# NONRENEWABLE & RENEWABLE SOURCES OF ENERGY

Asst.Prof.Vishnu Sankar, Department of Mechanical Engineering

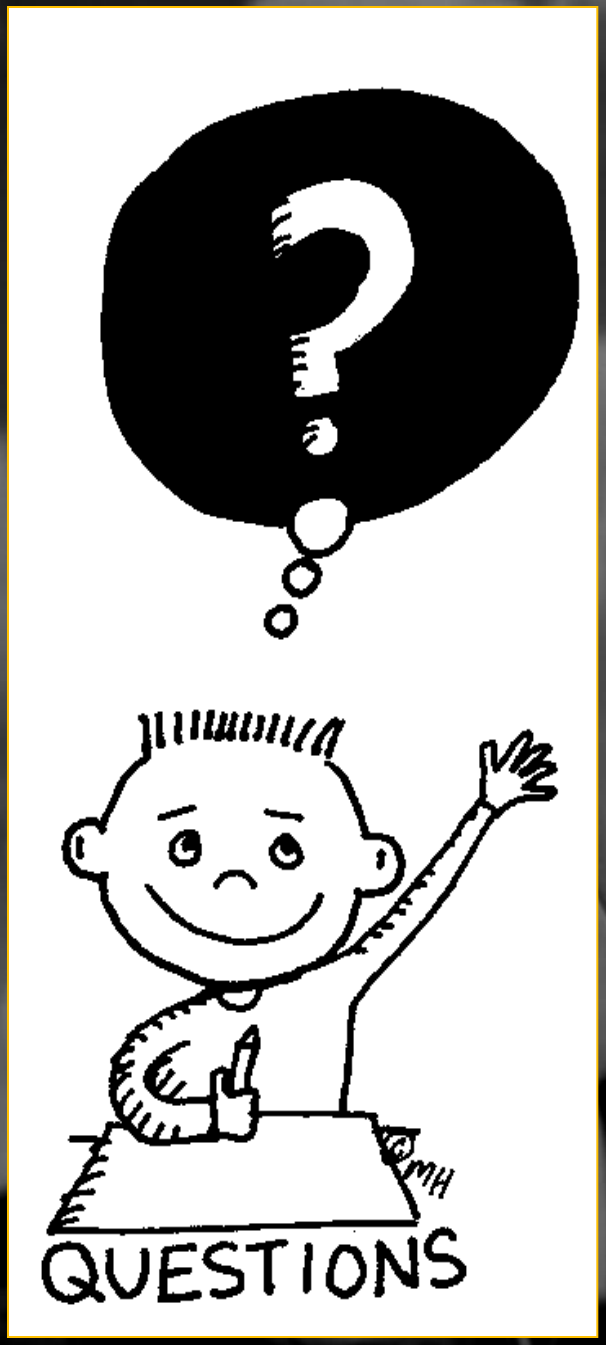
# HMMMM....

What do you think nonrenewable resources are?

Break it down...

Nonrenewable?

Resource?



# NONRENEWABLE RESOURCES

A nonrenewable resource is a natural resource that cannot be re-made or re-grown at a scale comparable to its consumption.

# NUCLEAR ENERGY

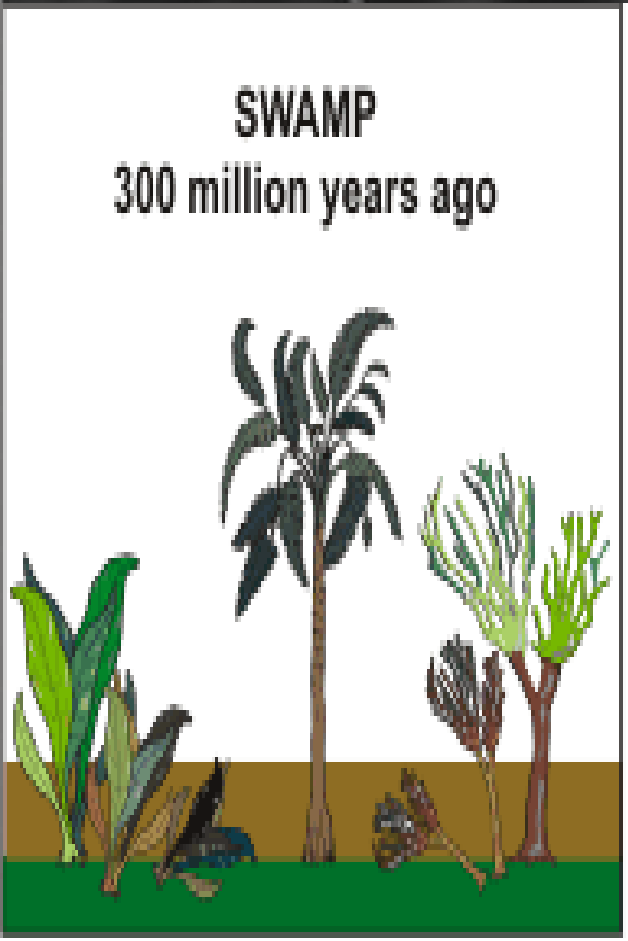
Nuclear fission uses uranium to create energy.

Nuclear energy is a nonrenewable resource because once the uranium is used, it is gone!

