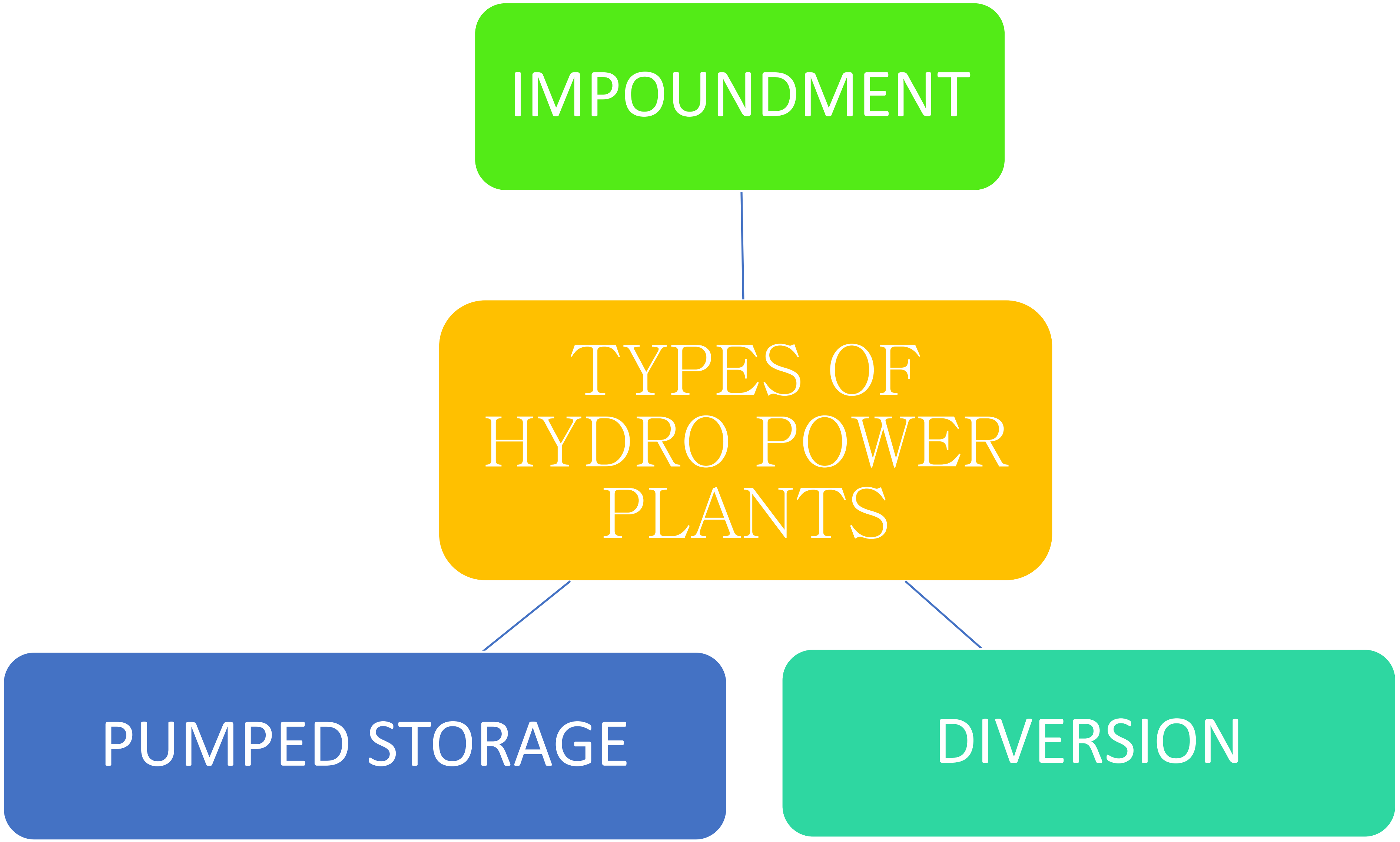
- Still in use today, Niagra Falls was the first hydropower site developed for a vast quantity of electricity

- Nearly 10% of the United States' electricity came from hydroelectric power in 1997

