

# Unit 4:- Wind Energy



## Syllabus...Unit 4

- **Wind Energy:** Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydro power system, water pumping and conversion to electricity, hydraulic pump.

## Books ...

- Gilbert M. Masters, *Renewable and Efficient Electrical Power Systems*, Wiley - IEEE Press, August 2004.
- Godfrey Boyle, *Renewable Energy*, Third edition, Oxford University Press, 2012.
- Chetan Singh Solanki, *Solar Photovoltaics-Fundamentals, Technologies and Applications*, PHI Third Edition, 2015.

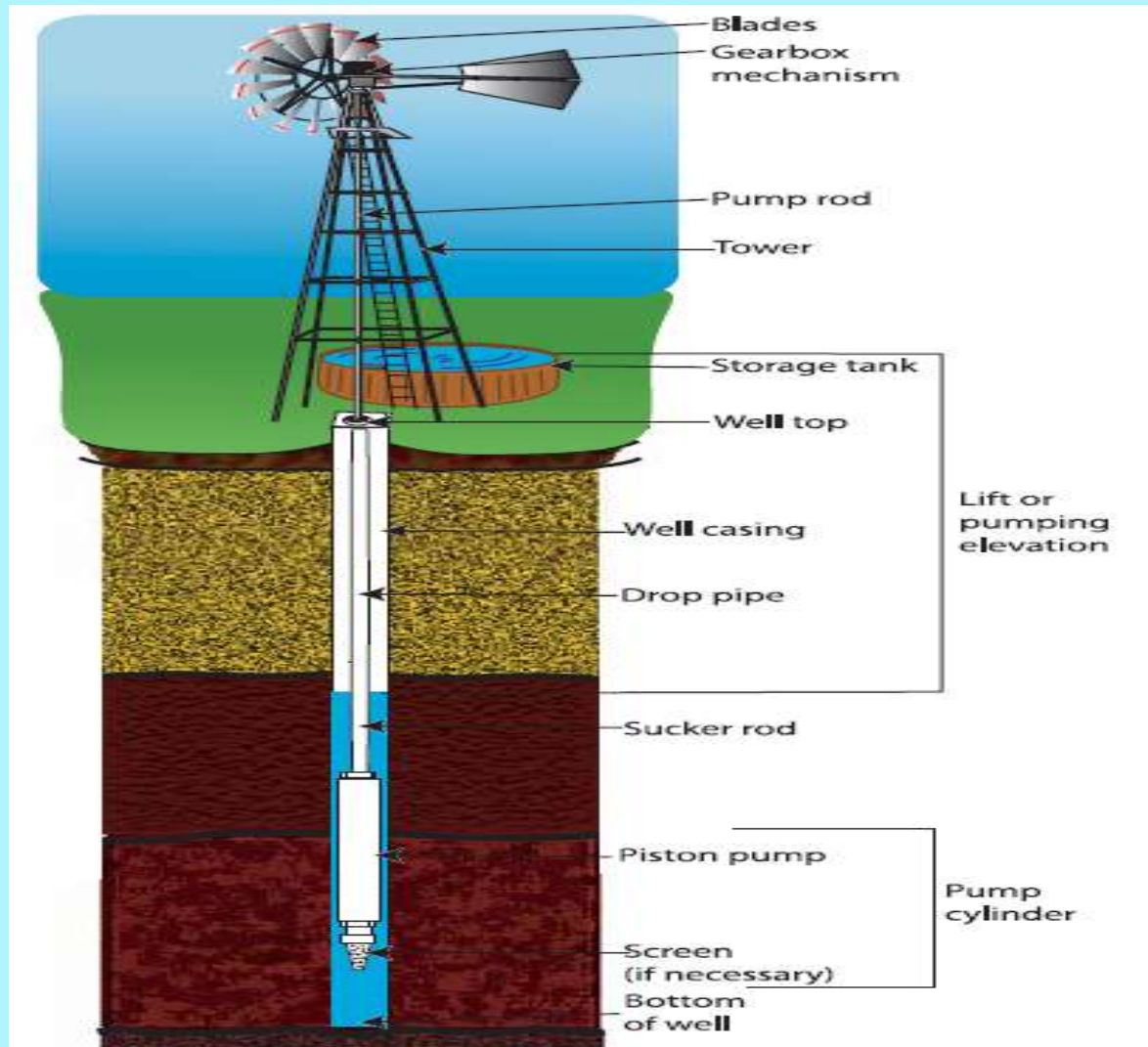
### Supplementary Reading:

- D.P.Kothari, K.C.Singal, Rakesh Rajan, *Renewable Energy Sources and Emerging Technologies*, PHI Second Edition, 2011.

# Lecture 6

- Wind Water Pumping System
- Hydraulic Wind Turbine
- Hybrid Power System
- Renewable Hydro Power
- Small Hydro Power: India
- Difference :Micro, Mini & Small Hydro Power
- Small Hydro Power Plant
- Mini Hydro Power Plant
- Micro Hydro Power Plant
- Pico Hydro Power Plant
- Advantages of Mini Hydro Power
- Disadvantages of Mini Hydro Power
- Environmental Issues

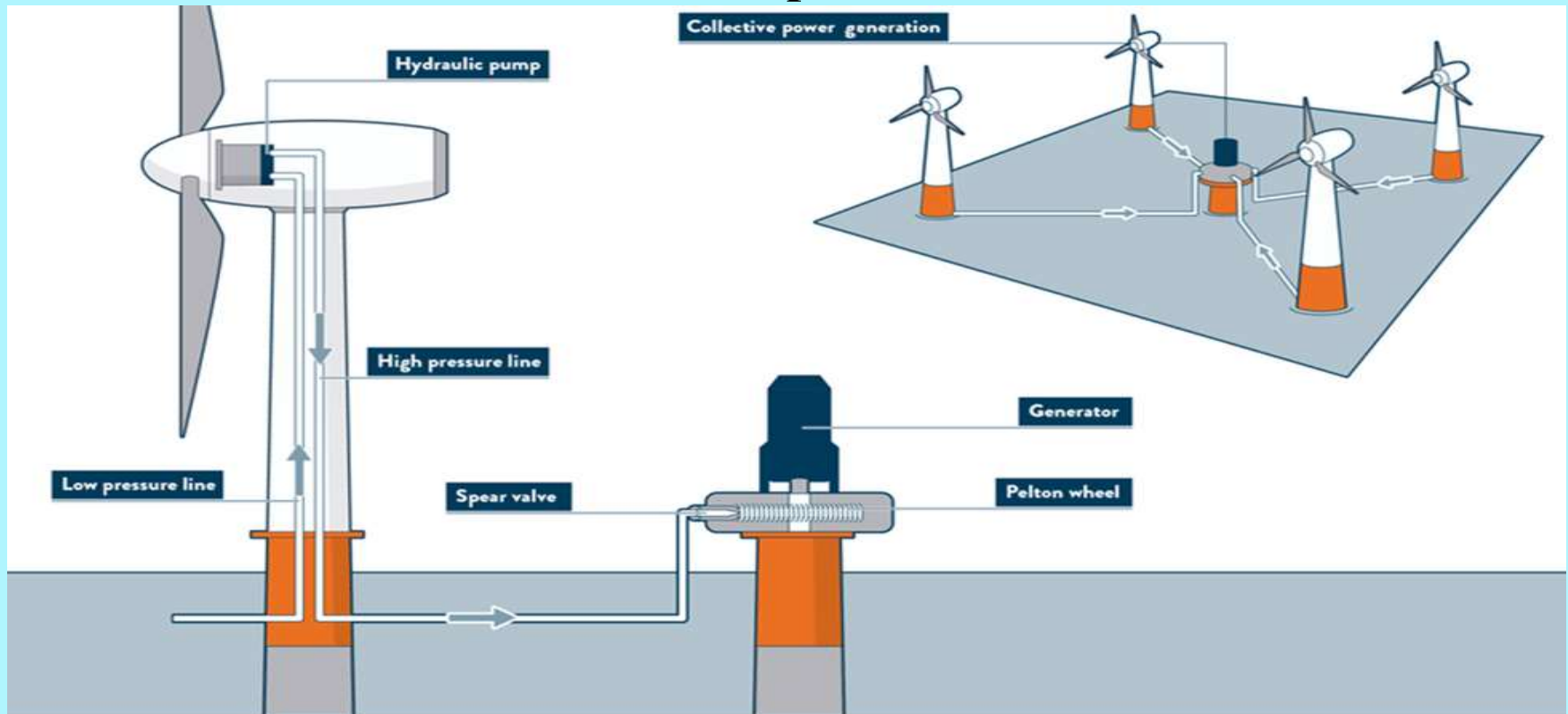
# Wind Water Pumping System



Using wind energy water pumping is also possible.