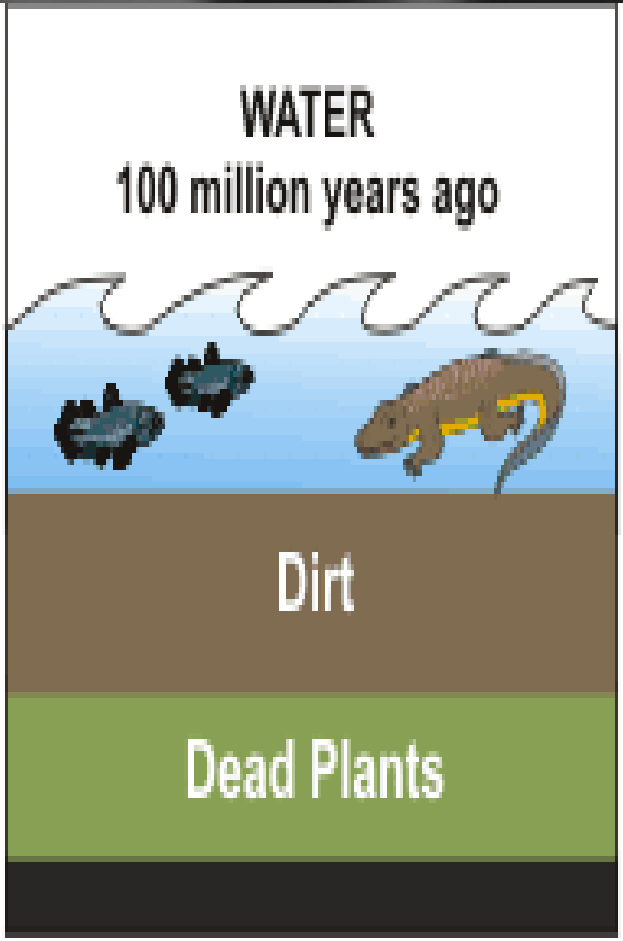
# COAL, PETROLEUM, AND GAS

Coal, petroleum, and natural gas are considered nonrenewable because they can not be replenished in a short period of time. These are called fossil fuels.

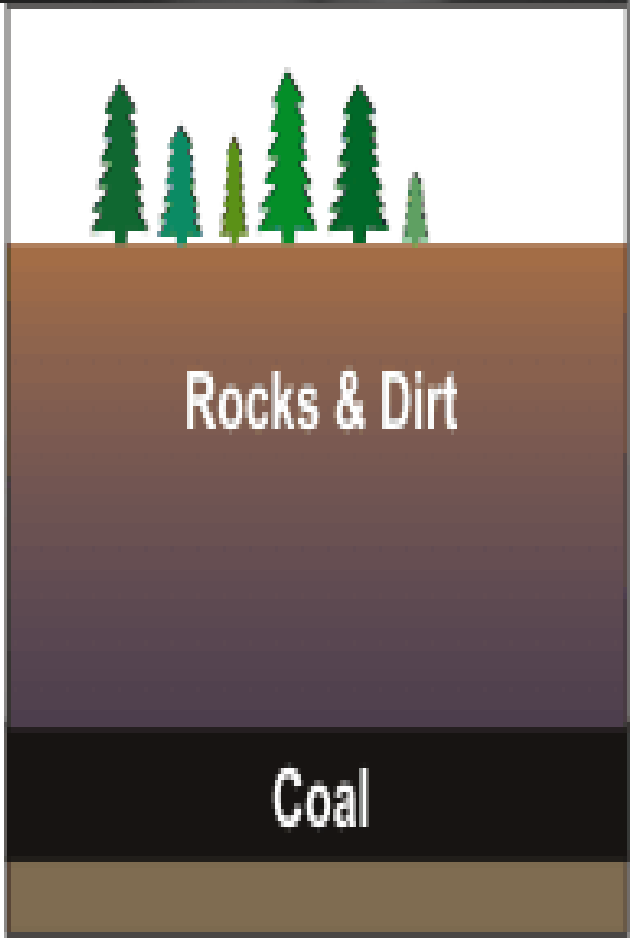
# HOW IS COAL MADE ???




Before the dinosaurs, many giant plants died in swamps.



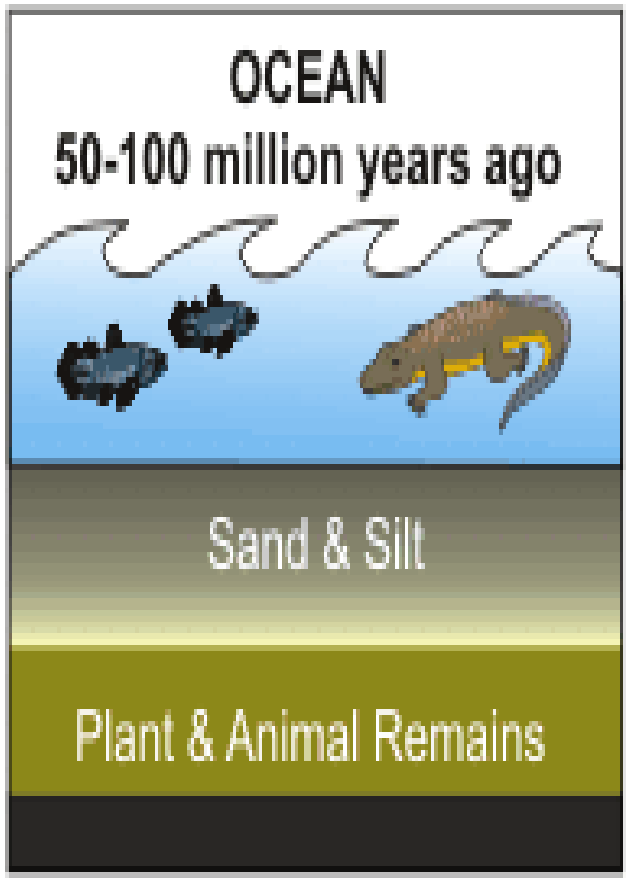

Over millions of years, the plants were buried under water and dirt.