Hydroelectric power generation

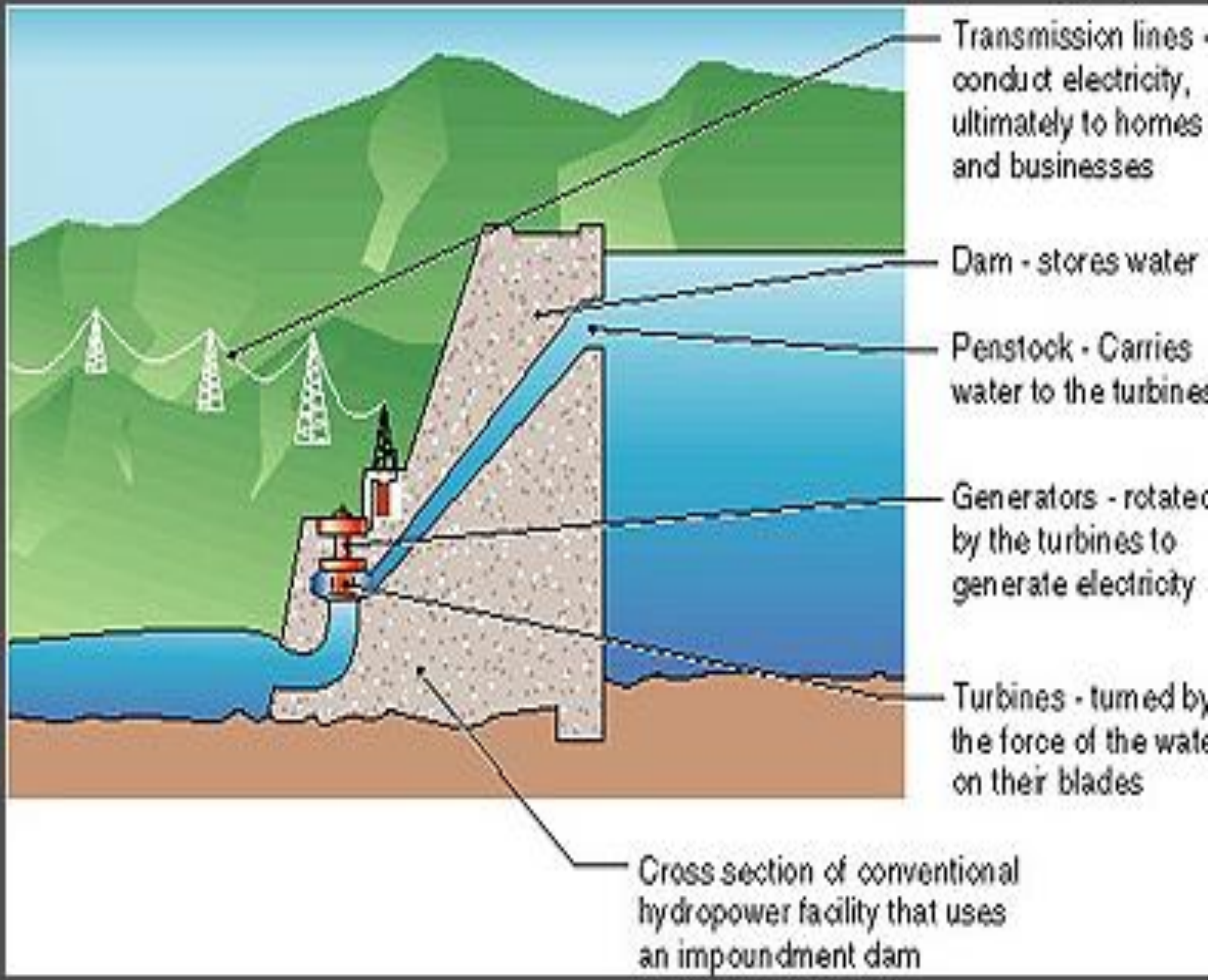


Source: Environment Canada


IMPOUNDMENT
TYPES OF HYDRO POWER PLANTS
PUMPED STORAGE
DIVERSION

IMPOUNDMENT

An impoundment facility, typically a large hydropower system, uses a dam to store river water in a reservoir



