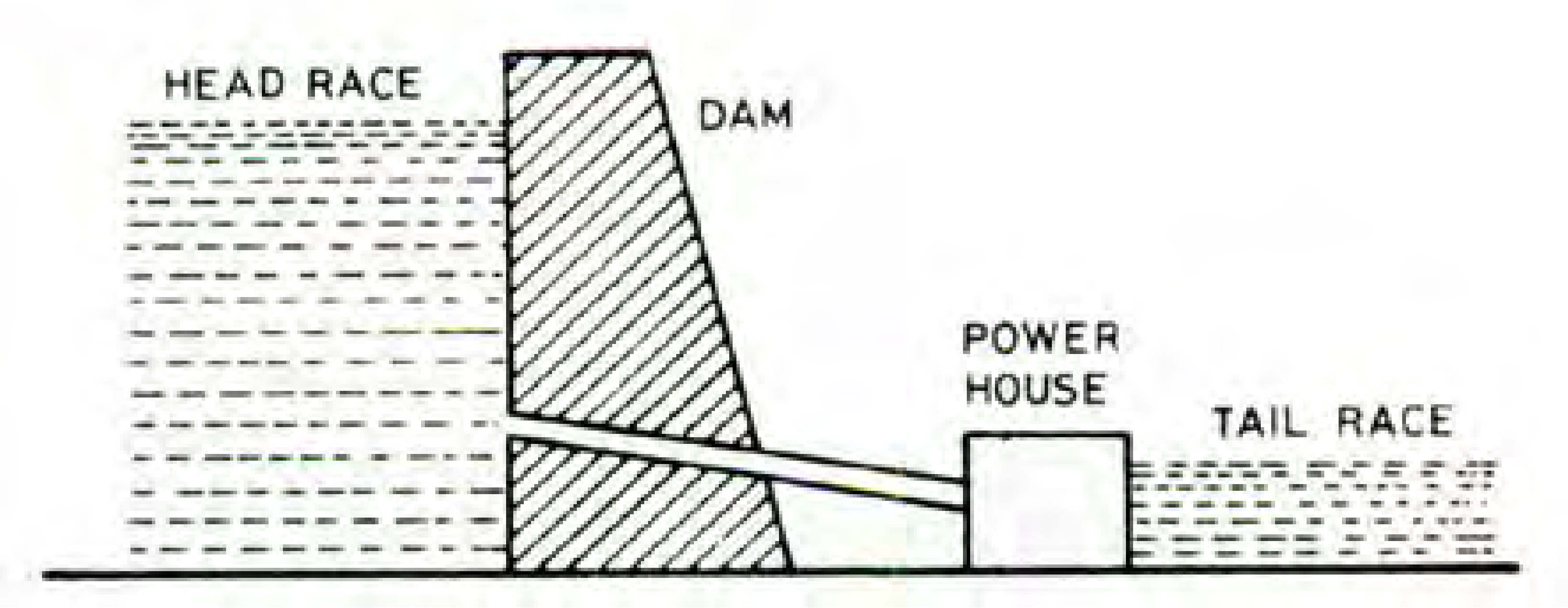
Low head plants

- In this case a small dam is built across the river to provide the necessary head.
- The excess water is allowed to flow over the dam itself.
- In such plants Francis, Propeller or Kaplan types of turbines are used.
- Also no surge tank is required.
- These plants are constructed where the water head available less then 30mtrs.
- The production of electricity will be less due to low head.

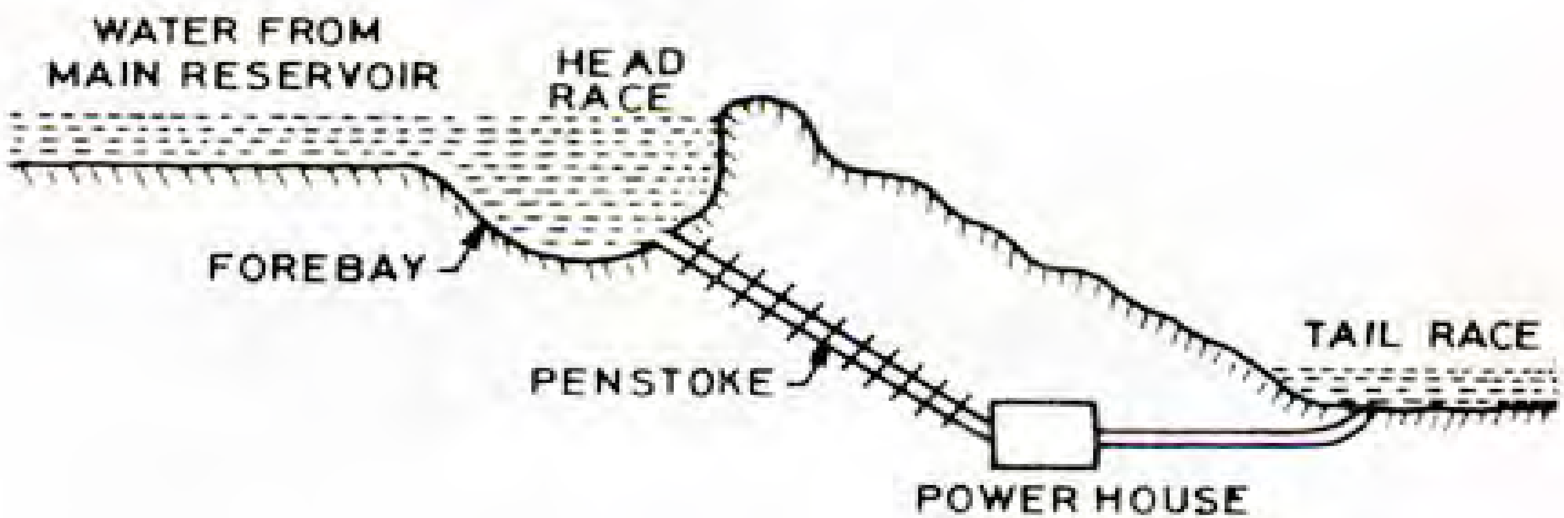
Low Head Plant



Medium head plants

- Mainly forebay provided before the Penstock, acts as water reservoir for medium head plants.
- In this plants mainly water is carried through main reservoir to forebay and then to the penstock.
- The forebay acts as surge tank for these plants.
- The turbines used will be Francis type of the steel encased variety.

Medium Head Plant



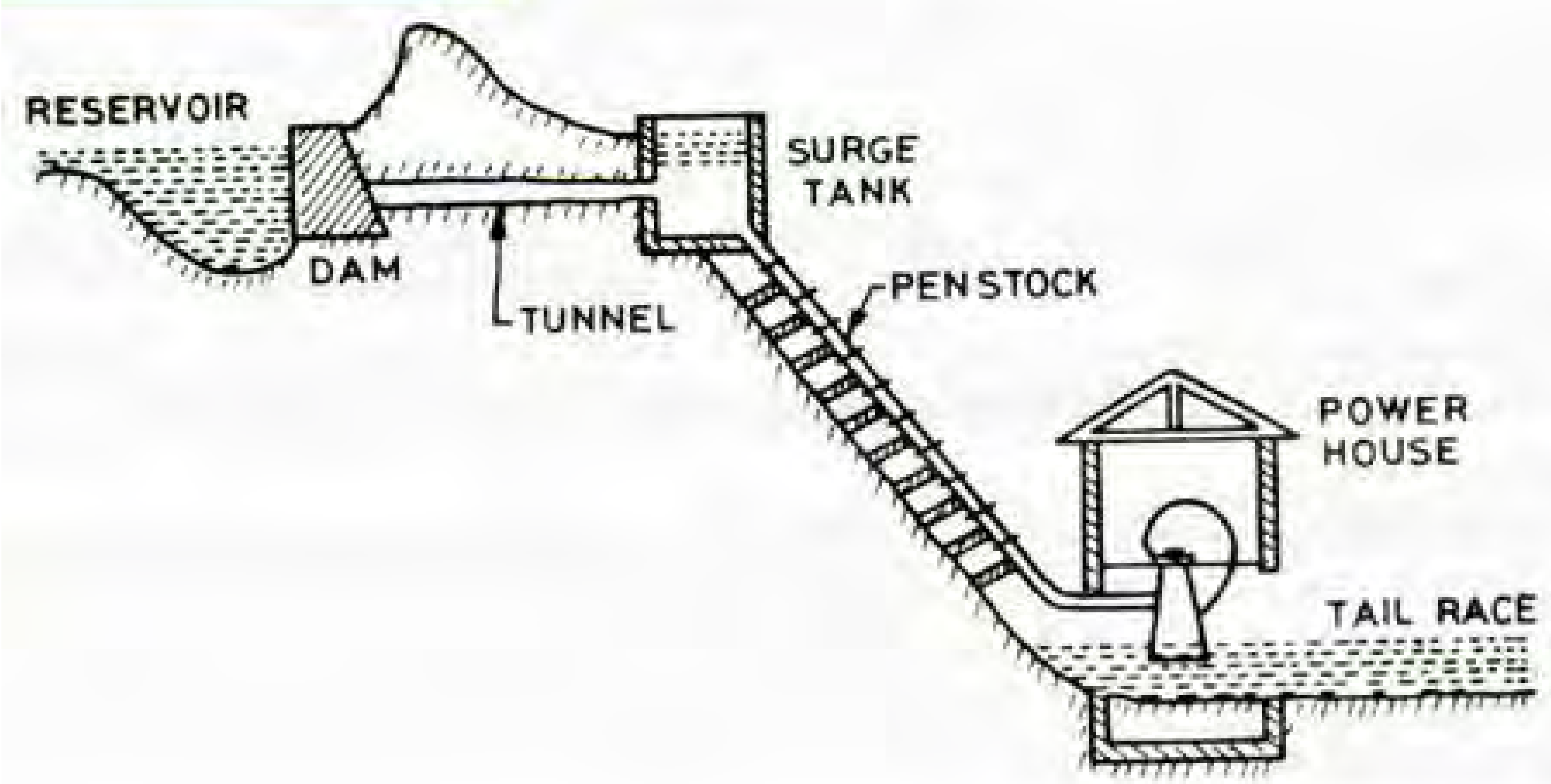
High head plants

- Mainly in these plants pressure tunnel is provided before the surge tank, which inturn connected to penstock.
- A pressure tunnel is taken off from the reservoir and water brought to the valve house at the start of the penstocks.
- The penstocks are huge steel pipes which take large quantity of water from the valve house to the power house.

- The valve house contains main sluice gates and in addition automatic isolating valves which come into operation when the penstock bursts, cutting further supply of water.
- Surge tank is an open tank and is built just in between the beginning of the penstocks and the valve house.
- In absence of surge tank, the water hammer can damage the fixed gates.

- In Majority of dams Sluice gates are provided.
- The sluice gates are opened when dam level is below level and there is shortage water for irrigation.
- Normally the high head plants are 500 meters above and for heads above 500 meters Pelton wheels are used.