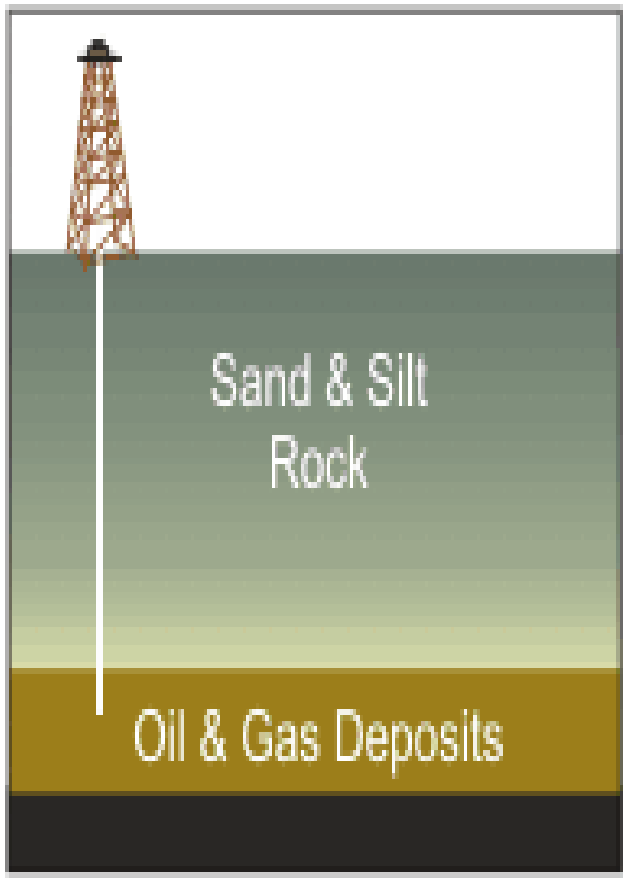

Heat and pressure turned the dead plants into coal.

# HOW ARE OIL AND GAS MADE ???


Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of silt and sand.




Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.




Today, we drill down through layers of sand, silt, and rock to reach the rock formations that contain oil and gas deposits.

# WHAT WAS THE DIFFERENCE BETWEEN COAL AND OIL/GAS?


# HMMMM....


If nonrenewable resources are resources that cannot be re-made at a scale comparable to its consumption, what are renewable resources?

# RENEWABLE RESOURCES

Renewable resources are natural resources that can be replenished in a short period of time.

- Solar
- Geothermal
- Wind
- Biomass
- Water

# SOLAR

Energy from the sun.

Why is energy from the sun renewable?

# GEOTHERMAL

Energy from Earth's heat.

Why is energy from the heat of the Earth renewable?

# WIND

Energy from the wind.

Why is energy from the wind renewable?

# BIOMASS

Energy from burning organic or living matter.

Why is energy from biomass renewable?

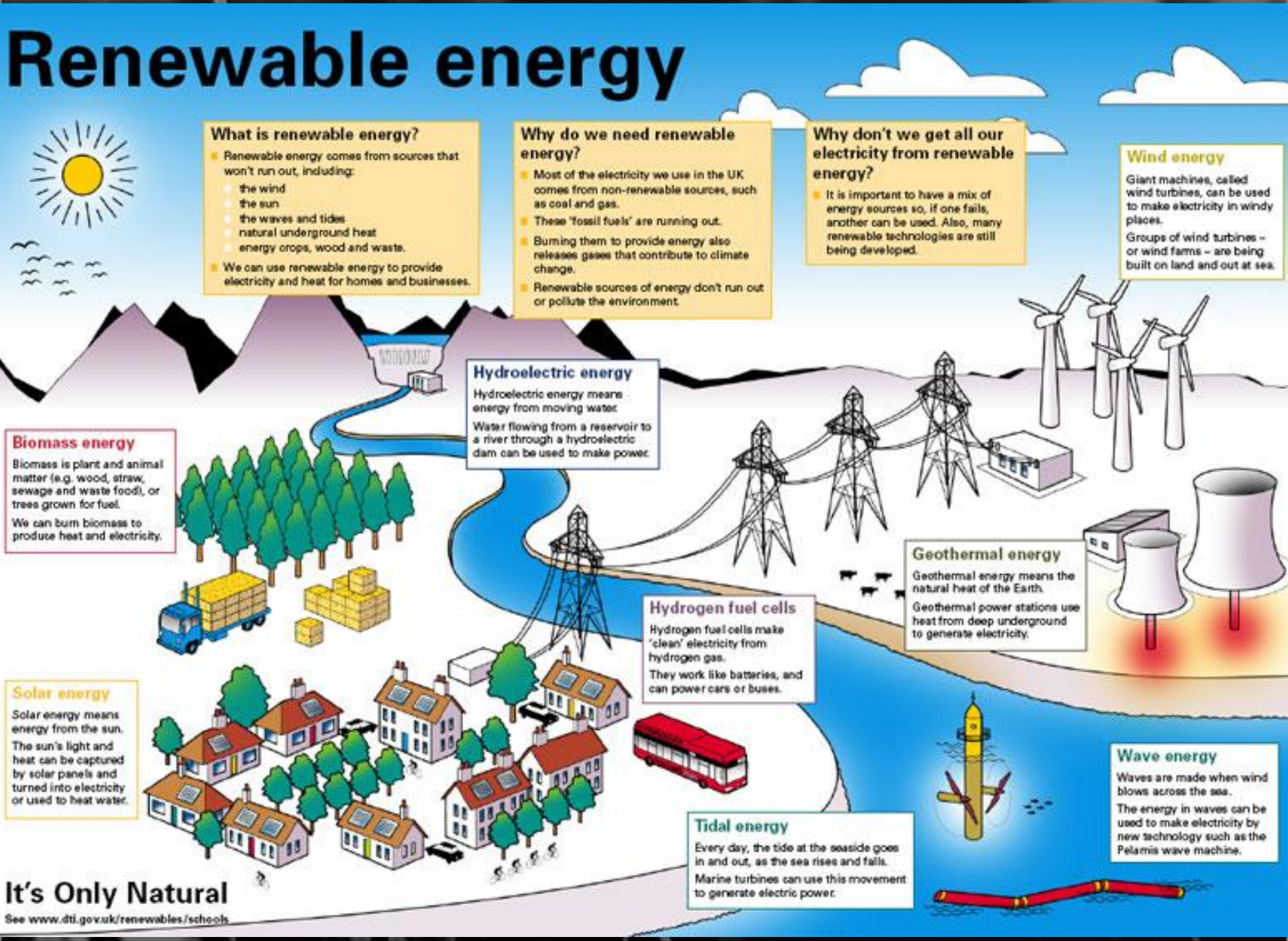
# WATER or HYDROELECTRIC

HOOVER DAM

**Energy from the flow of water.**

**Why is energy of flowing water renewable?**

# Renewable energy



## What is renewable energy?

- Renewable energy comes from sources that won't run out, including:
  - the wind
  - the sun
  - the waves and tides
  - natural underground heat
  - energy crops, wood and waste.
- We can use renewable energy to provide electricity and heat for homes and businesses.