An impoundment hydropower plant dams water in a reservoir

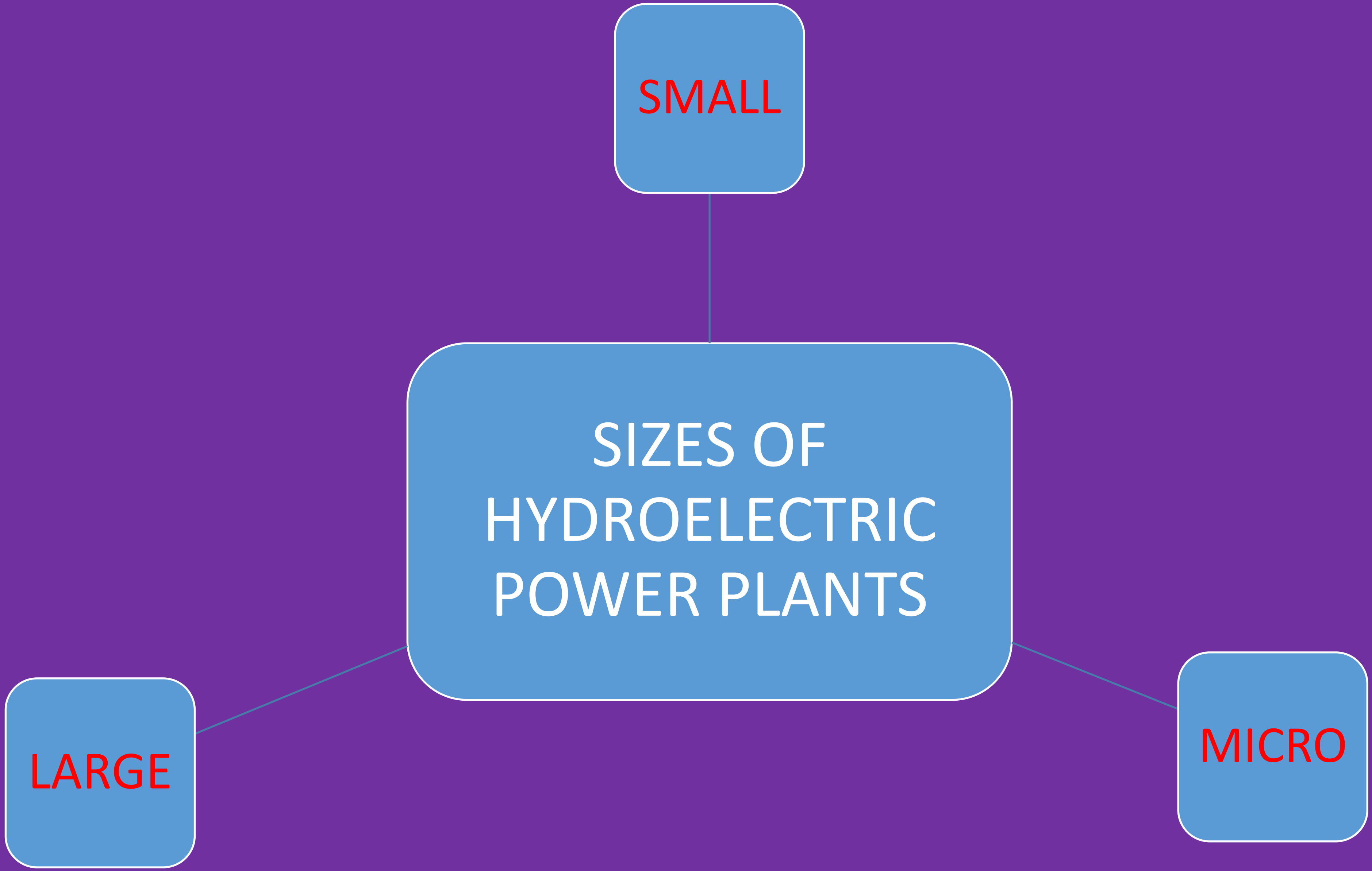
DIVERSION

A diversion, sometimes called run-of-river, facility channels a portion of a river through a canal or penstock. It may not require the use of a dam.

The Tazimina project in Alaska is an example of a diversion hydropower plant. No dam was required.