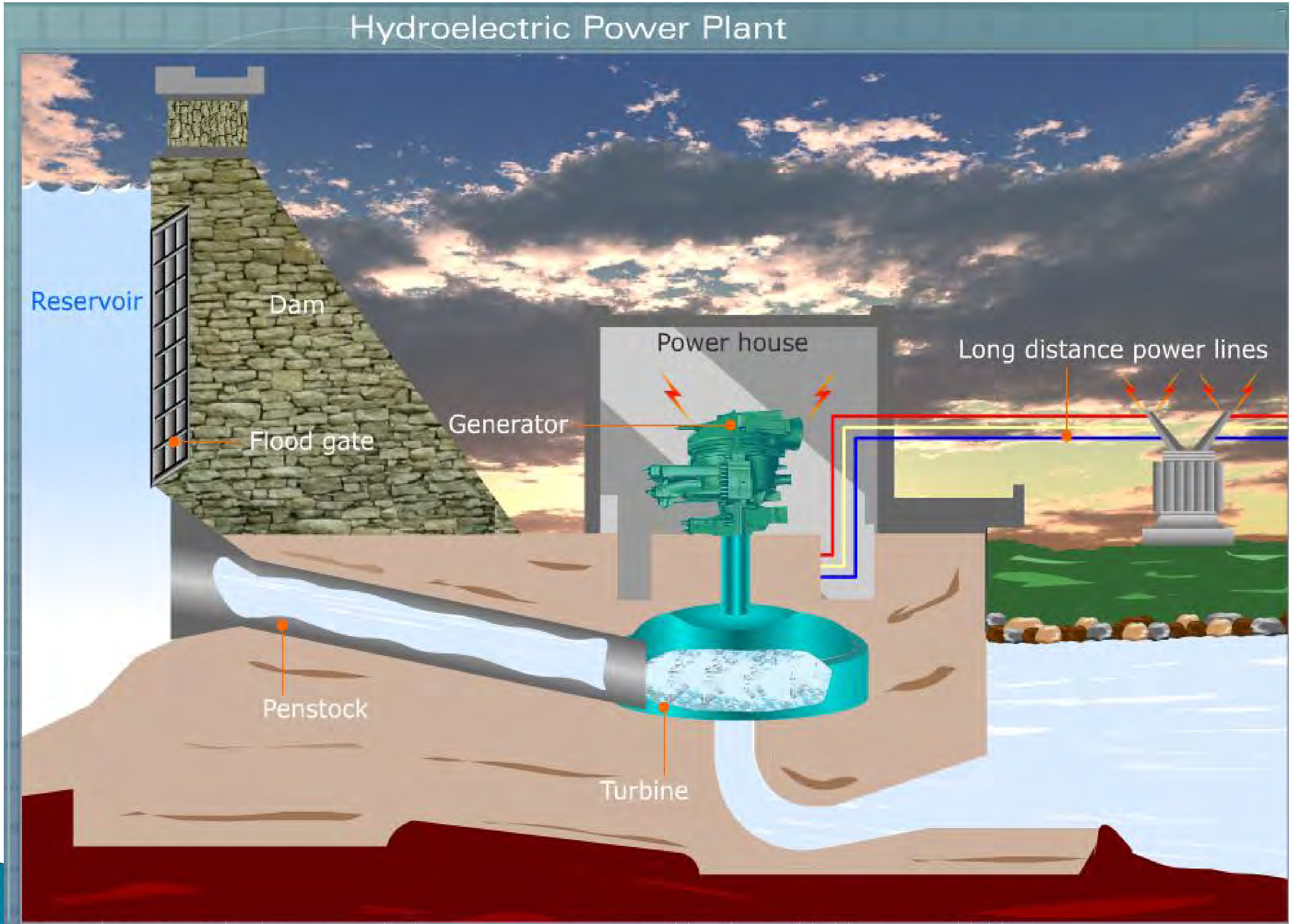
High Head Plant



Components of hydel scheme

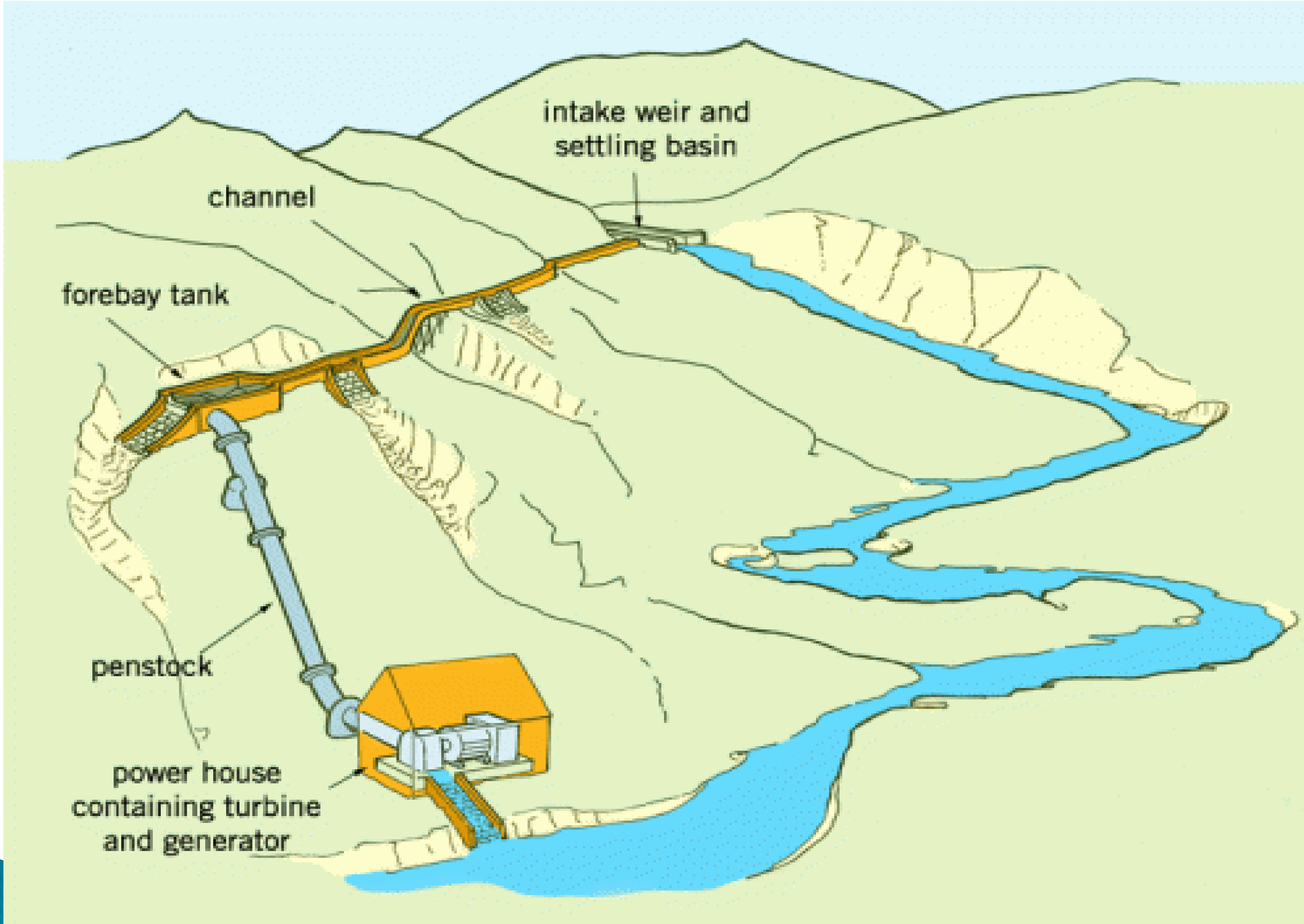
The principal components are:

1. Forebay
2. Intake structure
3. Penstocks
4. Surge tank
5. Turbines
6. Power house
7. Draft tube
8. Tail race


Hydroelectric Power Plant
Reservoir
Dam
Flood gate
Power house
Generator
Long distance power lines
Penstock
Turbine

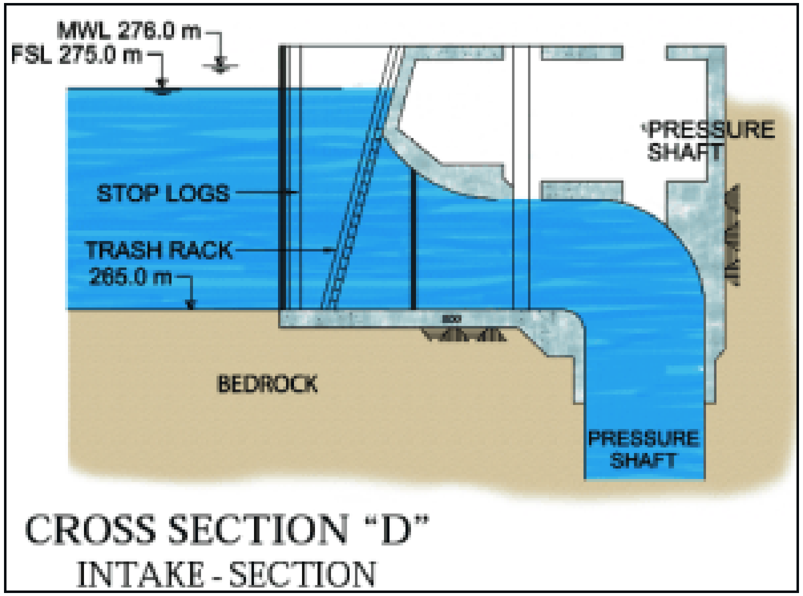
Forebay

- Enlarged body of water provided in front of penstock.
- Provided in case of run off river plants and storage plants.
- Main function to store water which is rejected by plant.
- Power house located closed to dam penstock directly take water from reservoir, reservoir act as forebay.


intake weir and
settling basin
channel
forebay tank
penstock
power house
containing turbine
and generator

Intake structure

- Water conveyed from forebay to penstocks through intake structures.
- Main components are trash rack and gate.
- Trash rack prevent entry of debris.



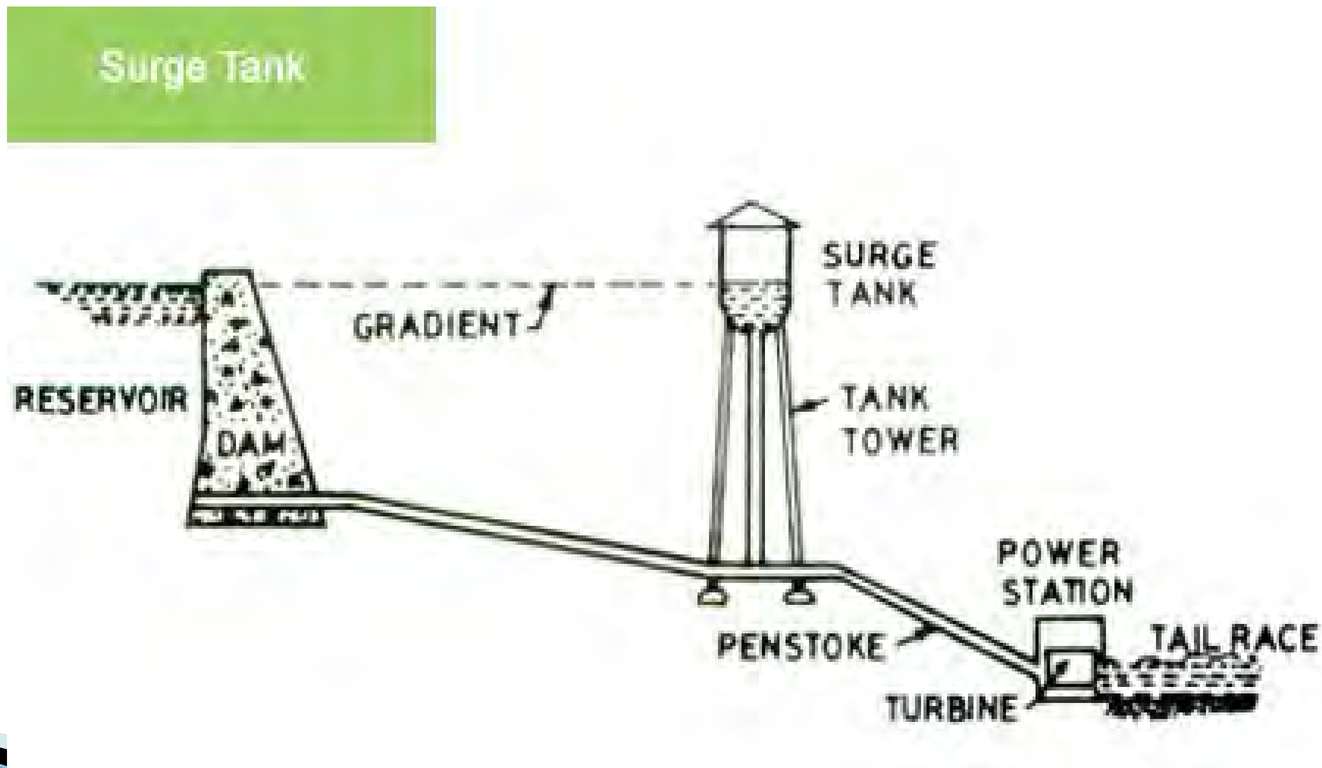
Penstocks

- open or closed conduits which carry water to the turbines.
- made of reinforced concrete or steel. Concrete penstocks are suitable for low heads less then 30mtrs.
- steel penstocks are designed for any head.
- thickness of penstocks increases with head or water pressure
- penstocks gates are fixed to initial of penstocks, and flow of water is controlled by operating penstock gates.
- Either buried in ground or kept exposed.

Surge tank

- additional storage for near to turbine, usually provided in high head plants.
- located near the beginning of the penstock.
- As the load on the turbine decreases or during load rejection by the turbine the surge tank provides space for holding water.

- surge tank over comes the abnormal pressure in the conduit when load on the turbine falls and acts as a reservoir during increase of load on the turbine.



Turbines

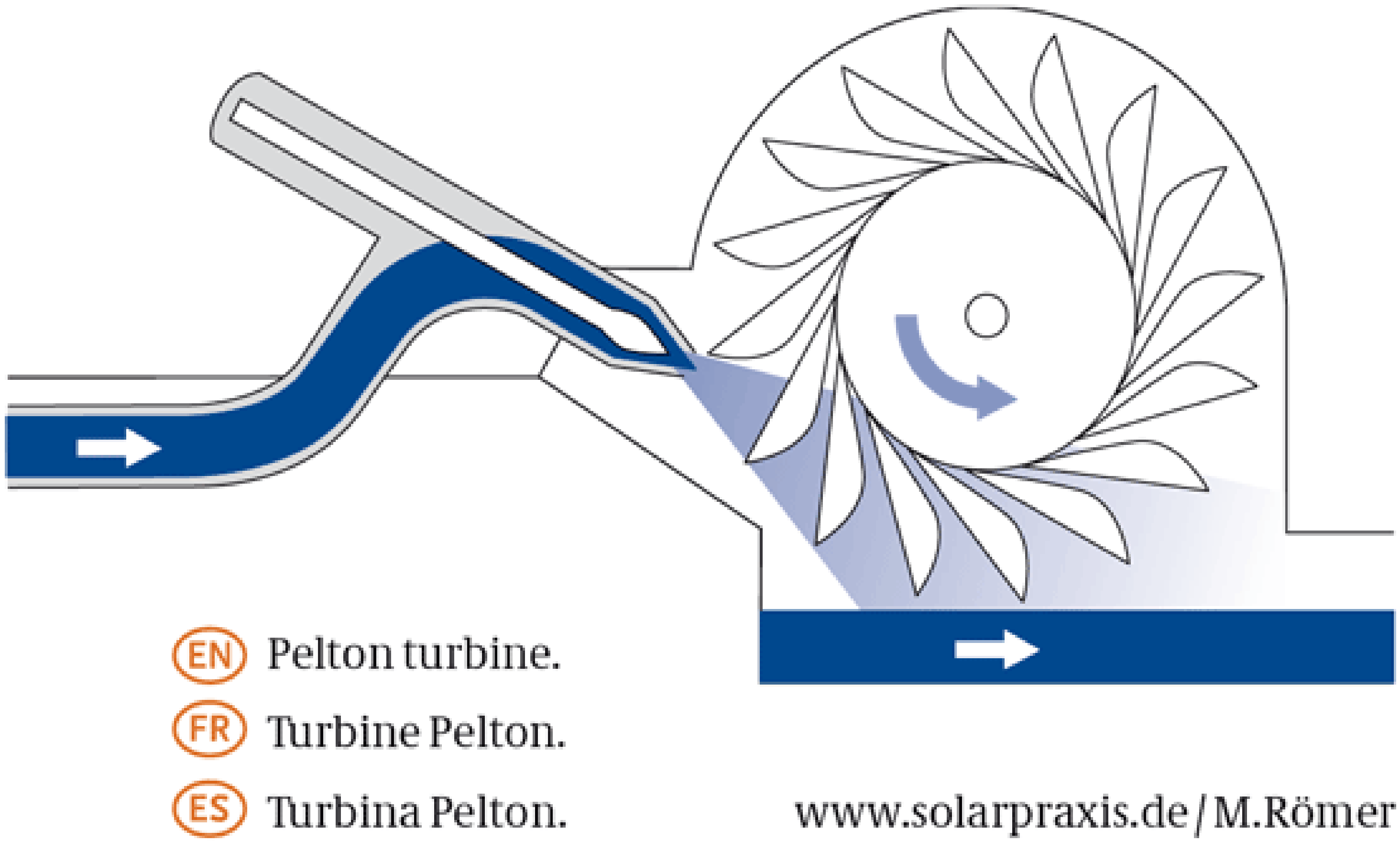
- turbines are used to convert the energy water of falling water into mechanical energy.
- water turbine is a rotary engine that takes energy from moving water.
- flowing water is directed on to the blades of a turbine runner, creating a force on the blades.
- Since the runner is spinning, the force acts through a distance n this way, energy is transferred from the water flow to the turbine.
- The principal types of turbines are:

1) Impulse turbine
2) Reaction Turbine

Impulse turbines: mainly used in high head plants.