## Why do we need renewable energy?

- Most of the electricity we use in the UK comes from non-renewable sources, such as coal and gas.
- These 'fossil fuels' are running out.
- Burning them to provide energy also releases gases that contribute to climate change.
- Renewable sources of energy don't run out or pollute the environment.

## Why don't we get all our electricity from renewable energy?

- It is important to have a mix of energy sources so, if one fails, another can be used. Also, many renewable technologies are still being developed.

## Wind energy

Giant machines, called wind turbines, can be used to make electricity in windy places.

Groups of wind turbines – or wind farms – are being built on land and out at sea.

## Hydroelectric energy

Hydroelectric energy means energy from moving water.

Water flowing from a reservoir to a river through a hydroelectric dam can be used to make power.

## Biomass energy

Biomass is plant and animal matter (e.g. wood, straw, sewage and waste food), or trees grown for fuel.

We can burn biomass to produce heat and electricity.

## Geothermal energy

Geothermal energy means the natural heat of the Earth.

Geothermal power stations use heat from deep underground to generate electricity.

## Hydrogen fuel cells

Hydrogen fuel cells make 'clean' electricity from hydrogen gas.

They work like batteries, and can power cars or buses.

## Solar energy

Solar energy means energy from the sun.

The sun's light and heat can be captured by solar panels and turned into electricity or used to heat water.

## Wave energy

Waves are made when wind blows across the sea.

The energy in waves can be used to make electricity by new technology such as the Pelamis wave machine.

## Tidal energy

Every day, the tide at the seaside goes in and out, as the sea rises and falls.

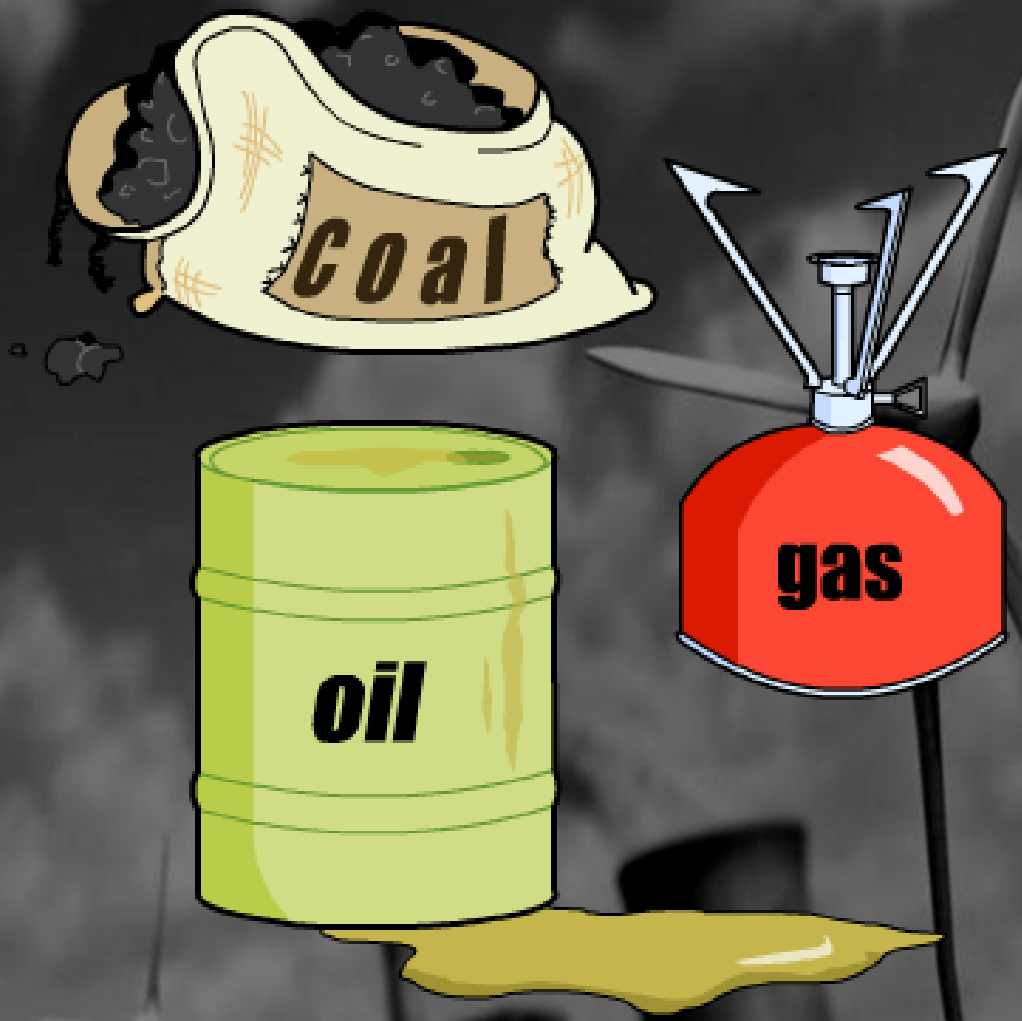
Marine turbines can use this movement to generate electric power.

**It's Only Natural**

See www.dti.gov.uk/renewables/schools

# FUELS

- Coal
- LSHS
- FO
- LNG
- HSD
- Biodiesel
- Biogas



# Coal

- Coal is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen
- Coal forms when dead plant matter is converted into peat, which in turn is converted into lignite, then sub-bituminous coal, after that bituminous coal, and lastly anthracite.
- This involves biological and geological processes that take place over a long period.