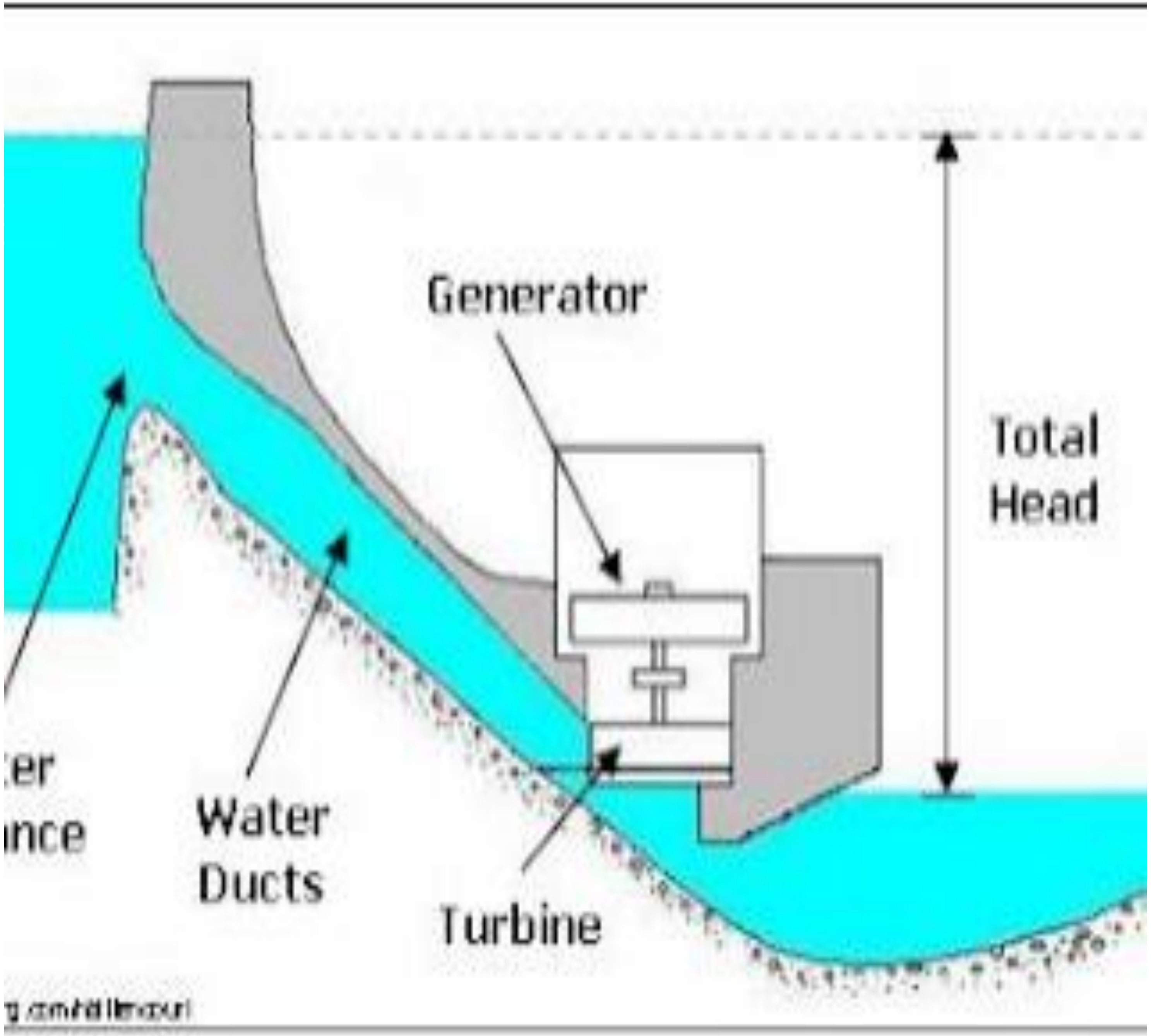
PUMP STORAGE

When the demand for electricity is low, a pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir. During periods of high electrical demand, the water is released back to the lower reservoir to generate electricity.


SMALL
SIZES OF HYDROELECTRIC POWER PLANTS
LARGE
MICRO

WORKING OF HYDROELECTRIC POWER

In hydroelectric power plants the potential energy of water due to its high location is converted into electrical energy. The total power generation capacity of the hydroelectric power plants depends on the head of water and volume of water flowing towards the water turbine.