- the entire pressure of water is converted into kinetic energy in a nozzle and the velocity of the jet drives the blades of turbine.
- The nozzle consist of a needle, and quantity of water jet falling on the turbine is controlled this needle placed in the tip of the nozzle.
- If the load on the turbine decreases, the governor pushes the needle into the nozzle, thereby reducing the quantity of water striking the turbine.

- Examples of Impulse turbines are:
- Pelton Wheel.
- Turgo
- Michell-Banki (also known as the Cross flow or Ossberger turbine.


EN Pelton turbine.
FR Turbine Pelton.
ES Turbina Pelton.
www.solarpraxis.de / M.Römer

Reaction turbines : are mainly for low and medium head plants.

- In reaction turbine the water enters the runner partly with pressure energy and partly with velocity head.
- 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.

- In this turbine the runner blades changed with respect to guide vane opening.
- As the sudden decrease of load takes place, the guide vane limit decreases according to that runner blade closes.

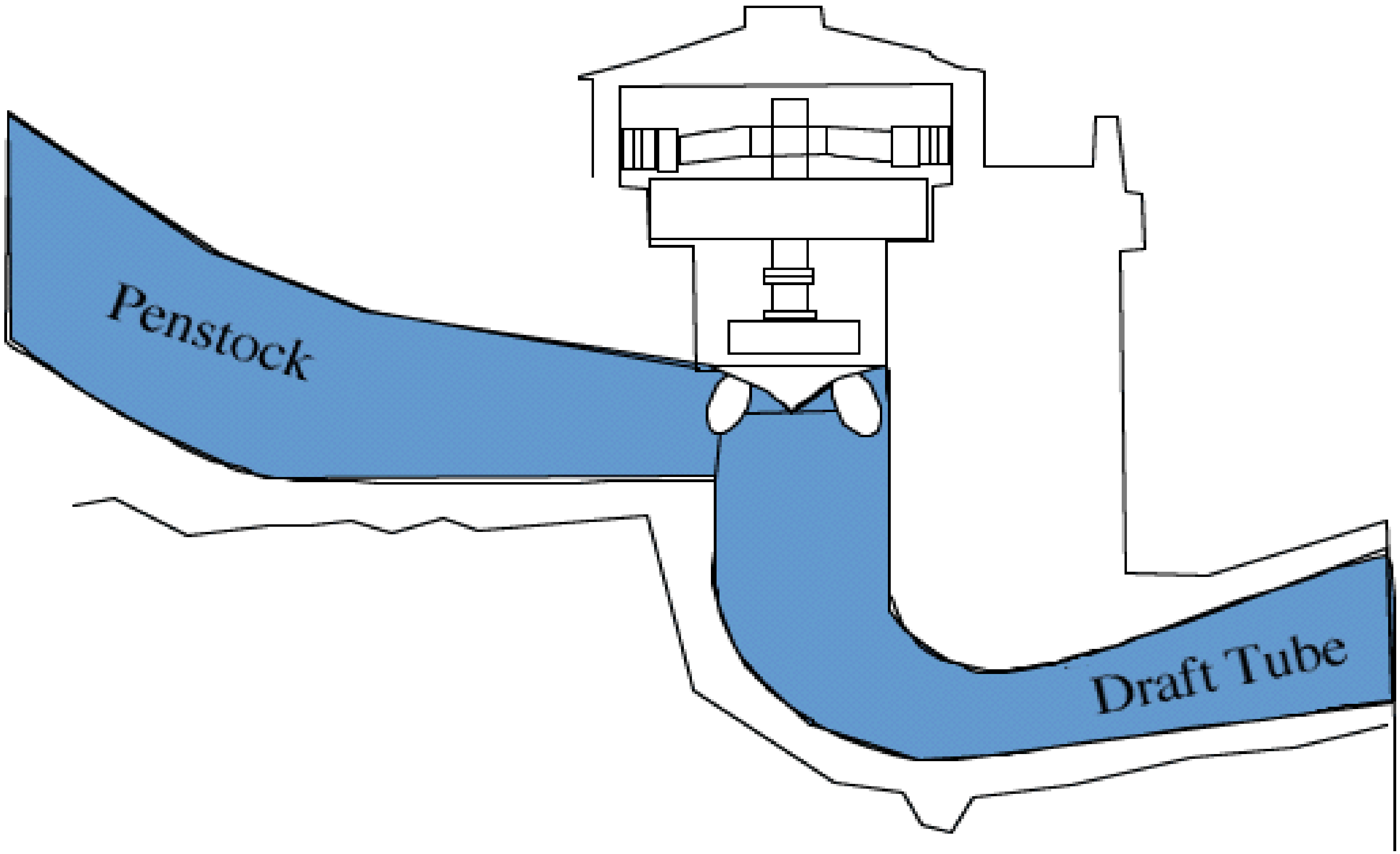
- Examples of reaction turbines are:
  - Francis turbine
  - Kaplan turbine

Francis

Kaplan

Draft tube

- Draft tube is a pipe or passage of gradually increasing cross sectional area, which connect to the exit to tail race.
- it reduces high velocity of water discharged by the turbine.
- draft tube permits turbines to be installed at a higher level than the tail race level, which help the maintaince and repair of turbines.

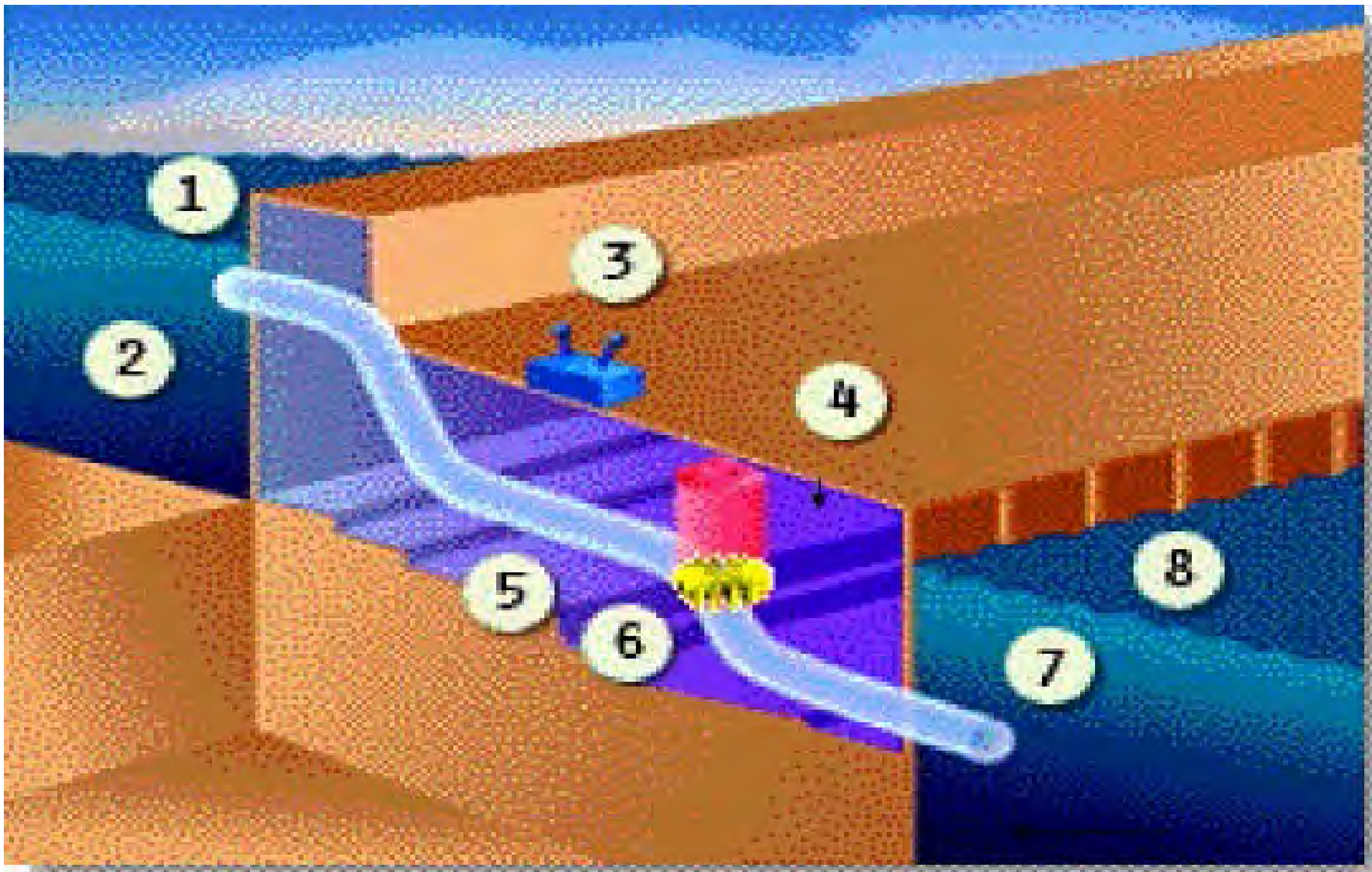

Penstock
Draft Tube

Power house

- Power house contains the electro mechanical equipment i.e. hydro power turbine, Generator, excitation system, main inlet valves, transformers, Switchyard, DC systems, governor, bus duct, step up transformers, step down transformers, high voltages switch gears, control metering for protection of systems.

Tail race

- tail race tunnel or channel are provided to direct the used water coming out of draft tube back to the river.
- important criteria of designing the tail race is kind of draft tube, the gross head and geographical situation of the area.
- Tail race is designed in such a way that water hammer is minimizes when water leaves the draft tube.


1
2
3
4
5
6
7
8

Power generation

The amount of electricity that can be generated by a hydropower plant depends on two factors:

- **flow rate** – the quantity of water flowing in a given time; and
- **head** – the height from which the water falls.

The greater the flow and head, the more electricity produced.

Flow Rate = the quantity of water flowing
Head = the height from which water falls

A standard equation for calculating energy production:

$$\text{Power} = \frac{(\text{Head}) \times (\text{Flow}) \times (\text{Efficiency})}{11.8}$$

Power = the electric power in kilowatts or kW

Head = the distance the water falls (measured in feet)

Flow = the amount of water flowing (measured in cubic feet per second or **cfs**)

Efficiency = How well the turbine and generator convert the power of falling water into electric power. This can range from 60% (0.60) for older, poorly maintained hydroplants to 90% (0.90) for newer, well maintained plants.

11.8 = Index that converts units of feet and seconds into kilowatts

As an example, let's see how much power can be generated by the power plant.

The dam is 357 feet high, the **head** (distance the water falls) is 235 feet. The typical **flow rate** is 2200 cfs. Let's say the turbine and generator are 80% efficient.

$$\text{Power} = \frac{(\text{Head}) \times (\text{Flow}) \times (\text{Efficiency})}{11.8}$$

$$\text{Power} = \frac{235\text{ft.} \times 2200 \text{ cfs} \times .80}{11.8}$$

$$\text{Power} = \frac{517{,}000 \times .80}{11.8}$$

$$\text{Power} = \frac{413{,}600}{11.8}$$

Power = 35,051 kilowatts (kW)

The power developed at the shaft of the prime mover is given by

$$HP = \left(\frac{mh}{75}\right).\eta_h = (\rho Q h).\eta_h$$

Where

m = the mass flow rate of water through the prime mover in Kg/sec

h = height of fall in metres

η_h = the hydraulic efficiency of prime mover

ρ = the density of water in Kg/m^3

Q = the volume of flow rate through the prime mover in m^3/sec

The power available at the terminal of the generator in kW can be assessed by the following expression:

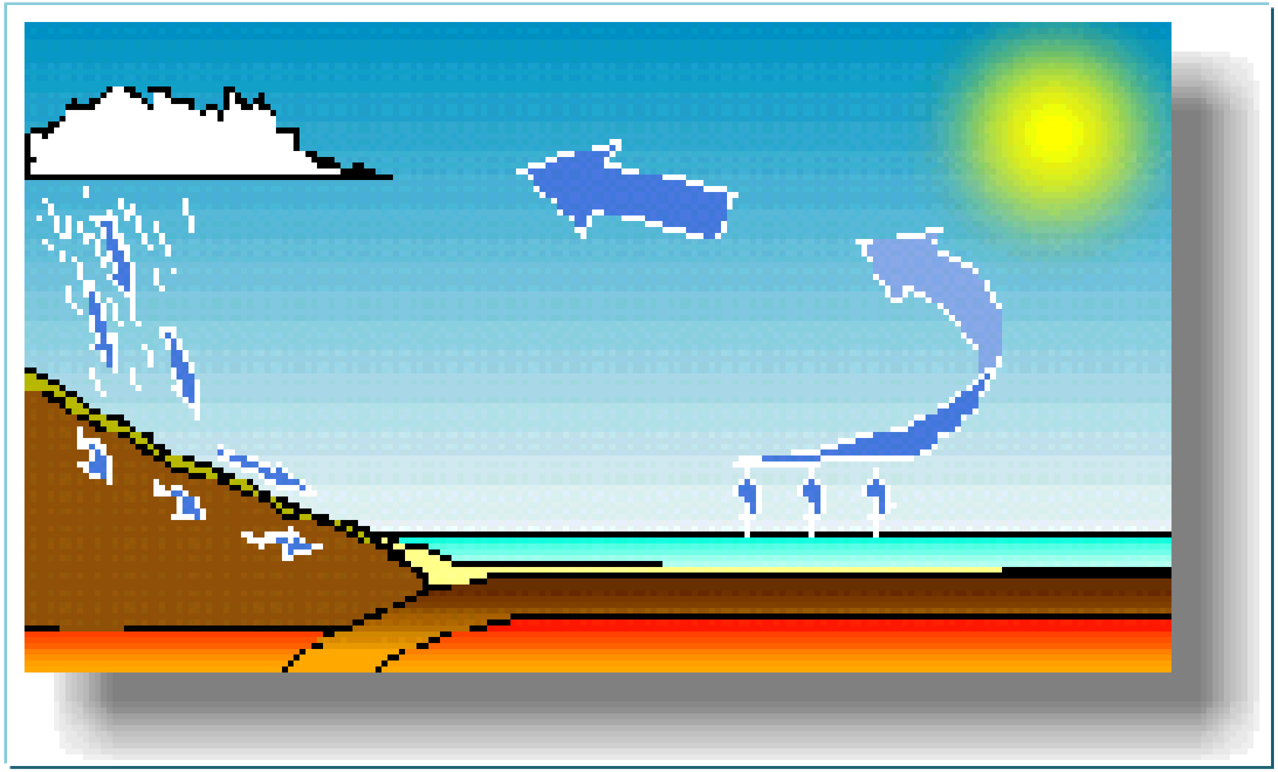
$$\textbf{kW (power)} = (\rho Q h / 75) \cdot \eta_h \, \eta_m \, \eta_g \cdot 0.736$$

Where

η_m = the mechanical efficiency

η_g = the generator efficiency

0.736 = the conversion factor from HP to kW.