# LSHS (Low Sulphur Heavy Stock )

- Residual fuel processed from indigenous crude. This fuel used where furnace oil is suitable. The main difference with LSHS and FO is in the form of higher pour point, higher calorific value and lower sulphur content in LSHS.
- As this fuel has higher pour point than that of FO it requires special handling arrangements. LSHS is handled hot at all stages and is maintained at 75OC. Special care is also taken so that no 'boil over' of the product takes place in the storage tank

# LSHS (Low Sulphur Heavy Stock )

## Uses

- As fuel for Power Generation in DG Sets
- As fuel for Boilers/Furnaces/ Air preheater/ Any other Heaters
- As fuel for Bunkering
- As fuel/ Feedstock in Fertilizer Plants

# HSD (High Speed Diesel )

- Two main grades of diesel fuel are marketed in India, High Speed Diesel (HSD) and Light diesel oil (LDO). The former is a 100% distillate fuel while the latter is a blend of distillate fuel with a small proportion of residual fuel
- HSD is normally used as a fuel for high speed diesel engines operating above 750 rpm i.e. buses, lorries, generating sets, locomotives, pumping sets etc. Gas turbine requiring distillate fuels normally make use of HSD as fuel.
- LDO is used for diesel engines, generally of the stationery type operating below 750 rpm

# FO (Furnace/ Fuel Oil)

- A dark viscous residual fuel obtained by blending mainly heavier components from crude distillation unit, short residue and clarified oil from fluidized catalytic cracker unit
- Fuel oil is a fraction obtained from petroleum distillation, either as a distillate or a residue. Broadly speaking, fuel oil is any liquid petroleum product that is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power

# LNG (Liquefied natural gas )

- Liquefied natural gas or LNG is natural gas (predominantly methane, $CH_4$) that has been converted to liquid form for ease of storage or transport.
- Liquefied natural gas takes up about 1/600th the volume of natural gas in the gaseous state. It is odorless, colorless, non-toxic and non-corrosive. Hazards include flammability, freezing and asphyxia.
- LNG is principally used for transporting natural gas to markets, where it is regasified and distributed as pipeline natural gas.

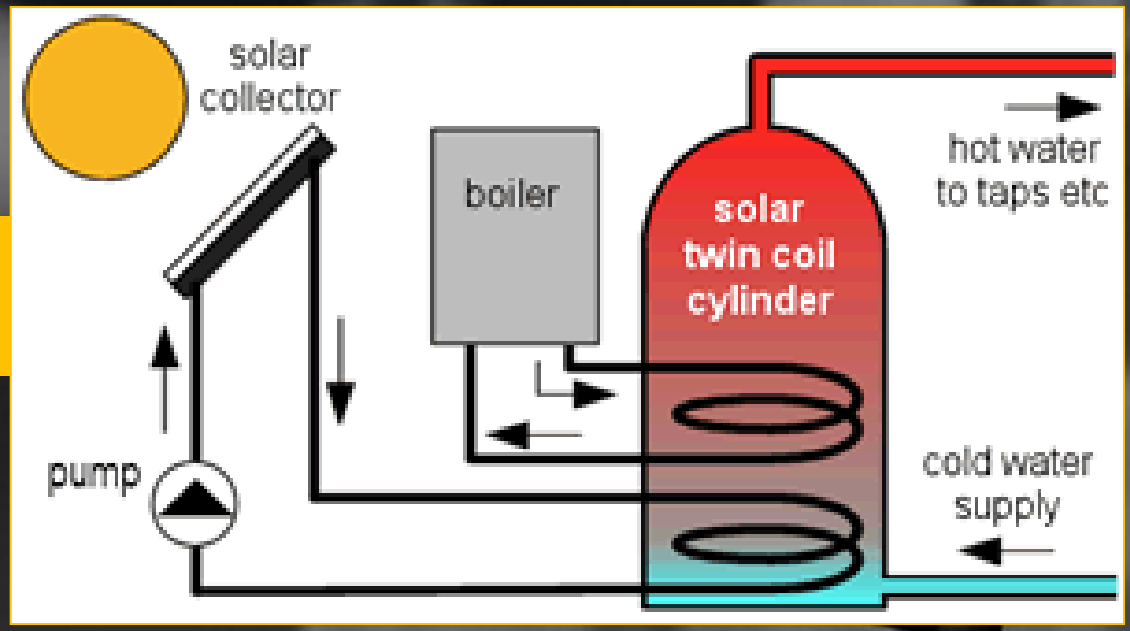
# Biogas

- Biogas is a renewable energy source, like solar and wind energy. Furthermore, biogas can be produced from regionally available raw materials and recycled waste and is environmentally friendly and $CO_2$ neutral.
- Biogas is produced by the anaerobic digestion or fermentation of biodegradable materials such as manure, sewage, municipal waste, green waste, plant material, and crops
- Biogas comprises primarily methane ($CH_4$) and carbon dioxide ($CO_2$) and may have small amounts of hydrogen sulphide ($H_2S$), moisture and siloxanes

# Biodiesel

- Biodiesel refers to a vegetable oil- or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, propyl or ethyl) esters. Biodiesel is typically made by chemically reacting lipids (e.g., vegetable oil, animal fat) with an alcohol producing fatty acid esters.
- Biodiesel is meant to be used in standard diesel engines and is thus distinct from the vegetable and waste oils used to fuel converted diesel engines. Biodiesel can be used alone, or blended with petrodiesel. Biodiesel can also be used as a low carbon alternative to heating oil.