P=r h g

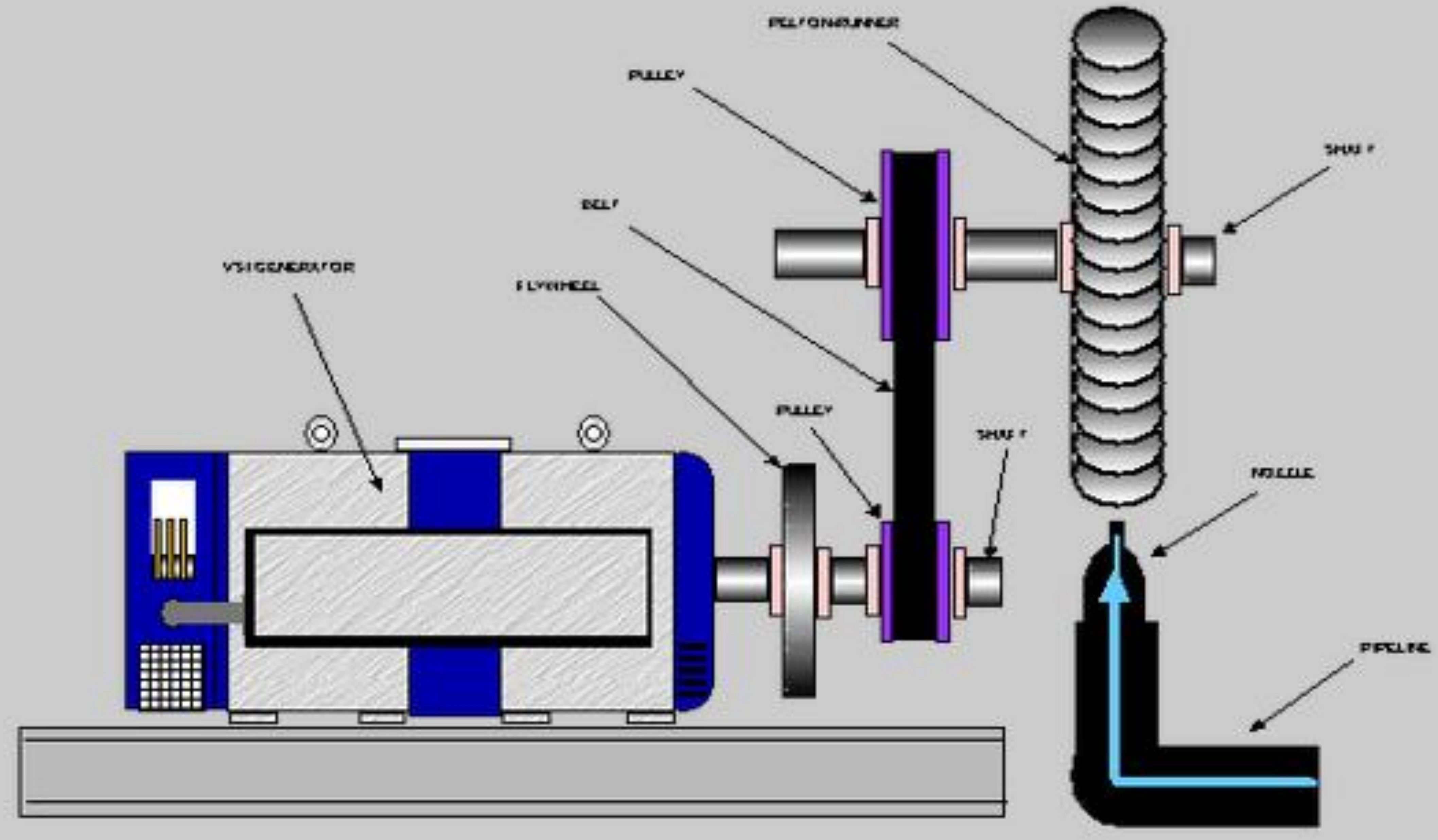
P=POWER PRODUCED IN WATT

r=rate of flow of water in cubic/msec

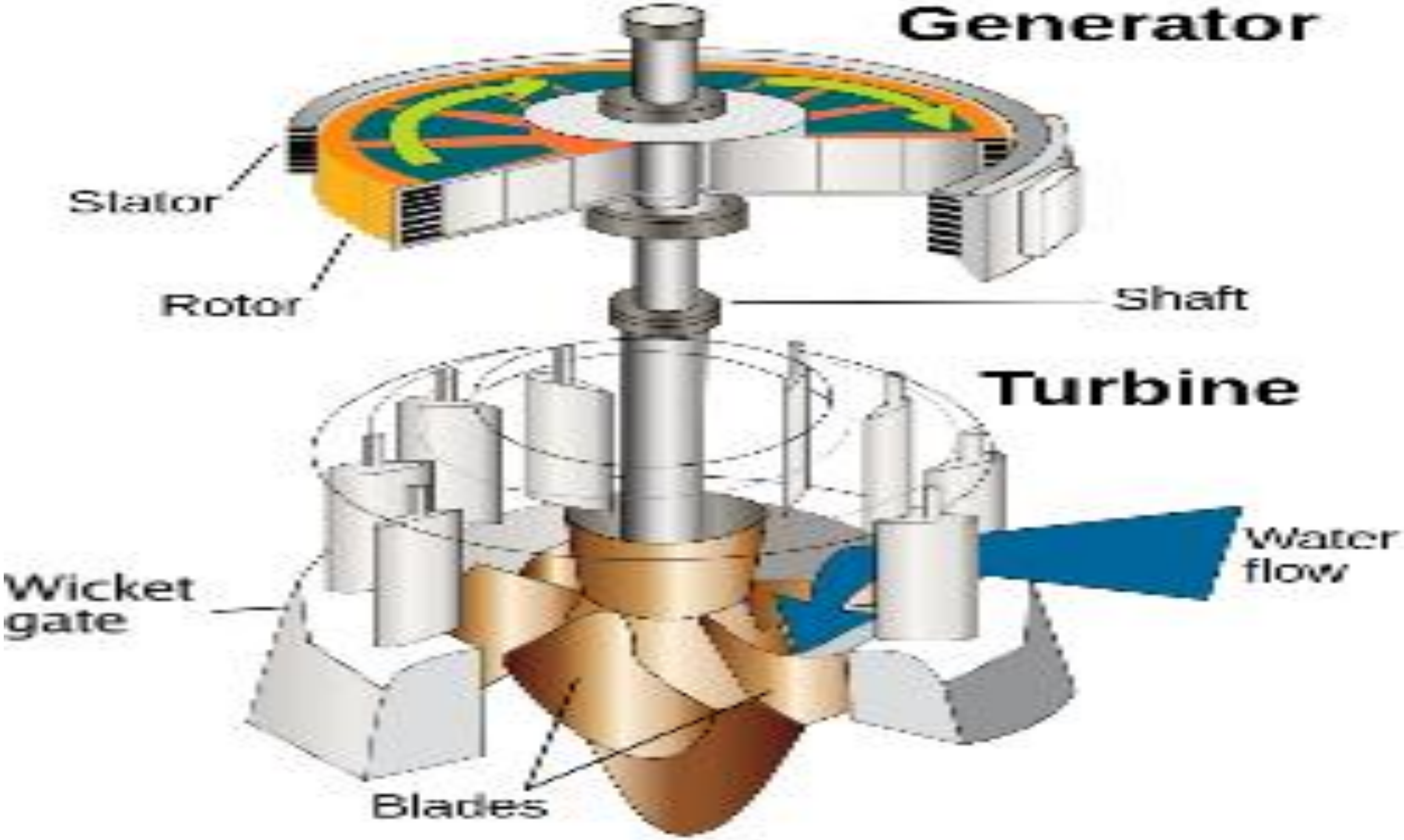
h=height of water which is measured in meter