The Sun evaporates water from the sea and lakes, which forms clouds and falls as rain in the mountains, keeping the dam supplied with water. It is drive and rotate to shaft of the turbine and produce electricity.

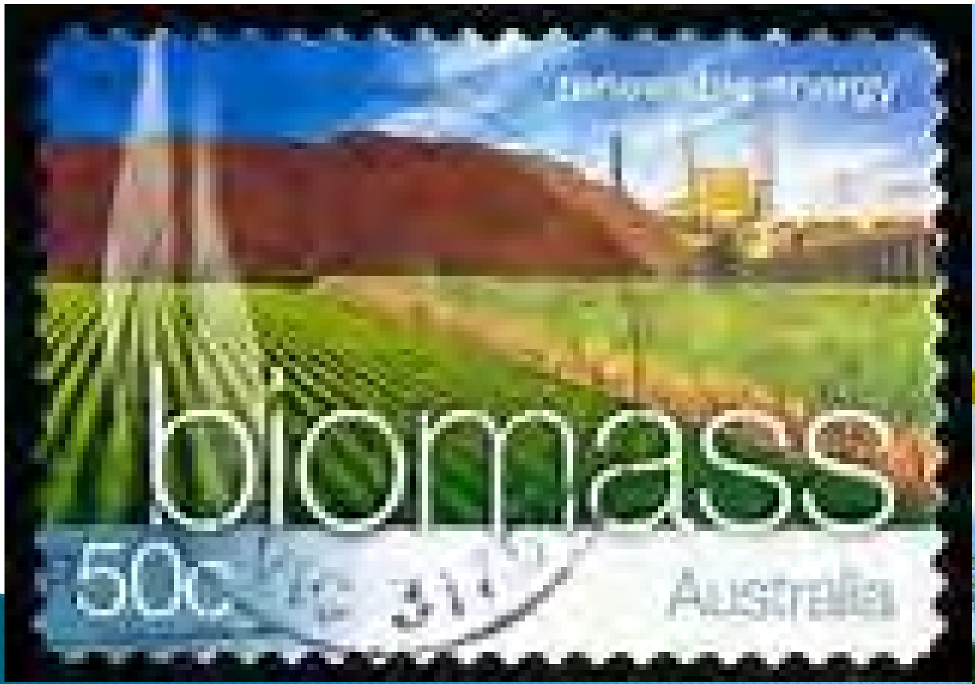
Advantages

- Once the dam is built, the energy is virtually free.
- No waste or pollution produced.
- Much more reliable than wind, solar or wave power.
- Water can be stored above the dam ready to cope with peaks in demand.
- Hydro-electric power stations can increase to full power very quickly, unlike other power stations.
- Electricity can be generated constantly.

Disadvantages

- The dams are very expensive to build. However, many dams are also used for flood control or irrigation, so building costs can be shared.
- Building a large dam will flood a very large area upstream, causing problems for human and animals that used to live there.
- Finding a suitable site can be difficult - the impact on residents and the environment may be unacceptable.
- Water quality and quantity downstream can be affected, which can have an impact on plant life.

BIOMASS ENERGY



INDEX

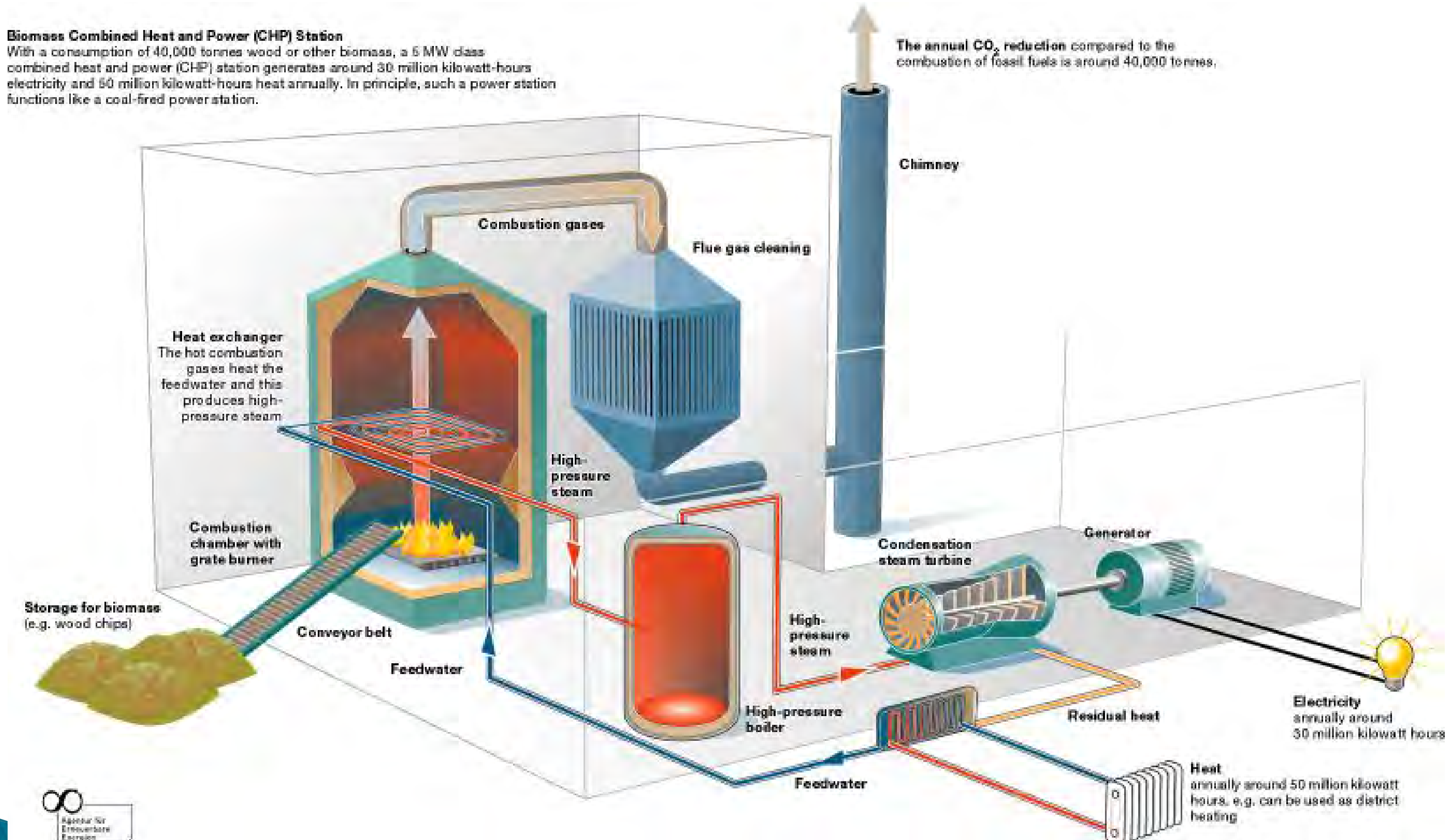
- Definition of biomass energy
- Plant operation.
- Advantages and disadvantages.
- Biomass plants in Galicia and Spain.
- Biomass plants in Europe and in the world.
- World´s largest biomass power plant.
- Other biomass power plants
- Accidents in these plants.
- Conclusions

Biomass and Biodiesel

- Biogas
- Biodiesel
- Current Status of Utilization of Biomass and Bio Diesel production in Myanmar
- Biomass and Bio-diesel Potential in Myanmar
- Biomass and Bio-diesel Energy Applications in Myanmar
- Biomass and Bio-diesel Energy Research in Myanmar

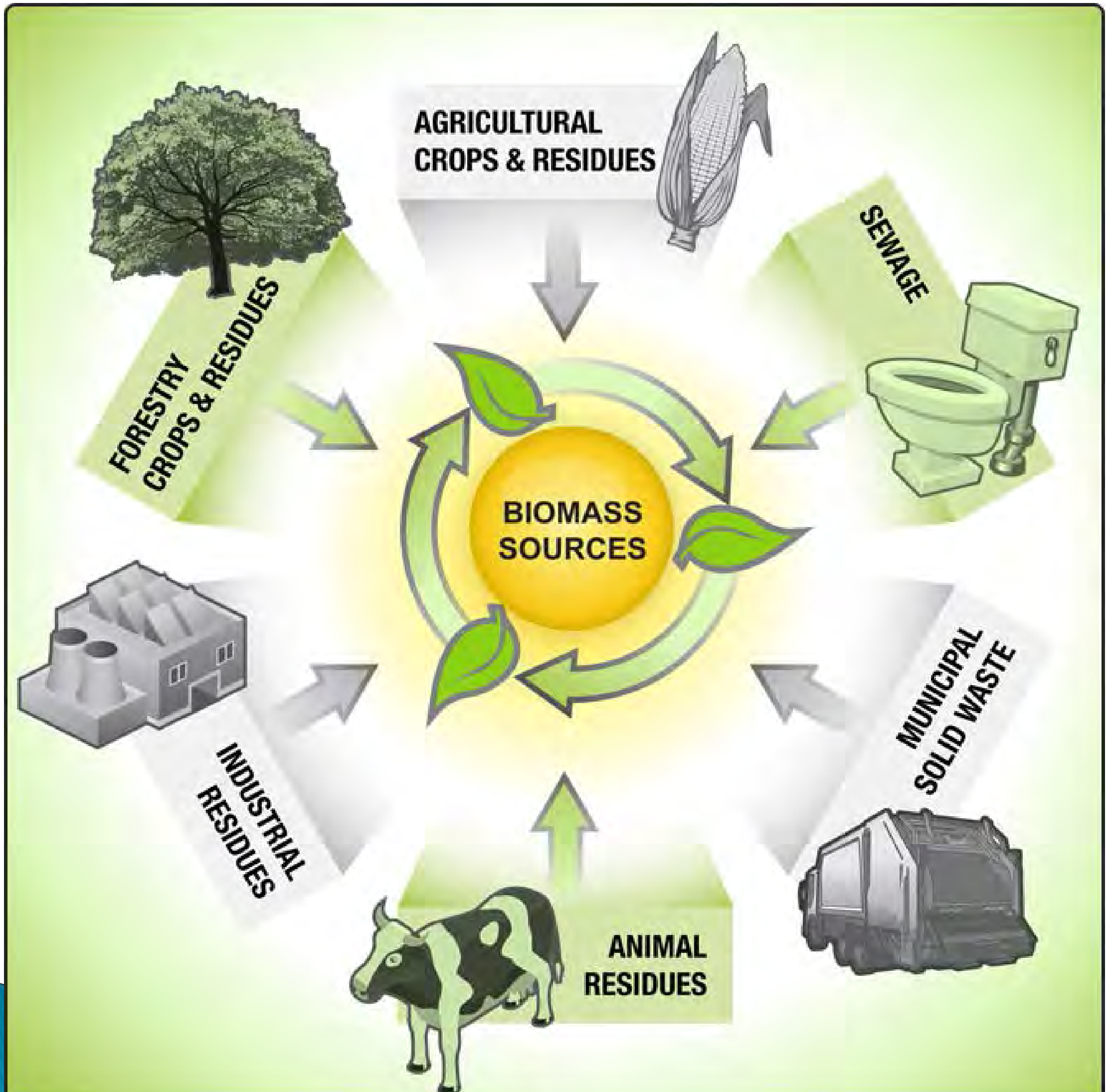
PLANT OPERATION

- Biomass is organic compounds produced in natural processes.
- These compounds are transported to the biomass plant and burned to heat water.
- Steam is produced at high pressure and it moves a turbine and this moves the generator to produce electricity.


Biomass Combined Heat and Power (CHP) Station
With a consumption of 40,000 tonnes wood or other biomass, a 5 MW class combined heat and power (CHP) station generates around 30 million kilowatt-hours electricity and 50 million kilowatt-hours heat annually. In principle, such a power station functions like a coal-fired power station.
The annual CO_2 reduction compared to the combustion of fossil fuels is around 40,000 tonnes.
Chimney
Combustion gases
Flue gas cleaning
Heat exchanger
The hot combustion gases heat the feedwater and this produces high-pressure steam
High-pressure steam
Combustion chamber with grate burner
Storage for biomass
(e.g. wood chips)
Conveyor belt
Feedwater
High-pressure steam
High-pressure boiler
Condensation steam turbine
Generator
Residual heat
Electricity
annually around 30 million kilowatt hours
Heat
annually around 50 million kilowatt hours, e.g. can be used as district heating
Feedwater

ADVANTAGES

- It's a renewable source of energy.
- It's a comparatively lesser pollution generating energy.
- Biomass energy helps in cleanliness in villages and cities.
- There is tremendous potential to generate biogas energy.
- Biomass energy is relatively cheaper and reliable.
- It can be generated from every day human and animal wastes, vegetable and agriculture left-over etc.
- Growing biomass crops use up carbon dioxide and produces oxygen.