# Solar power




## How Solar Works

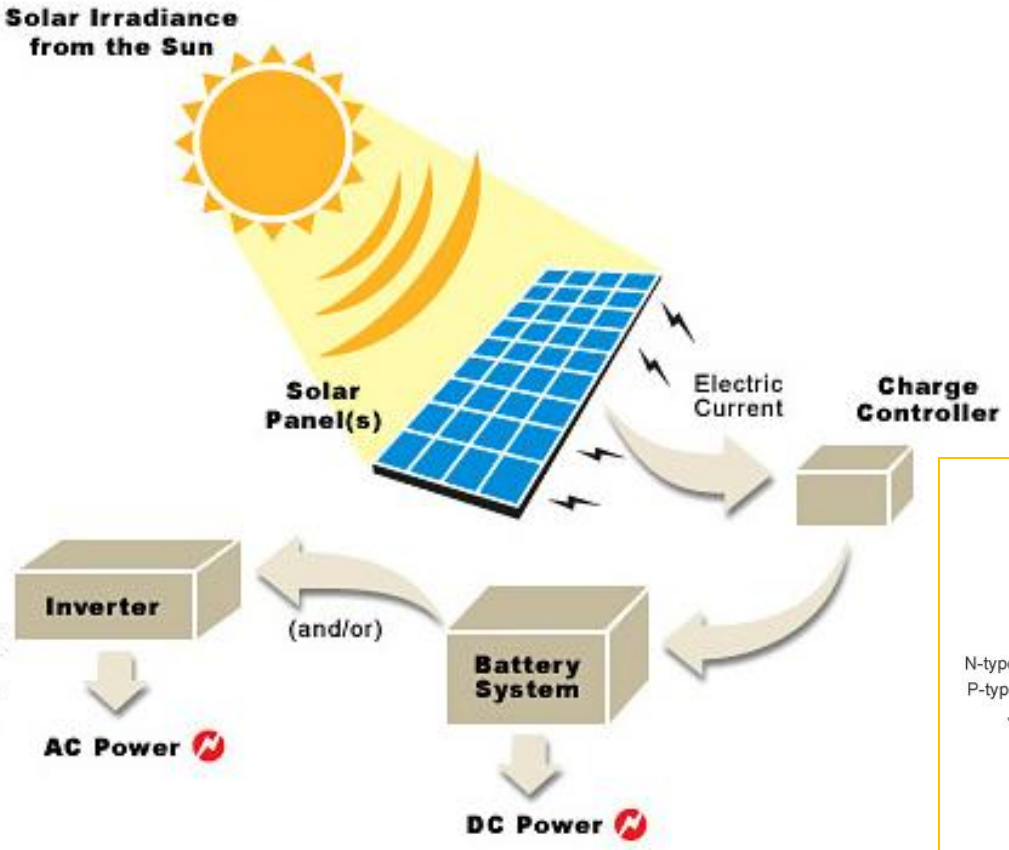

Why Wait?
Great Solar Financing Packages Available

Make the Switch to Energy Efficient Lighting!

Get Solar Power For Your Home & Save Money

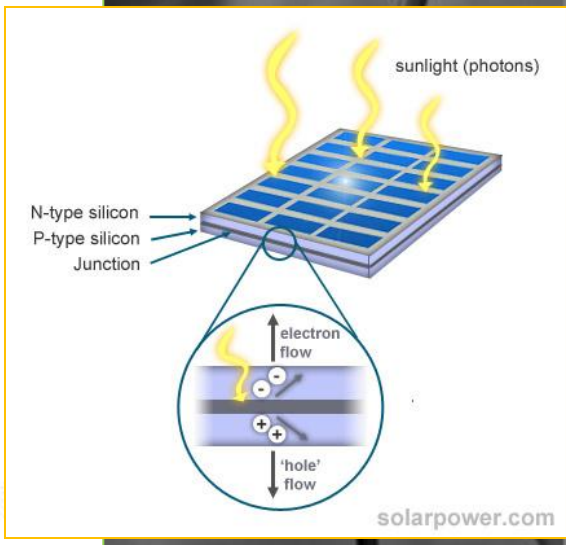
## Solar Panels

Solar panels are installed on your roof or adjacent structure. These panels are made up of photovoltaic cells, which convert sunlight into DC power.




## Inverter

The DC power from the photovoltaic cells is sent to an inverter, where it is converted into AC power, or standard household electricity.




## Electrical Panel

The AC power travels from the inverter to the electrical panel, or breaker box. This power is then available to service all of your electrical needs. The utility meter continually measures your electrical supply; when your solar system produces more power than you need, the meter literally spins backwards, racking up your credits with the utility company.