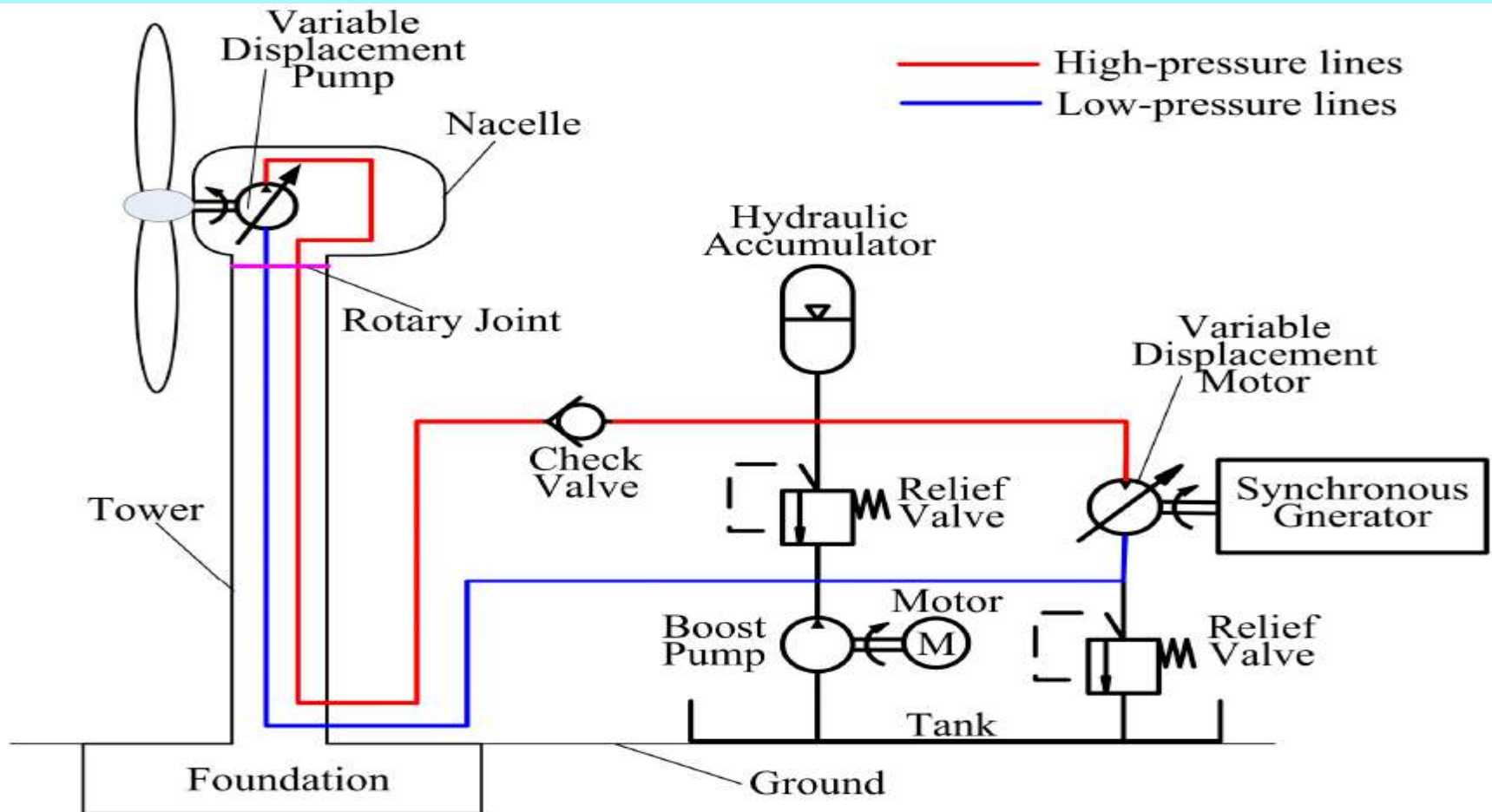
# Hydraulic Wind Turbine System

Wind turbines actually rely on **hydraulics** to produce the density and provide the durability they need for generating **electricity**. **Hydraulics** produce high pressure that helps the blades of large two-ton and three-ton **turbines** spin.