AGRICULTURAL CROPS & RESIDUES
SEWAGE
FORESTRY CROPS & RESIDUES
BIOMASS SOURCES
INDUSTRIAL RESIDUES
MUNICIPAL SOLID WASTE
ANIMAL RESIDUES


Wood
Crops
Garbage
Landfill Gas
Alcohol Fuels

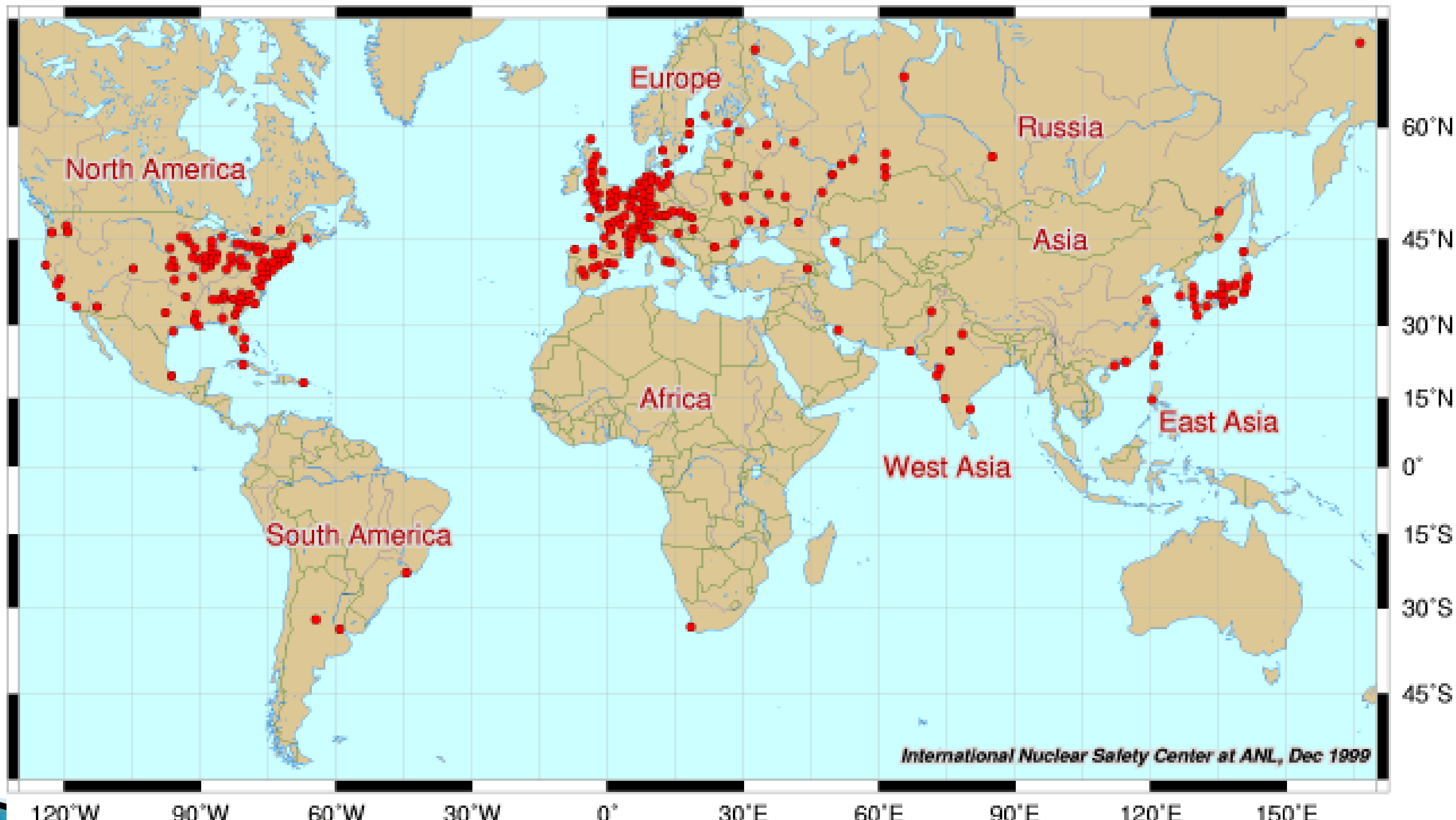
DISADVANTAGES

- Cost of construction of biogas plant is high, so only rich people can use it.
- Some people don't like to cook food on biogas produced from sewage waste.
- Biogas plant requires space and produces dirty smell.
- It is difficult to store biogas in cylinders.
- Transportation of biogas through pipe over long distances is difficult.
- Crops which are used to produce biomass energy are seasonal and are not available over whole year.

BIOMASS PLANTS IN SPAIN

BIOMASS PLANTS IN EUROPE

BIOMASS PLANTS IN THE WORLD



WORLD´S LARGEST BIOMASS POWER PLANT

The world´s largest biomass power plant is located in Poland.

OTHER BIOMASS POWER PLANTS

It´s located in United Kingdom

Drax, U.K.´s largest biomass power station.

It´s located in Finland.

It´s located in The Netherlands.

It´s located in Sweden.

It´s located in Italy.

ACCIDENTS IN THESE PLANTS

- A fire threatened the world's largest biomass power station today as the fuel caught fire.

Fire rages at RWE's UK biomass power plant

CONCLUSIONS

- Biomass plants seem a good choice because they help clean up the waste that we produce and are relatively cheap and safe, but their construction is very expensive, so only rich people can use them. They are also power generators that pollute comparatively less, but require much space and produce odor.

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- http://ars.els-cdn.com/content/image/1-s2.0-S0045653502008056-gr1.gif

Wave and Tide Energy

- Introduction to wave and tide energy
- Ocean energy potential in Myanmar
- Current situation of ocean energy in Myanmar

Ocean Energy

- The ocean can produce two types of energy: *thermal energy* from the sun's heat, and *mechanical energy* from the tides and waves.

- Oceans cover more than 70% of Earth's surface, making them the world's largest solar collectors. The sun's heat warms the surface water a lot more than the deep ocean water, and this temperature difference creates thermal energy.

- Just a small portion of the heat trapped in the ocean could power the world.

- Ocean thermal energy is used for many applications, including electricity generation.

- There are three types of electricity conversion systems: *closed-cycle, open-cycle,* and *hybrid.* Closed-cycle systems use the ocean's warm surface water to vaporize a *working fluid*, which has a low-boiling point, such as ammonia.

- The vapour expands and turns a turbine. The turbine then activates a generator to produce electricity. Open-cycle systems actually boil the seawater by operating at low pressures.

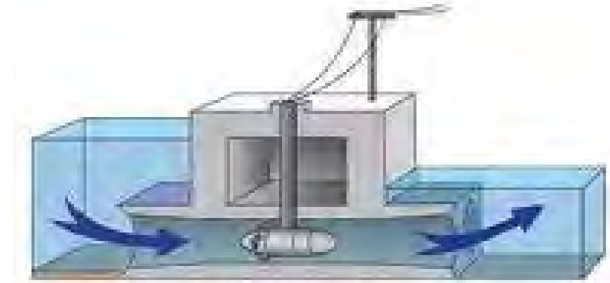
- This produces steam that passes through a turbine/generator. And hybrid systems combine both closed-cycle and open-cycle systems.

Workers install equipment for an ocean thermal energy conversion experiment in 1994 at Hawaii's Natural Energy Laboratory. Credit: A. Resnick, Makai Ocean Engineering, Inc.

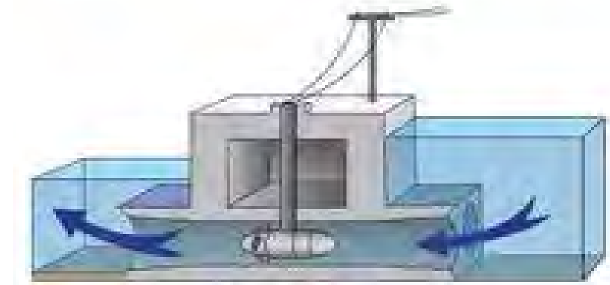
- Ocean mechanical energy is quite different from ocean thermal energy. Even though the sun affects all ocean activity, tides are driven primarily by the gravitational pull of the moon, and waves are driven primarily by the winds.

- As a result, tides and waves are intermittent sources of energy, while ocean thermal energy is fairly constant. Also, unlike thermal energy, the electricity conversion of both tidal and wave energy usually involves mechanical devices.

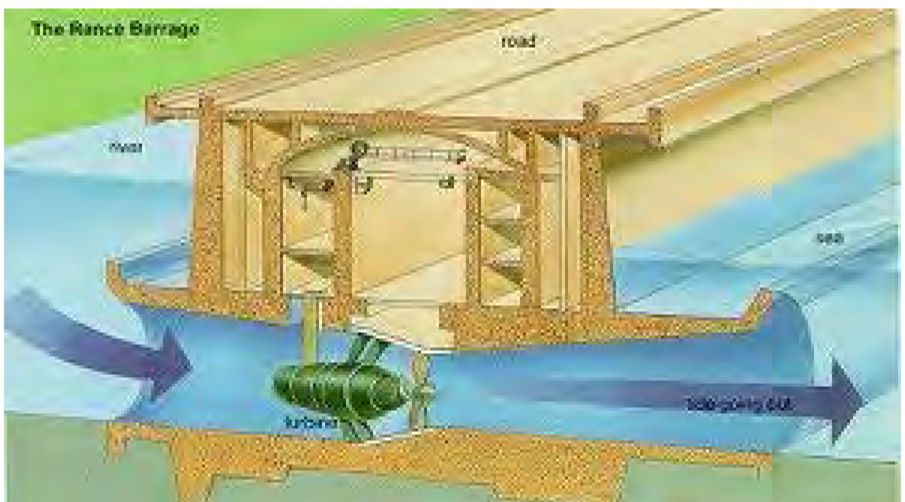
- A *barrage* (dam) is typically used to convert tidal energy into electricity by forcing the water through turbines, activating a generator.
- For wave energy conversion, there are three basic systems: *channel systems* that funnel the waves into reservoirs; *float systems* that drive hydraulic pumps; and *oscillating water column systems* that use the waves to compress air within a container.
- The mechanical power created from these systems either directly activates a generator or transfers to a working fluid, water, or air, which then drives a turbine/generator.

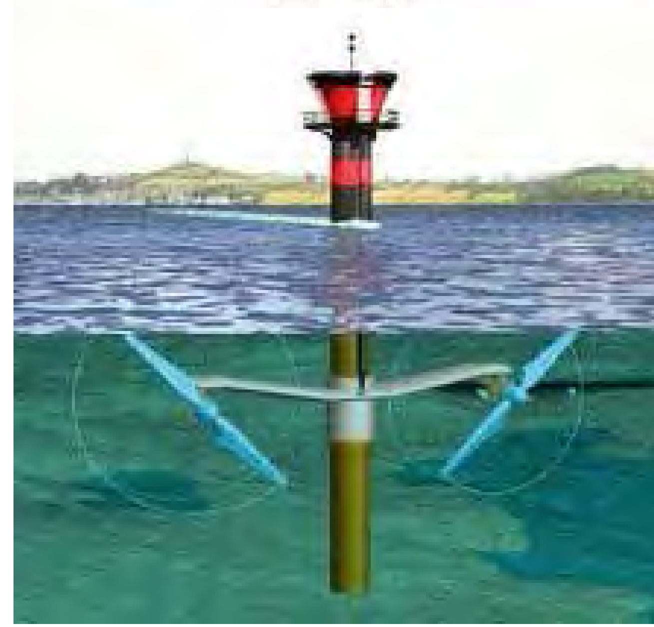


Tide Coming In



Tide Going Out





Wave Power

- **Wave power** is the transport of energy by ocean surface waves, and the capture of that energy to do useful work – for example, electricity generation, water desalination, or the pumping of water (into reservoirs). Machinery able to exploit wave power is generally known as a **wave energy converter** (WEC).

- Waves are generated by wind passing over the surface of the sea.

- As long as the waves propagate slower than the wind speed just above the waves, there is an energy transfer from the wind to the waves.

- Both air pressure differences between the upwind and the lee side of a wave crest, as well as friction on the water surface by the wind, making the water to go into the shear stress causes the growth of the waves.[4]

- Wave height is determined by wind speed, the duration of time the wind has been blowing, fetch (the distance over which the wind excites the waves) and by the depth and topography of the seafloor (which can focus or disperse the energy of the waves).

- A given wind speed has a matching practical limit over which time or distance will not produce larger waves. When this limit has been reached the sea is said to be "fully developed".

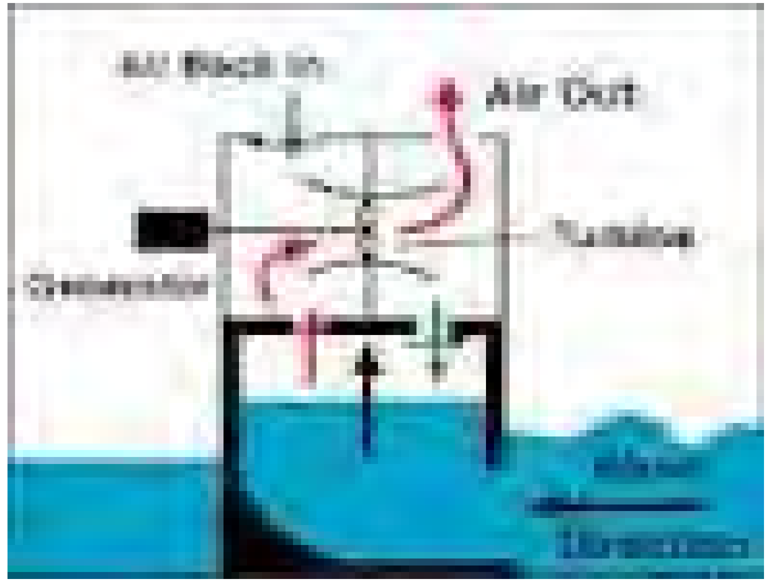
Wave power formula

- In deep water where the water depth is larger than half the wavelength, the wave energy flux is

$$P = \frac{\rho g^2}{64\pi} H_{m0}^2 T \approx \left(0.5 \frac{\mathrm{kW}}{\mathrm{m}^3 \cdot \mathrm{s}}\right) H_{m0}^2 \; T,$$

- with P the wave energy flux per unit of wave-crest length, H_{m0} the significant wave height, T the wave period, ρ the water density and g the acceleration by gravity.