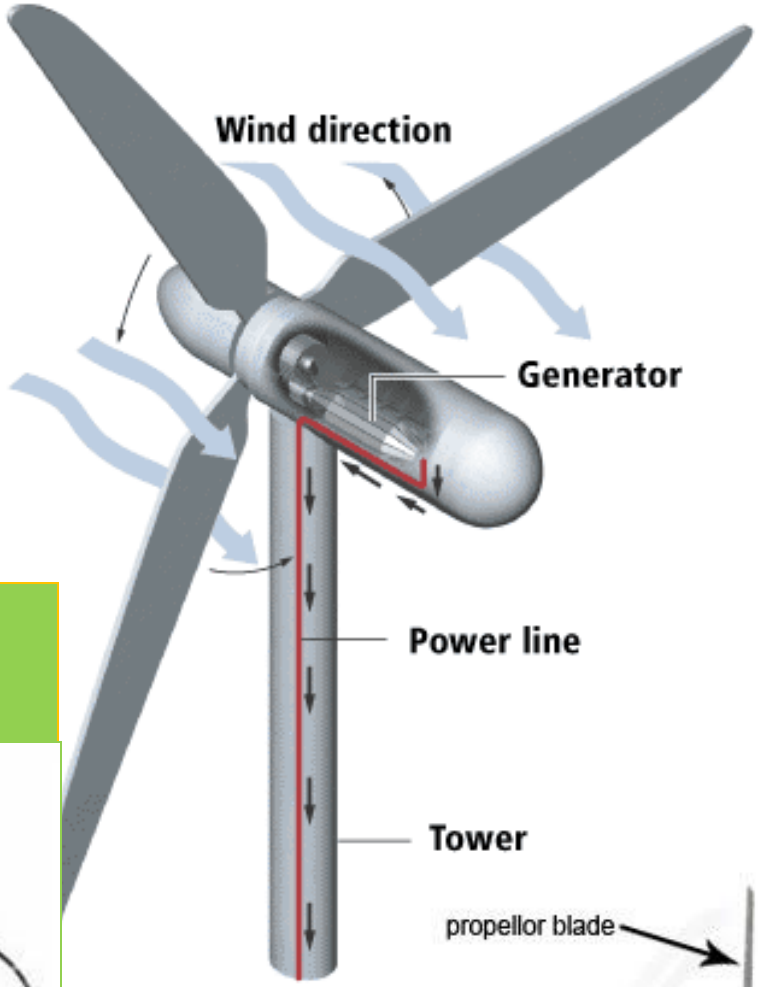
## Utility Grid

The utility grid remains in place to supply you with electricity when you need more power than your system has produced; this usually happens at night.

# TURNING WIND INTO ELECTRICITY

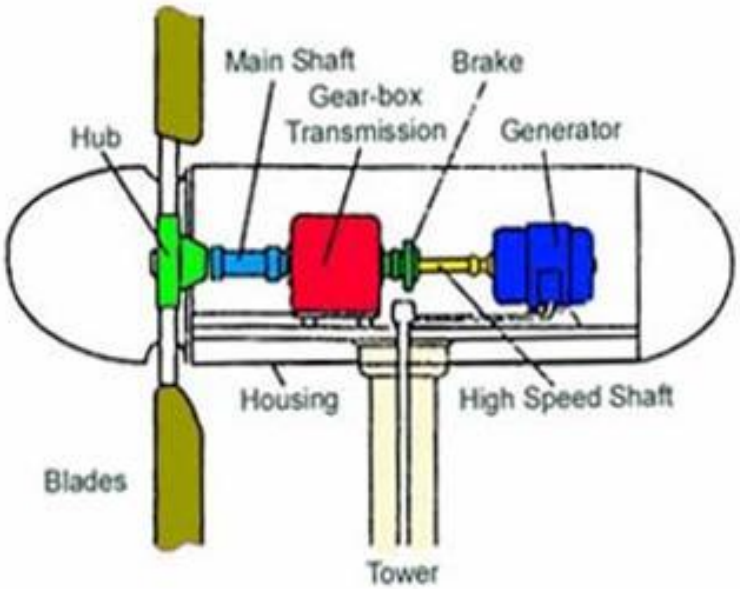
Wind power is the fastest-growing energy source in the world. Turbines powered by wind are mounted on towers 100 or more feet above the ground, where the wind is faster and less turbulent.