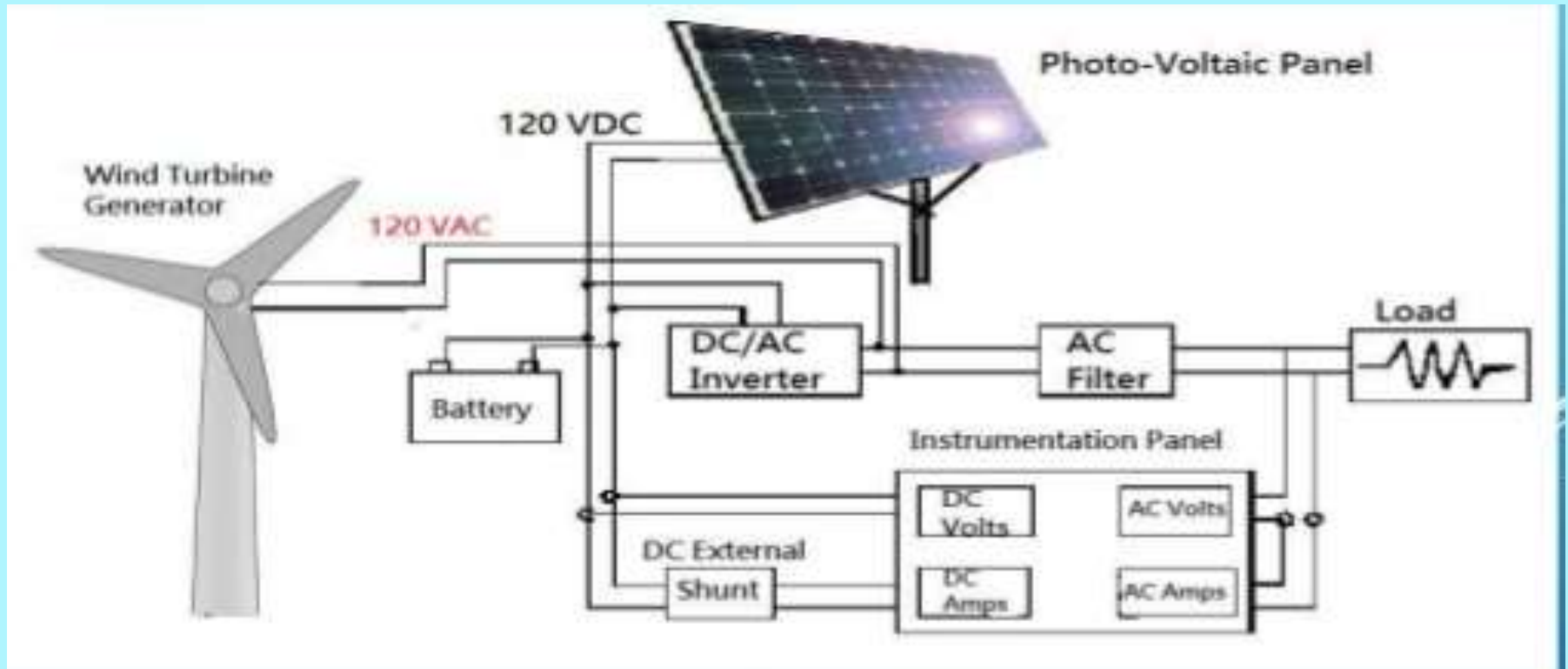


# Hydraulic Wind Turbine System

## 600 kW Closed Hydraulic Wind Turbine with an Energy Storage System



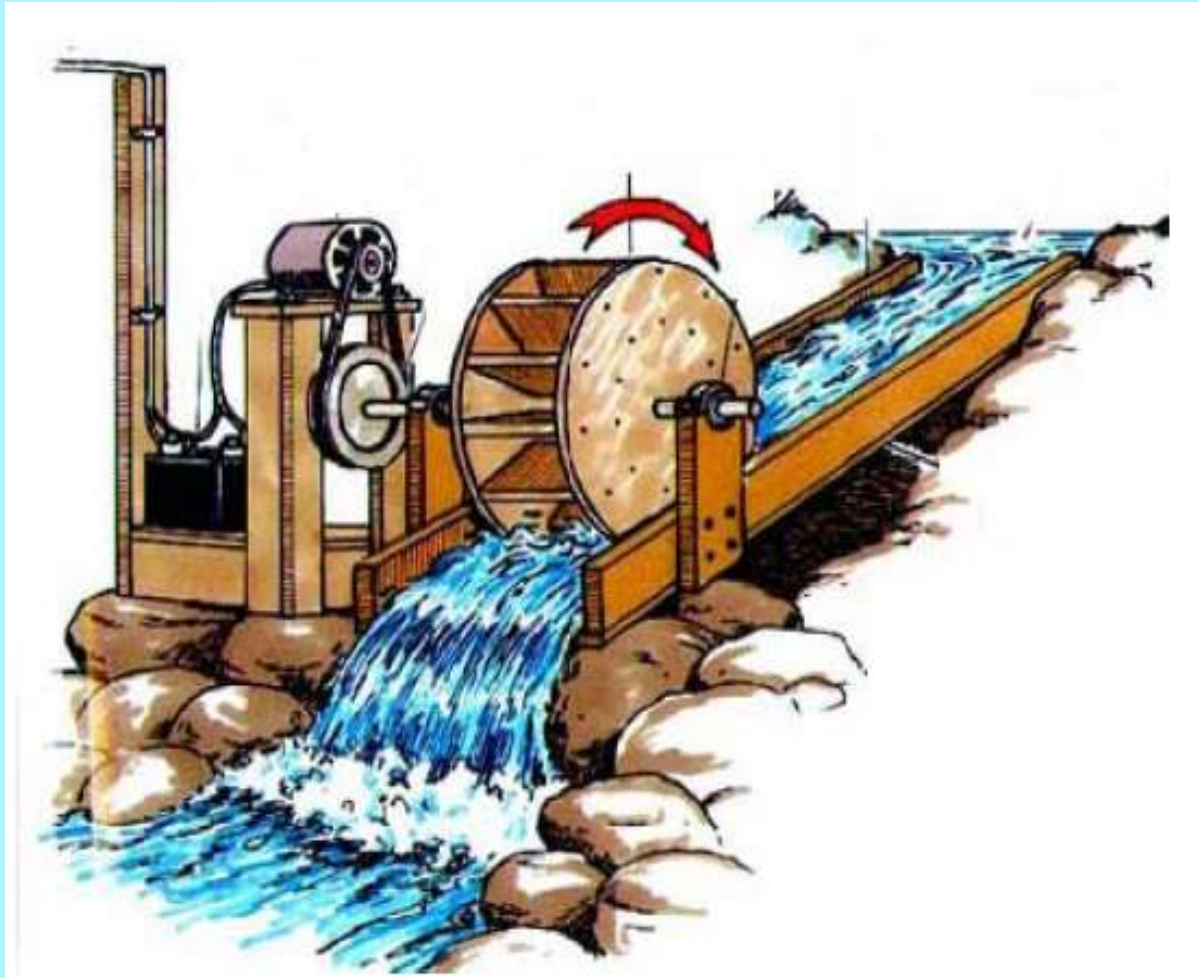
# Hybrid Power System



Wind speeds are low in the summer when the sun shines brightest and longest. The wind is strong in the winter when less sunlight is available. Because the peak operating times for wind and solar systems occur at different times of the day and year, hybrid systems are more likely to produce power when you need it.



# Renewable Hydro Power



A small hydropower generating unit is identified as a power supply that feeds a distant or a local load from a small hydroelectric source, which could either be run-of river, or have a small impoundment.



# Small Hydro Power India

India is the 7th largest producer of hydroelectric power in the world. As of 30 April 2017, India's installed hydroelectric capacity was 44,594 MW, or 13.5% of its total utility power generation capacity. Different countries have different size criteria to classify small hydro power project capacity ranging from 10MW to 50 MW. In India, hydro power plants of 25MW or below capacity are classified as small hydro. In India Small Hydro projects up to 3MW comes under Ministry of New and Renewable Energy (MNRE) rest all projects comes under Ministry of Power Govt. Of India.