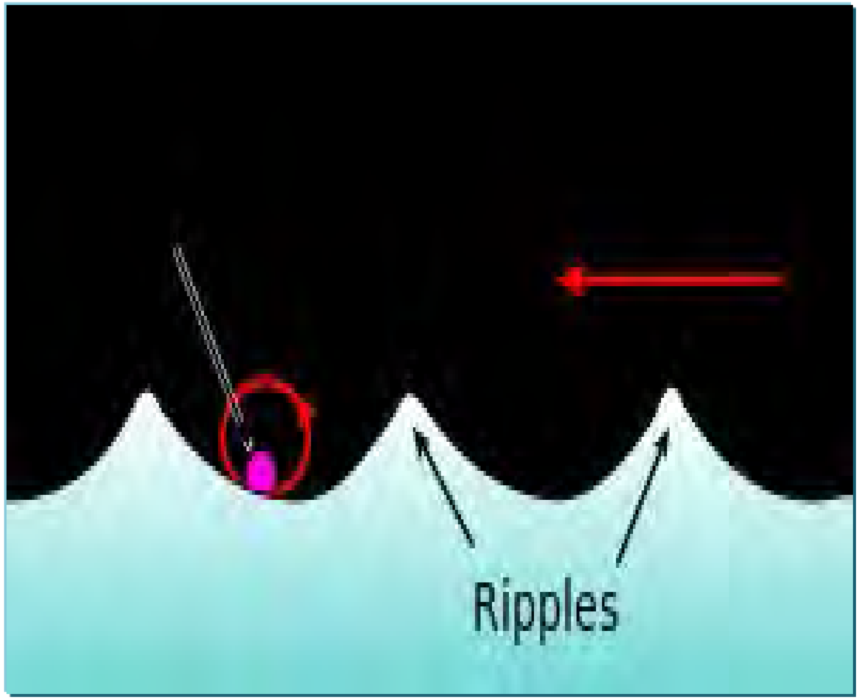
- The above formula states that wave power is proportional to the wave period and to the square of the wave height. When the significant wave height is given in meters, and the wave period in seconds, the result is the wave power in kilowatts (kW) per meter of wavefront length.

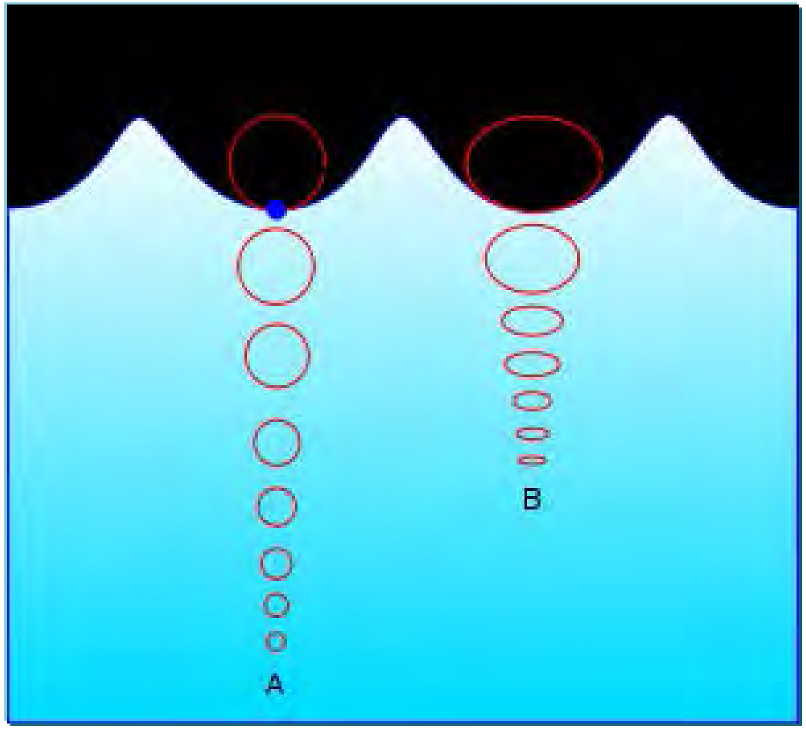


Example: Consider moderate ocean swells, in deep water, a few kilometers off a coastline, with a wave height of 3 meters and a wave period of 8 seconds. Using the formula to solve for power, we get

$$P \approx 0.5 \frac{\mathrm{kW}}{\mathrm{m}^3 \cdot \mathrm{s}} (3 \cdot \mathrm{m})^2 (8 \cdot \mathrm{s}) \approx 36 \frac{\mathrm{kW}}{\mathrm{m}},$$

meaning there are 36 kilowatts of power potential per meter of wave crest.





Motion of a particle in an ocean wave.
A = At deep water. The orbital motion of fluid particles decreases rapidly with increasing depth below the surface.
B = At shallow water (ocean floor is now at B). The elliptical movement of a fluid particle flattens with decreasing depth.
1 = Propagation direction.
2 = Wave crest.
3 = Wave trough.

Tidal Energy

Tidal power, also called **tidal energy**, is a form of hydropower that converts the energy of tides into useful forms of power - mainly electricity.

Tides are the waves caused due to the gravitational pull of the moon and also sun(though its pull is very low).

During high tide, the water flows into the dam and during low tide, water flows out which result in turning the turbine.

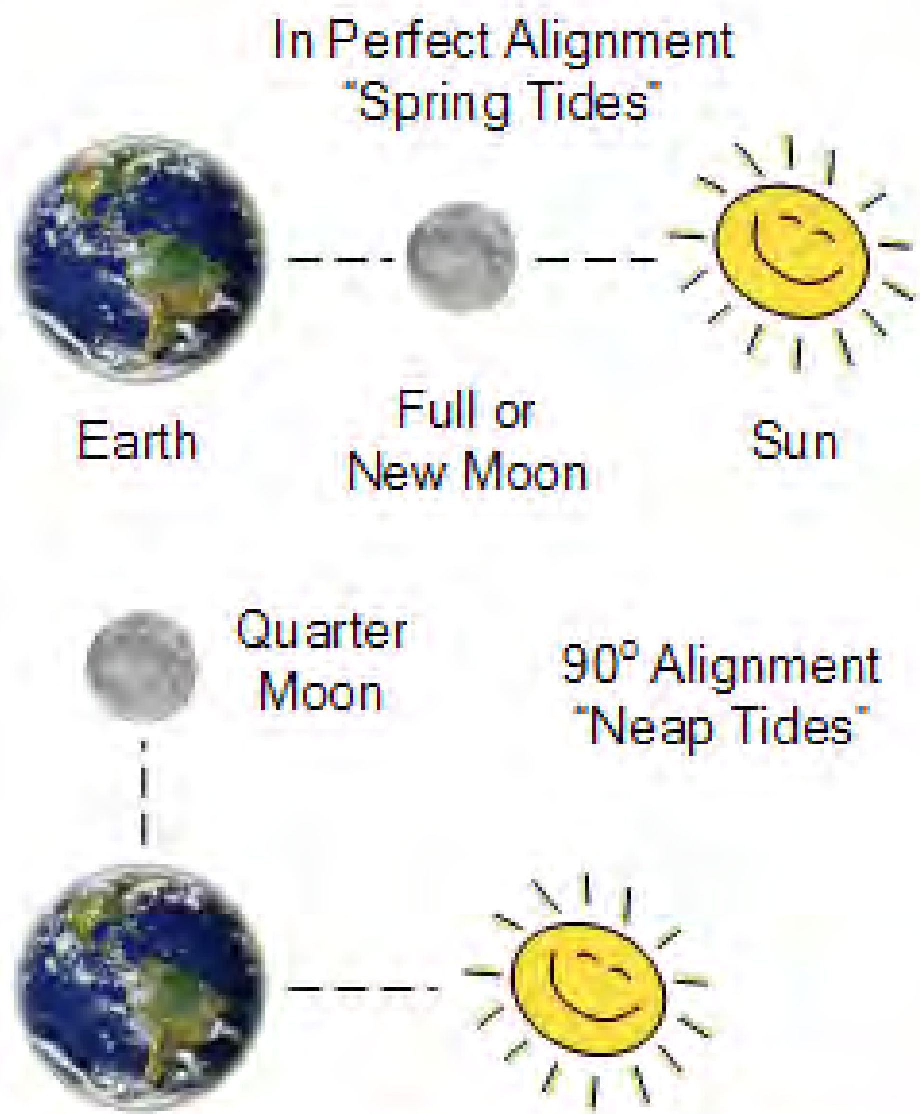
Ocean tides are the periodic rise and fall of ocean water level occurs twice in each lunar day.

During one lunar day (24.83 H) the ocean water level rises twice and fall twice.

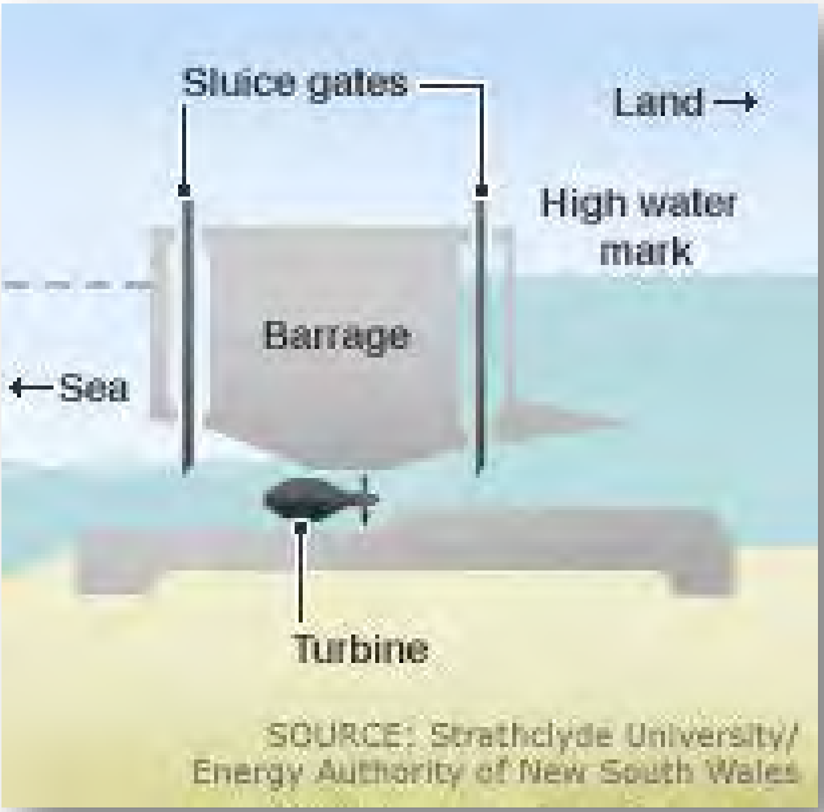
Time interval between a consecutive low tide and high tide is 6.207 hrs.

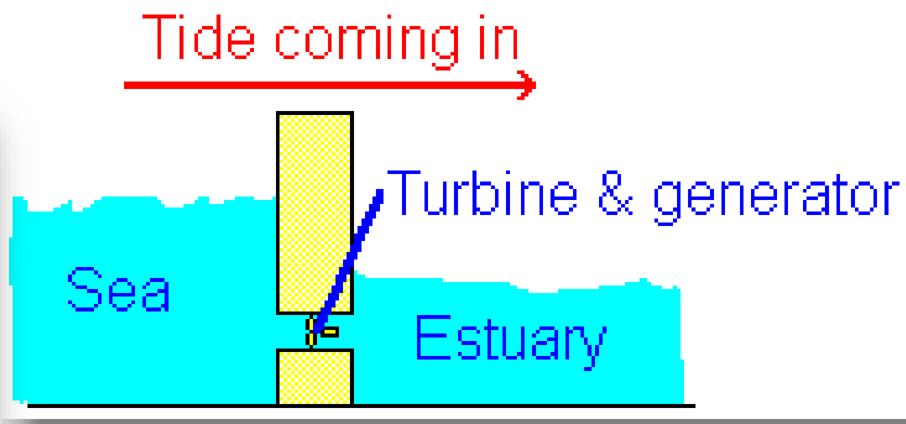
Tidal range is the difference between the consecutive high tide and low tide.

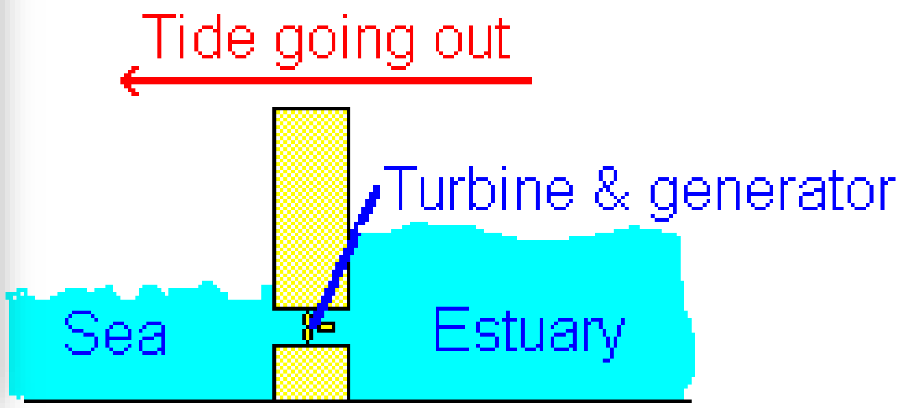

Tides are the periodic rise and fall of the sea surface, occurring once or twice a day, driven by the gravitational attraction of the Sun and the Moon and by the Earth's rotation.