g=gravity constant is 9.81m/sec square

VSI GENERATOR HYDROELECTRIC APPLICATION

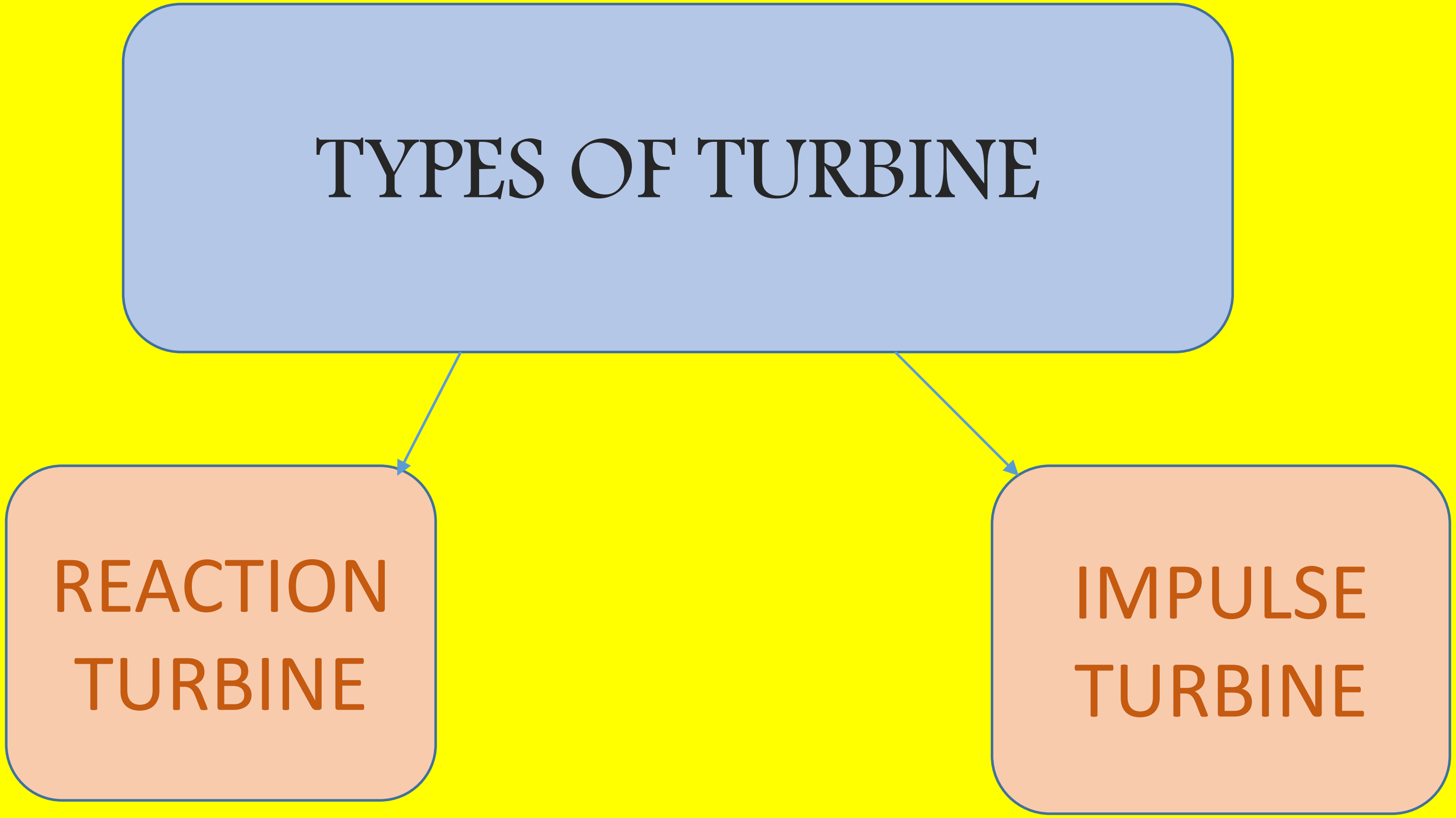


WATER TURBINE



Their generators are usually salient-type rotor with many poles.
To maintain the generator
voltage frequency constant, the turbine must spin the
generator at a constant speed
given by
n =120f/p

where f is the generated voltage frequency and p is the
number of poles of the
generator


TYPES OF TURBINE
REACTION TURBINE
IMPULSE TURBINE

REACTION TURBINE

Reaction turbines are acted on by water, which changes pressure as it moves through the turbine and gives up its energy. They must be encased to contain the water pressure (or suction), or they must be fully submerged in the water flow.