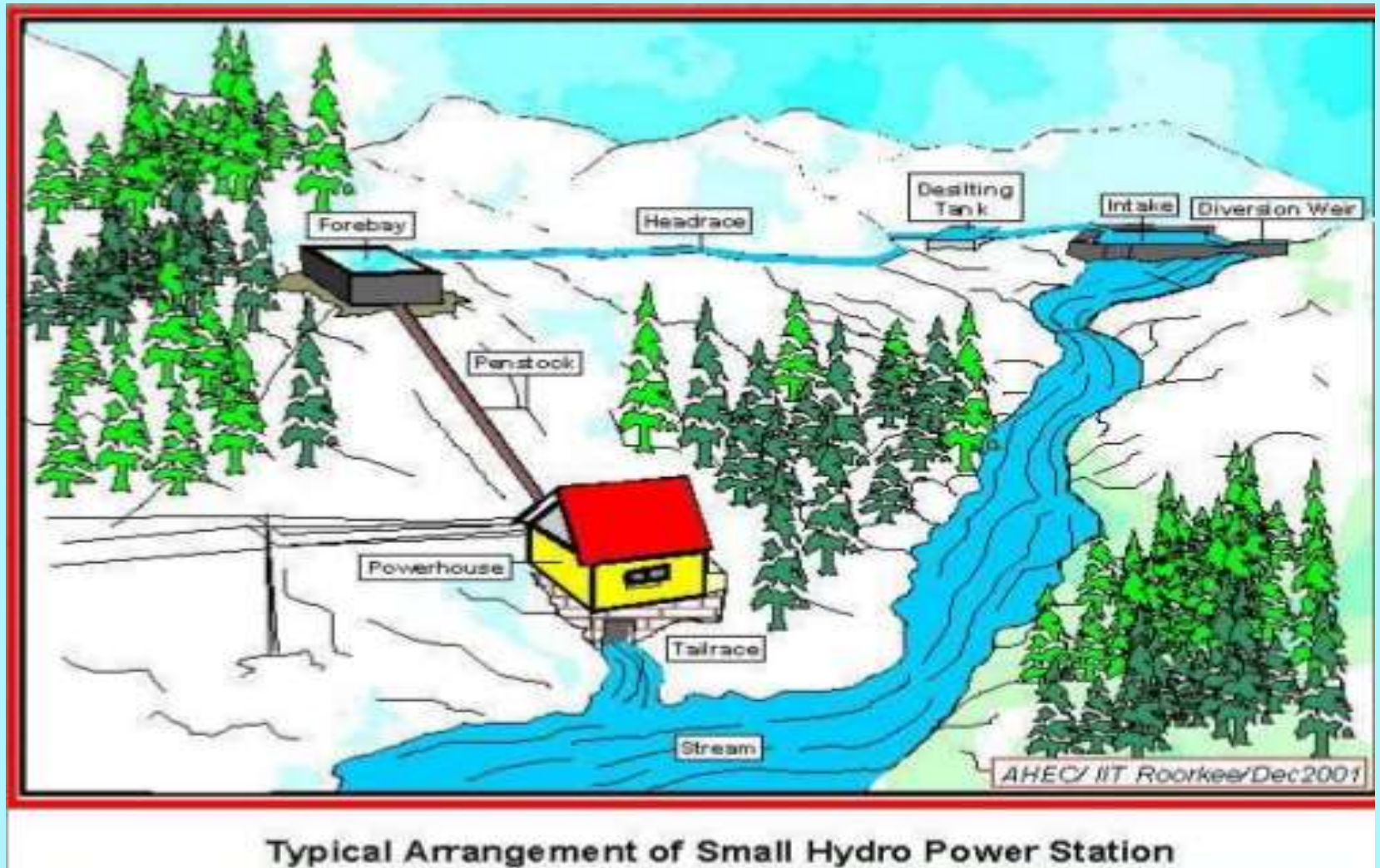


## Difference :Micro, Mini & Small Hydro Power

Hydro Category	Power Range	No. of Homes Powered
<b>Pico</b>	0 kW – 5 kW	0 – 5
<b>Micro</b>	5 kW – 100 kW	5 – 100
<b>Mini</b>	100 kW – 1 MW	100 – 1,000
<b>Small</b>	1 MW – 10 MW	1,000 – 10,000
<b>Medium</b>	10 MW – 100 MW	10,000 – 100,000
<b>Large</b>	100 MW+	100,000+

Renewables First operates in the micro hydro and mini hydro categories, so from 5 kW to 1 MW power output, because so many refer to this scale of hydro as ‘small’, all use this designation a lot.

# Small Hydro Power Plant





# Small Hydro Power



# Mini Hydro Power





# Mini Hydro Power



# Micro Hydro Power





# Pico Hydro Power



# Pico Hydro Power





# Pico Hydro Power



## **Advantages of Mini Hydro Power**

1. When compared with an equivalent coal-fired power station output, this mini hydro system saves around 950 tones of CO<sub>2</sub>, 12 tones of SOX, and 5 tones of NOX.
2. The calculated payback period of the scheme is reasonable considering the estimated life expectancy of the power plant.
3. Lower operation and maintenance costs are expected owing to fewer and less complicated electrical and mechanical equipment in the powerhouse.
4. This scheme is an easy and reliable solution to tackle federal policies like Non-Fossil Fuel Obligation (NFFO)
5. The design can be implemented with minimal visual impact on the environment and be in harmony with the unique nature of rural communities.

## Disadvantages of Mini Hydro Power

1. Sensing equipment is needed to detect any build-up of material on the screened mesh at the intake chamber, and timely cleaning of the screen is required to maintain optimum flow to the turbine. This is routine maintenance.
2. Telemetry linked to the power station is required to ensure reliable monitoring of critical hydro parameters.
3. Although operating and maintenance costs are minimal periodic checks are required. If these checks are overlooked, sudden failure of the hydro system can result.

## Environmental Issues

1. Emission of dust and materials into water could result in the short-term increase of suspended particles in the water thereby affecting the aquatic species and reducing the natural attractiveness of the river.
2. Construction equipment used at the site also releases pollutants temporarily, although the total amount is very small.
3. Small hydro impact from any development is site specific.
4. Small hydro schemes, if not carefully engineered, may also change the level of suspended solids in the water thereby affecting the erosion and siltation of the river. This might can effect natural flow patterns of the river which could impact activities downstream.
5. The use of biocides and anti fouling preparations for the cleaning of pipes can pollute the discharge water. However, good operating practices minimize the use of such chemicals.

**Thank You**