Alignment of the Moon and Sun on Tides

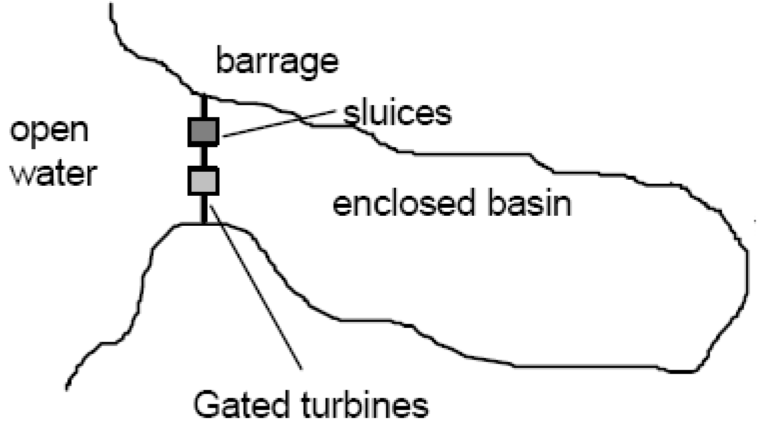

Sluice gates
Land →
High water mark
Barrage
← Sea
Turbine
SOURCE: Strathclyde University/
Energy Authority of New South Wales

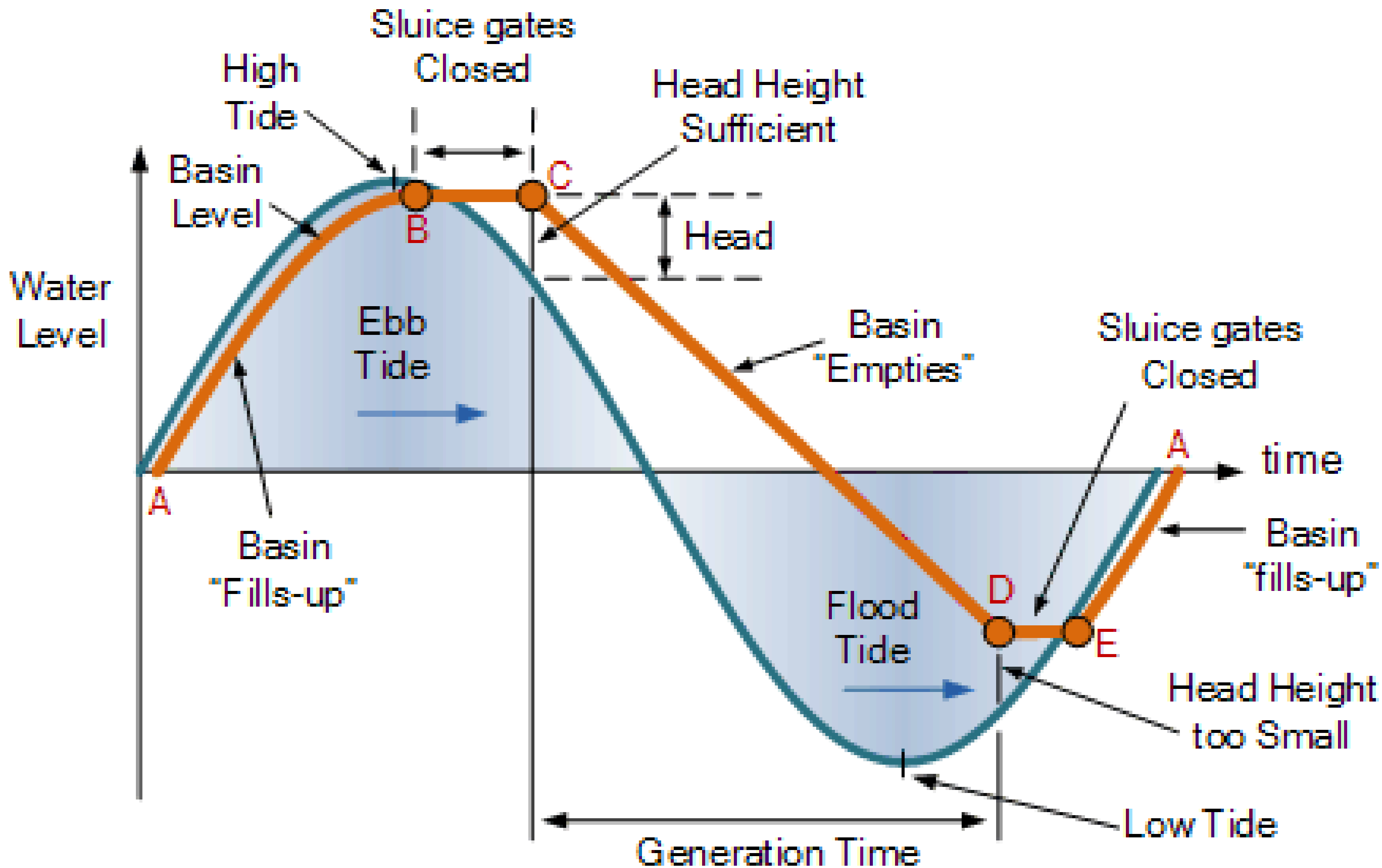

Tide coming in
Turbine & generator
Sea
Estuary

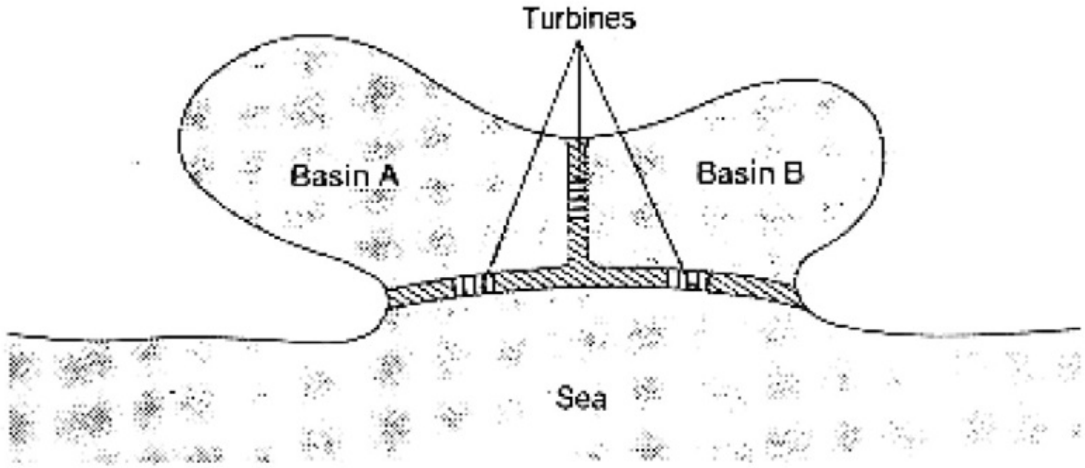

Tide going out
Turbine & generator
Sea
Estuary


Single Basin Scheme: This scheme has one barrage and one water storage basin, one way system, the incoming tide is allowed to fill the basin through sluice ways during the tide and the impounded water is used to generate electricity by letting the water flow from basin to the sea through the turbines during single basin schemes is intermittent generation power.

Figure 13-2 Hypothetical tidal barrage configuration
Source: Bryden




Sluice gates
Closed
High
Tide
Head Height
Sufficient
Basin
Level
C
B
Head
Water
Level
Ebb
Tide
Basin
"Empties"
Sluice gates
Closed
A
time
A
Basin
"Fills-up"
Basin
"fills-up"
D
Flood
Tide
E
Head Height
too Small
Low Tide
Generation Time



Double Basin Scheme: In the double basin scheme, there are two basins on the landward side with the powerhouse located at the interconnecting waterway between the two basins

Advantages of Tidal Energy

1) It is an inexhaustible source of energy.
2) Tidal energy is environment friendly energy and doesn't produce greenhouse gases.
3) As 71% of Earth's surface is covered by water, there is scope to generate this energy on large scale.
4) We can predict the rise and fall of tides as they follow cyclic fashion.
5) Efficiency of tidal power is far greater as compared to coal, solar or wind energy. Its efficiency is around 80%.
6) Although cost of construction of tidal power is high but maintenance costs are relatively low.
7) Tidal Energy doesn't require any kind of fuel to run.
8) The life of tidal energy power plant is very long.
9) The energy density of tidal energy is relatively higher than other renewable energy sources.

Disadvantages of Tidal Energy

1) Cost of construction of tidal power plant is high.
2) There are very few ideal locations for construction of plant and they too are localized to coastal regions only.
3) Intensity of sea waves is unpredictable and there can be damage to power generation units.
4) Influences aquatic life adversely and can disrupt migration of fish.
5) The actual generation is for a short period of time. The tides only happen twice a day so electricity can be produced only for that time.
6) Frozen sea, low or weak tides, straight shorelines, low tidal rise or fall are some of the obstructions.
7) Usually the places where tidal energy is produced are far away from the places where it is consumed. This transmission is expensive and difficult.

Renewable Energy Sector In Myanmar

Small scale hydro turbine

(ဆ–၃) 1000 W Propeller
တာဘိုင်ယူနစ်ပုံ

(ဆ–၄) 1000 W Propeller
တာဘိုင်၏ပန်ကာဒလက်များ၏ပုံ

အိမ်သုံးရေအားလျှပ်စစ်စက်များ၏ဓာတ်ပုံမှတ်တမ်း

ပူးတွဲ(ဆ)

(ဆ–၁) 1000 W Propeller
တာဘိုင်တပ်ဆင်ထားပုံ

(ဆ–၂) 1000 W Propeller
တာဘိုင်၏ Dynamo ပုံ

(ဆ–၅) 1000 W Propeller
တာဘိုင်၏ရေထွက်ပေါက်၏ပုံ

(ဆ–၆) 1500 W Propeller ၏ပုံ

Lei Myo Creek Hydropower Project MATUPI , CHIN State

(ပုံ–၁) မတူပီမြို့၊ လည်မြို့ချောင်းရေအားလျှပ်စစ်စက်ရုံ၏ အဝေးမြင်ကွင်း

Lei Myo Creek Hydropower Project MATUPI , CHIN State

Head	-	44 m
Discharged	-	0.784 m/s
Power	-	250 KW
Speed	-	1000 rpm
Turbine	-	Francis

The Hydro Electric Power Project which has been implemented at Lei Myo Creek, Matupi Township, in the Chin State, during March 2007. The electricity consumption rate of the town per day is 150 KW as the whole area has been in full consumption.

(ပုံ-၁၂)ဖိအားမြှင့်သံမဏိပိုက်သွယ်တန်းထားပုံ

(ပုံ-၁၆)တာဘိုင်အမှတ်(၁)စက်တပ်ဆင်ထားပုံ

Export Oriented Projects

- Among the hydro power sites on the Thanlwin river, GMS of Thailand had started feasibility study for the Tarhsan (7110 MW) Project. This Project is Mainly for export to Thailand.
- There are also many promising sites on the Thanlwin River for export oriented power projects such as Ywathit(3000 MW and Hutgyi (600MW): However a detailed study of the Thanlwin River Basin is required before choosing any specific sites for hydro power development on the Thanlwin River. (GMS and Its)- Thai of Thailand and other companies had shown interest in carrying out the basin duty for development of hydro power from the Thanlwin River.

Myanmar-Thai hydropower project starts on Thanlwin river

(1) Tar-hsan Hydropower Project

Location - Thanlwin River in eastern Shan State, Myanmar

Will produce - 35.446 billion kilowatt-hours a year

(2) Hutgyi Hydropower Project

Location - Thanlwin River in astern Kayin State, Myanmar

Will produce - 3.82 billion kilowatt-hours a year

Some research work for renewable energy field

- Implementation of research works. Various kinds of research concerning with renewable energy are continuously being done in universities and institutes under the Ministry of Education and Ministry of Science and Technology.

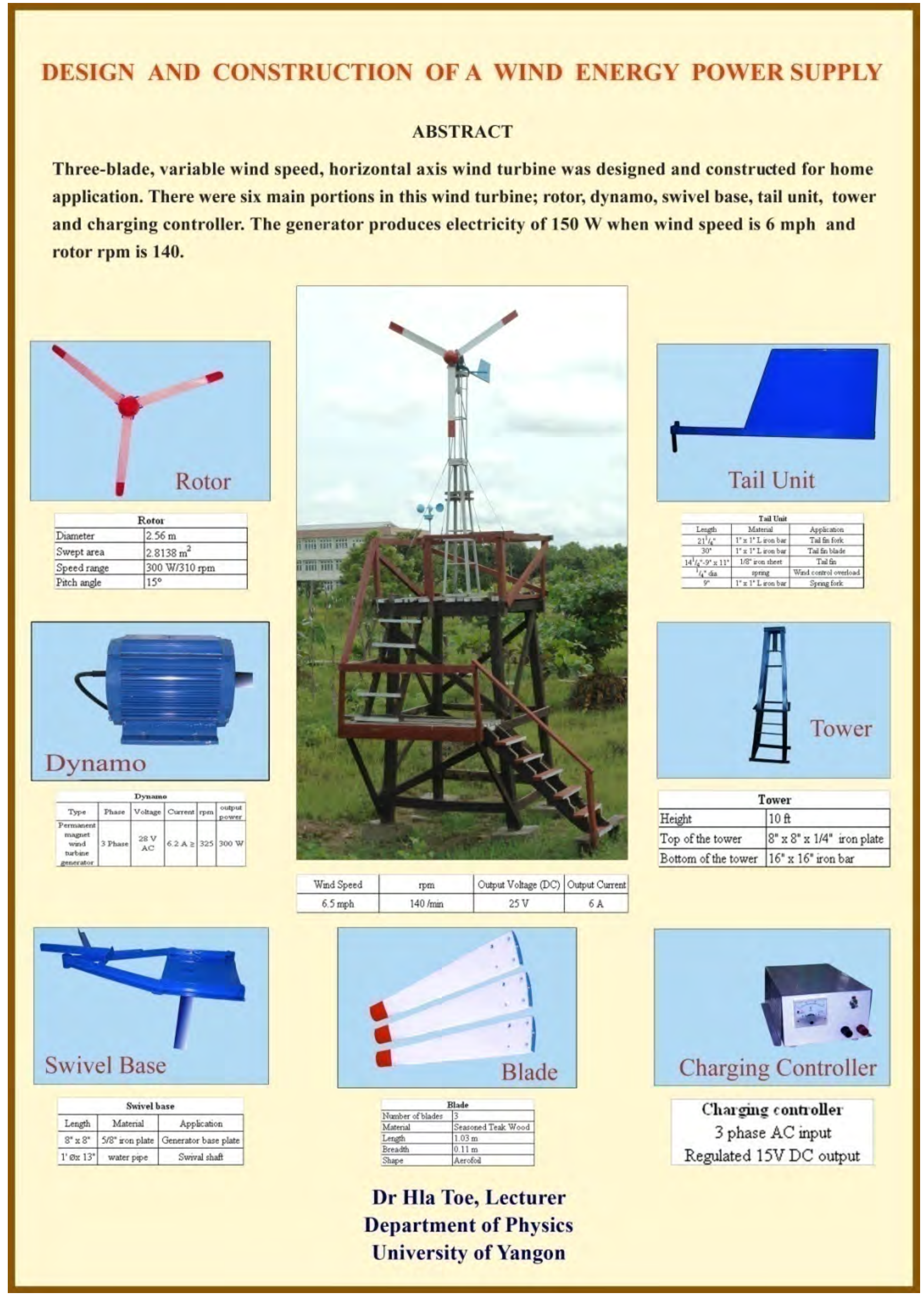
- These projects are mainly carried out with the tremendous support of the State and the Government.