Newton's third law describes the transfer of energy for reaction turbines.

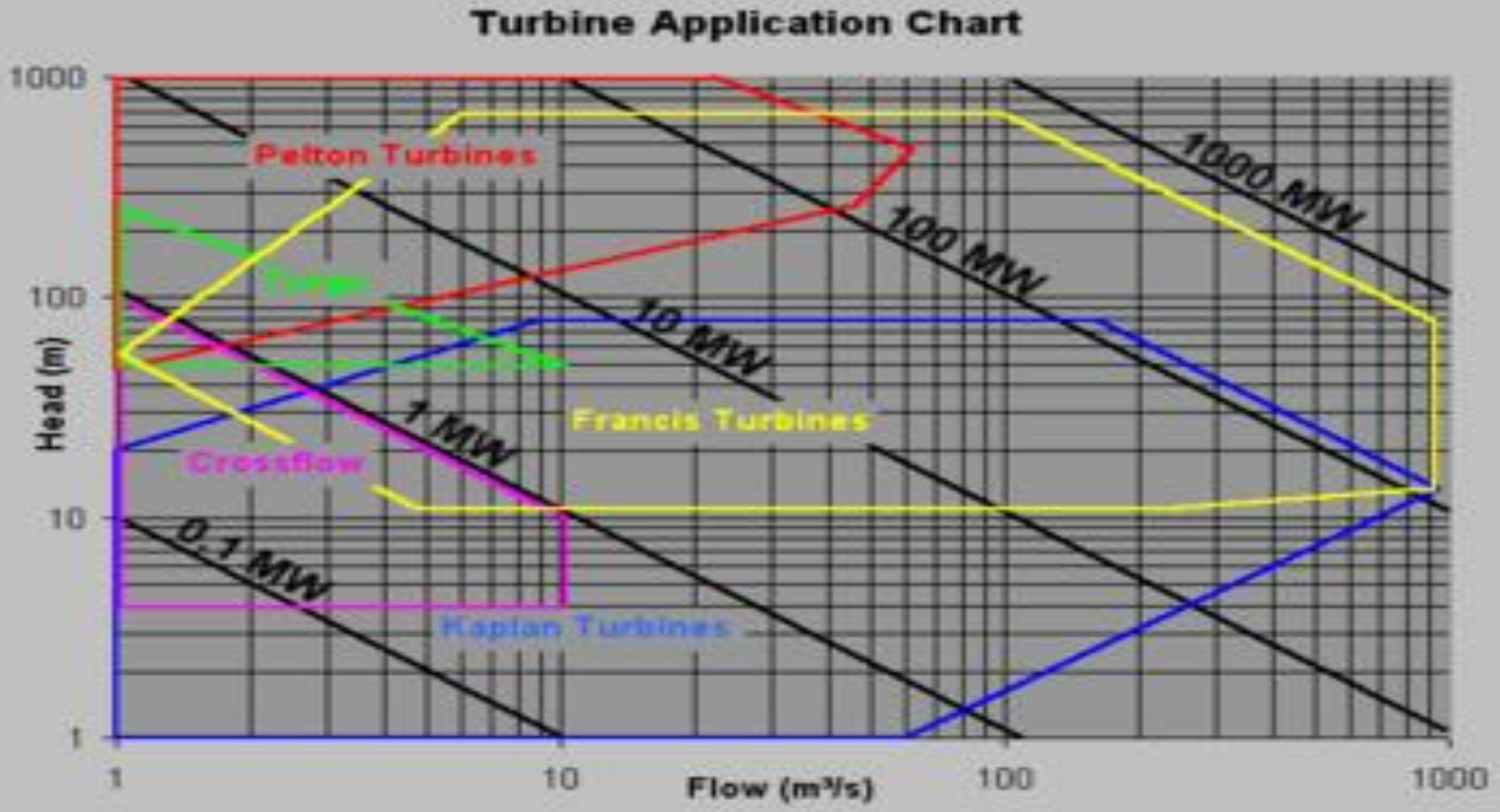
Most water turbines in use are reaction turbines and are used in low (<30m/98 ft) and medium (30-300m/98–984 ft) head applications. In reaction turbine pressure drop occurs in both fixed and moving blades.

IMPULSE TURBINE

Impulse turbines change the velocity of a water jet. The jet pushes on the turbine's curved blades which changes the direction of the flow. The resulting change in momentum (impulse) causes a force on the turbine blades. Since the turbine is spinning, the force acts through a distance (work) and the diverted water flow is left with diminished energy.

Newton's second law describes the transfer of energy for impulse turbines.

Impulse turbines are often used in very high (>300m/984 ft) head applications
.



Turbine Application Chart
Pelton Turbines
Turgo
Francis Turbines
Crossflow
Kaplan Turbines
1000 MW
100 MW
10 MW
1 MW
0.1 MW
Head (m)
Flow (m³/s)
1000
100
10
1
1
10
100
1000

• Hydraulic wheel turbine	$0.2 < H < 4$ (H = head in m)
• Archimedes' screw turbine	$1 < H < 10$
• Kaplan	$2 < H < 40$
• Francis	$10 < H < 350$
• Pelton	$50<H<1300$
• Turgo	$50<H<250$

Basin-Wise of Hydroelectric Potential of Indian River System

S.No.	Name of River	Number of Schemes	Firm Potential (MW)	Potential (MW) at 60% LF		Needed IC (MW)
				Economic Potential	Theoretical Potential	
1.	Great Indus	190 (including 23 storage)	11,992.8	19,988	50,172	33,832
2.	Great Brahmaputra	226 (including 76 storage)	23,951.9	34,920	146,170	66,065
3.	Ganga	142 (including 35 storage)	3,409.0	10,715		20,711
4.	West flowing river of South India	94	3,689.4	6,149	9,437	9,430
5.	East flowing rivers of South India	140	5,719.0	9,532	26,972	14,511
6.	Central Indian river system	53	1,664.2	2,740	14,888	4,152
Total		845	50,426.3	84,044	301,117	148,701

Hydropower Stations in Operation (IC of 50 MW and Above)

Name of Station	Name of River	State	IC (MW)	Year Commissioned
Lower Jhelum	Jhelum	Jammu & Kashmir	105	1978-79
Salal	Chenab	Jammu & Kashmir	690	1987-95
Uri	Jhelum	Jammu & Kashmir	480	1996-97
Upper Sindh II	Sindh nallah	Jammu & Kashmir	105	2000-01
Shanan	Uhi	Himachal Pradesh	110	1932-82
Bhakra LB	Sutlej	Himachal Pradesh	540	1960-61
Bhakra RB	Sutlej	Himachal Pradesh	660	1966-68
Bassi	Uhi	Himachal Pradesh	60	1970-81
Dehar	Beas	Himachal Pradesh	990	1977-78
Giri	Giri	Himachal Pradesh	60	1978
Pong	Beas	Himachal Pradesh	360	1978-83
Baira Siul	Baira/Siul	Himachal Pradesh	180	

N
INDIA
Hydro Power Plants
AFGHANISTAN
PAKISTAN
CHINA
(Tibet)
NEPAL
BHUTAN
BANGLADESH
MYANMAR
Sindh
Lower Jhelum
Pong
Dehar
Giri Bata
Yamuna (Stage 2)
Bhakra
Yamuna (Stage 1&4)
Nangal
Tehri
Gandki
Rana Pratap Sagar
Jawahar Sagar
Obra
Bihand
Loktak
Gandhi Sagar
Ukai
Hirkund
Bhivpuri
Khopoli
Koyna
Balimela
Upper Sileru
Lower Sileru
ARABIAN SEA
BAY OF BENGAL
Nagarjuna sagar
Malprabha
Tungbhadra
Kalindi
Sharawati
Bhadra
Jog
LAKSHADWEEP (INDIA)
ANDAMAN AND NICOBAR ISLANDS (INDIA)
Iduki
Kodayar
SRI LANKA
INDIAN OCEAN
LEGEND
Hydro Power Plant
Map not to Scale
Copyright © 2010 www.mapsofindia.com
This map is updated as on October 21, 2010

- A project with capacity of 130 kW installed at Sidrapong (Darjeeling) in the year 1897 was the first hydropower installation in India.
- A few old installations, e.g., Shiva Samundram in Mysore (2,000 kW)
- Chamba (40 kW) in 1902, Gagoi in Mussoorie (3,000 kW) in 1907 etc
- The Gagoi Power House that Lt. Col. W.W. Bell had built near Mussoorie was to provide electricity and to pump water upward to Mussoorie town. It was for the first time that water was pumped to a height of 516 m (the highest in Asia at that time).
- Hirakhud dam produces power of 307.5MW

CONCLUSION

At the time of independence (1947), the IC of hydropower projects was 508 MW, which was about 37% of the total IC at that time. But with the taking up of five-year plans, work began on many multi-purpose river valley projects, the so called ‘temples of modern India’. Bhakra dam was the notable showcase for a long time to come. At the end of 1998, the installed hydropower capacity was about 22,000 MW which was 24.85 % (lowest % so far) of the total IC of 88,543 MW. In the year 1962-63, the hydro: thermal ratio was the maximum at 50.62 However, over the years, the share of hydropower has continuously come down. It may be noted that a thermal-hydro mix in the ratio of 60:40 is considered as ideal.