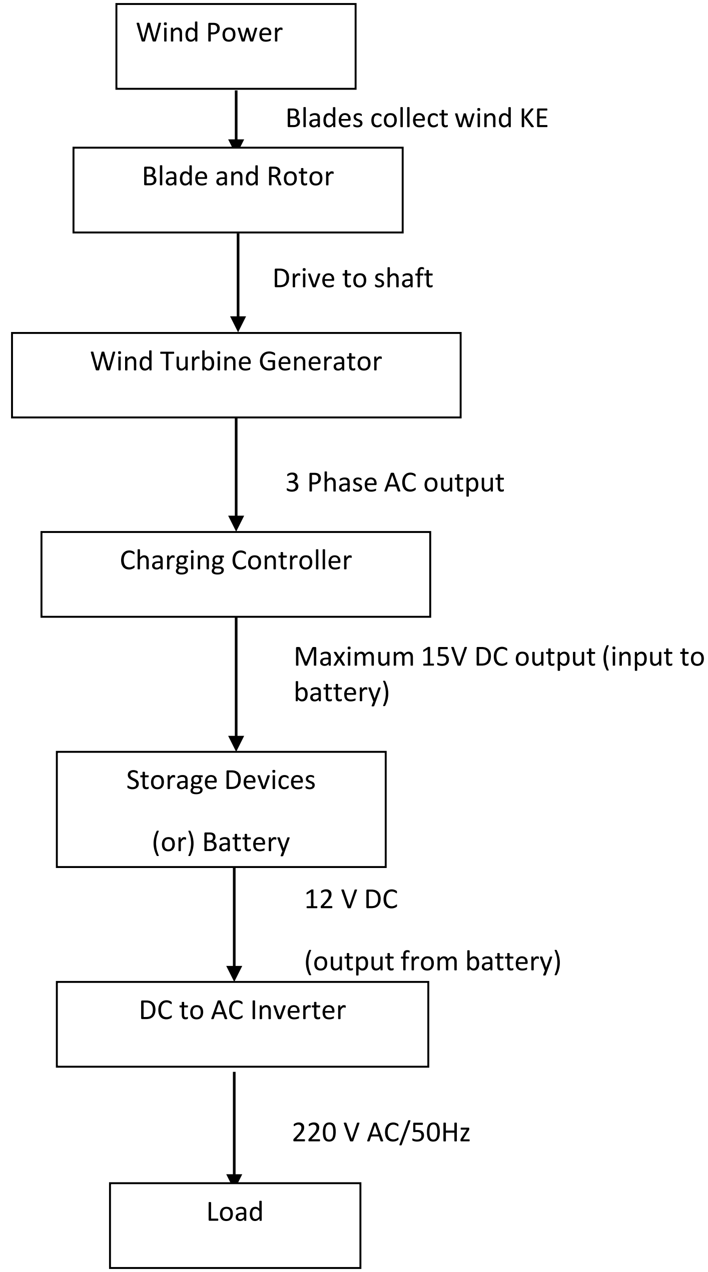
Wind power research projects are under-way in the areas which have the wind - speed of 3m/s and above to be able to produce wind–energy and output power is 300W.

This is the small - scale wind mill constructed by the renewable energy research team of Department of Physics, Yangon University.

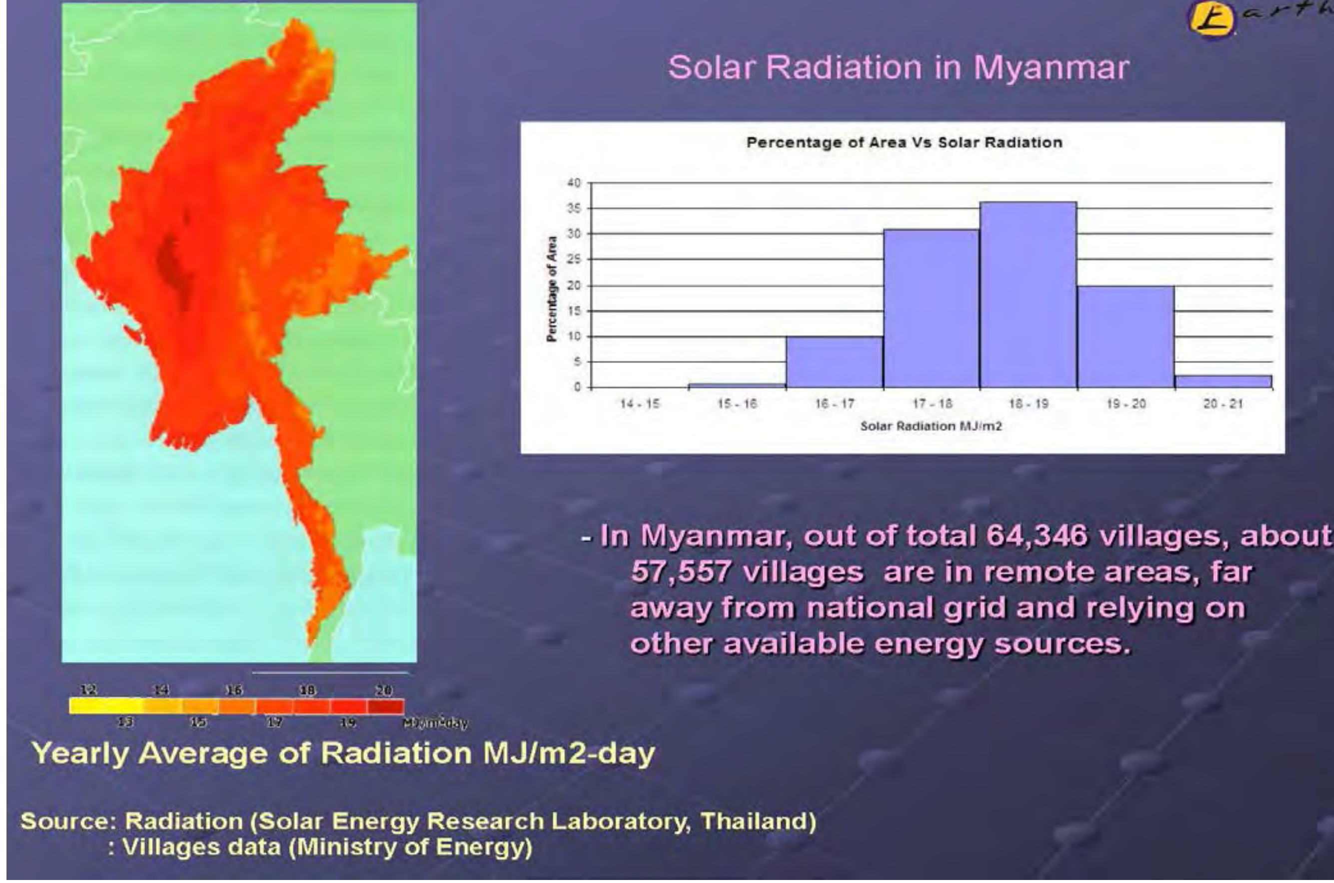
This is the small-scale wind mill at East Yangon University constructed by the renewable energy research team of Department of Physics, Yangon University.

This poster show the six main parts of small - scale (300W) wind mill constructed by the renewable energy research team of Department of Physics, Yangon University.




Wind Power
Blades collect wind KE
Blade and Rotor
Drive to shaft
Wind Turbine Generator
3 Phase AC output
Charging Controller
Maximum 15V DC output (input to battery)
Storage Devices
(or) Battery
12 V DC
(output from battery)
DC to AC Inverter
220 V AC/50Hz
Load

The multi-blade Wind Turbine for water-pumping has bean constructed in a farm in Bago Division, Myanmar.



Solar energy potential

As Myanmar is situated in the southeastern part of the Asian continent, it enjoys abundant sunshine all year round, especially in the Central Myanmar Dry Zone Area. Potential available solar energy of Myanmar is around 51973-8 TWh per year.

- Myanmar Electric Power Enterprise experimental measurement indicated that irradiation intensity of more that 5kWh. Sq-m/day was observed during the dry seasons.

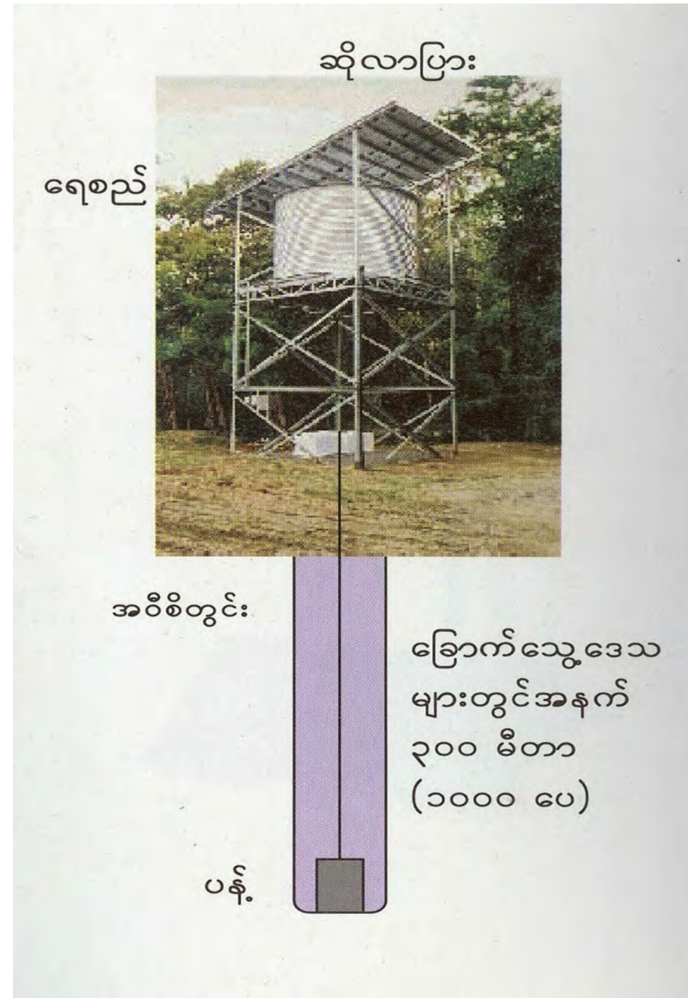
- NEDO performed in 1997 a study on RE in the Mekong Basin Countries and assessed that Myanmar has potential available Solar energy 51973.8 TW-hour/year.

Home Use Solar System

Estimated Cost - K200000 (200US$)

Central Distribution System

Estimated Cost- 20 Million Kyat, (20000US$)


ဆိုလာပြား
ရေစည်
အဝီစိတွင်း
ခြောက်သွေ့ဒေသ
များတွင်အနက်
၃၀၀ မီတာ
(၁၀၀၀ ပေ)
ပန့်

UNIVERSITY OF YANGON
DEPARTMENT OF PHYSICS

PREPARATION AND DEPOSITION OF CdS/p-Si THIN FILM SOLAR CELL

Hla Toe, Hla Htay, Win Kyaw, Win Win Thar and Tin Maung Tun

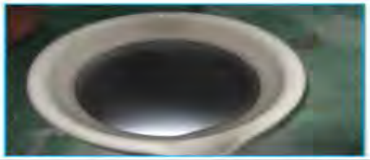
ABSTRACT

An n-CdS layers were deposited onto group-IV p-Si substrates by screen printing method. Deposition temperatures are 300ºC, 400ºC, 500ºC, 600ºC, 700ºC and 800ºC respectively for each 20 minute in vacuum. The electrical and photovoltaic properties of the CdS:Si junction are determined. Photovoltaic of CdS:Si junction (one inch square) is 0.204V in sun light. According to the electrical and photovoltaic properties, CdS:Si junction 600ºC sample more efficient than other samples 300ºC, 400ºC, 500ºC, 700ºC and 800ºC.

အသုံးဝင်ပုံ – နေရောင်ခြည်စွမ်းအင်မှ လျှပ်စစ်ဓာတ်အားထုတ်ယူသော နေရောင်ခြည်စွမ်းအင်သုံး ဆိုလာဆဲအဖြစ် အသုံးပြုနိုင်ပါသည်။

Objective

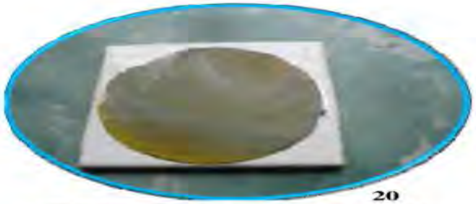
- Preparation of CdS layer on p-Si substrate using screen printing method and fabricated by thermal diffusion method
- Photovoltage of the film is investigated using 60W (yellow) light source
- Current-voltage characteristics of the film is observed under the various illuminations



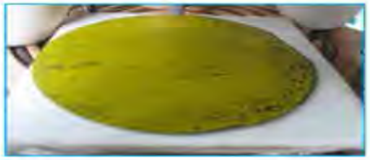
Clean with HCl:Ethanol:DI (1:1:1)

Preparing for CdS sol-gel with 2methoxyethanol :PPG (3:1)

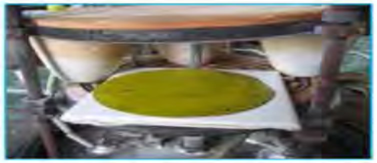
CdS paste deposition on Si substrate by screen printing method



(4" CdS/p-Si) After 600°C for 20 min (deposited temperature/time)



Mounted on ceramic plate

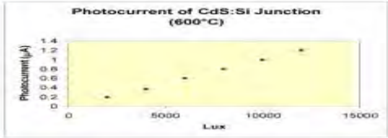


Placed in the chamber

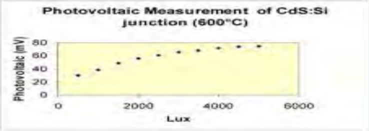
Experimental details

- Preparation of CdS/p-Si Thin Film
- Photovoltage measurement
- Current-voltage measurement

Photovoltaic measurement of CdS/Si solar cell



(1" CdS/p-Si) After 600°C for 20 min (deposited temperature/time)



BIOGAS
Community Size Biogas Plant

Sr.	State/Division	Nos. of Biogas Plant	Total installed (KW)
1	Mandalay Division	89	801
2	Sagaing Division	12	108
3	Magway Division	3	27
4	Northern Shan State	1	9
	Total	**105**	**945**

Biomass

- In Myanmar, nearly 52.5 percent of the total land area is covered with forest.
- 30.5 percent are reserved forests and 69.5 percent are unreserved ones.
- Wood-fuel plays vital role for cooking and cottage industries in both urban and rural areas.
- The main supply of wood-fuel comes from natural forest, fuel wood plantations, homestead garden, community forest and tops and lops from timber extracted areas.
- Natural forests produce about 19.12 million cubic tons of wood fuel annually.

Biomass Energy

- As Myanmar is an agriculture-based country, most of the population resides in rural.
- Consumption of Biomass in the form of Fuel- wood, Charcoal, agriculture residue and animal waste has been extensive.
- Almost 64 percent of primary energy is being supplied form the Biomass.
- As a drive against deforestation, the Government is encouraging the application of Biomass energy from animal waste and agricultural waste.