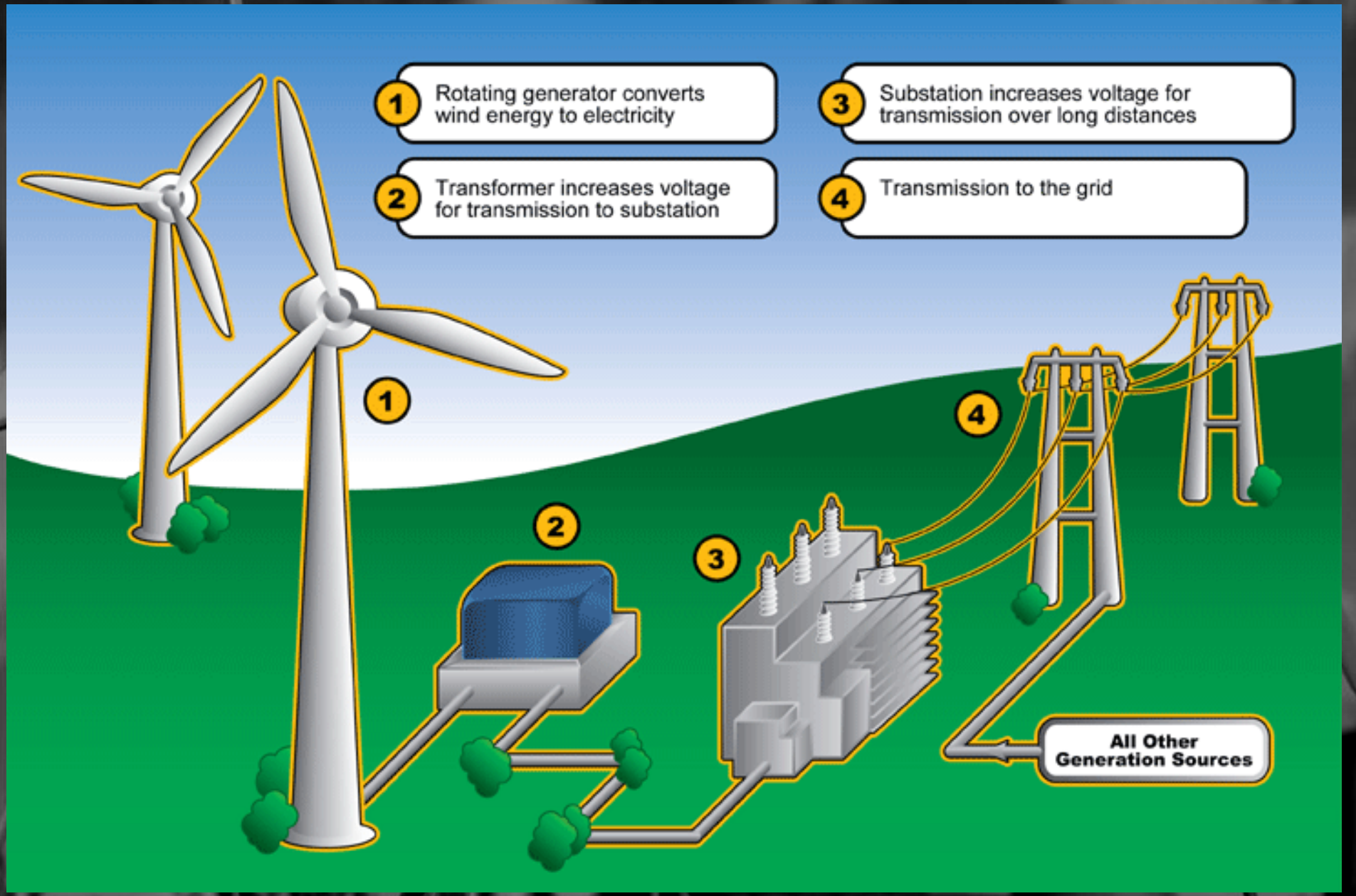
# Wind power



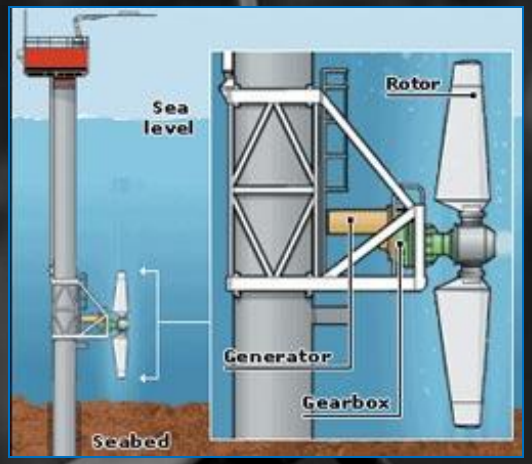

## HOW IT WORKS

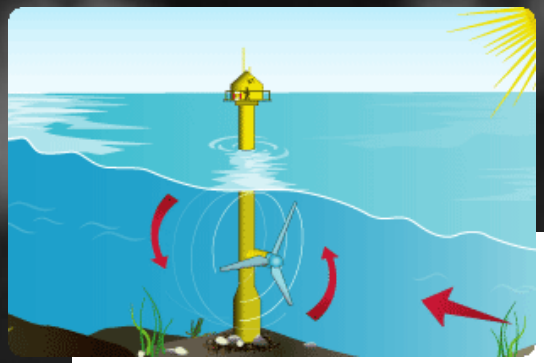
1. When the blades start moving, they spin a shaft that leads to a generator.
2. The generator consists of a conductor, such as a coiled wire, that is surrounded by magnets.
3. The rotating shaft turns the magnets around the conductor and generates an electrical current.
4. Sensors cause the top of the turbine to rotate to face into the wind and the blades change their angle to best catch the wind. The blades are flexible and stop spinning if wind is too strong.

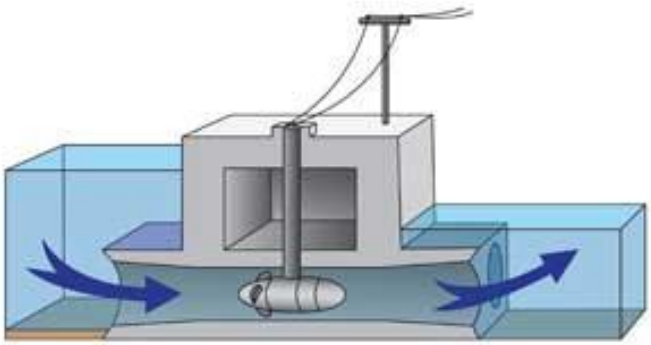




1 Rotating generator converts wind energy to electricity
2 Transformer increases voltage for transmission to substation
3 Substation increases voltage for transmission over long distances
4 Transmission to the grid
1
2
3
4
All Other Generation Sources

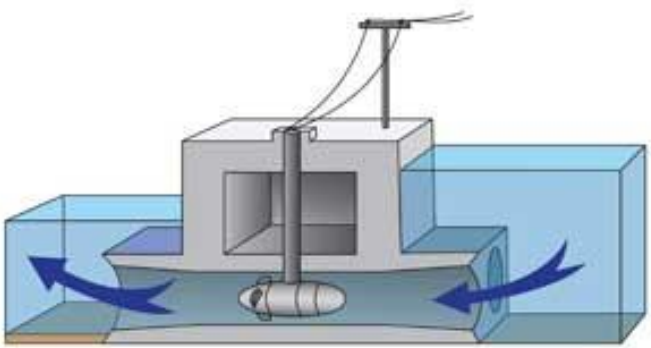
# Tidal power



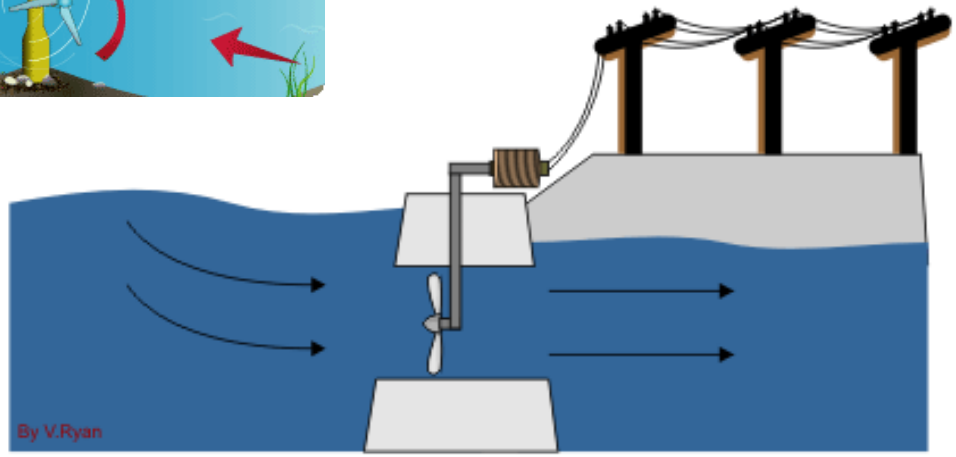





Tide Coming In

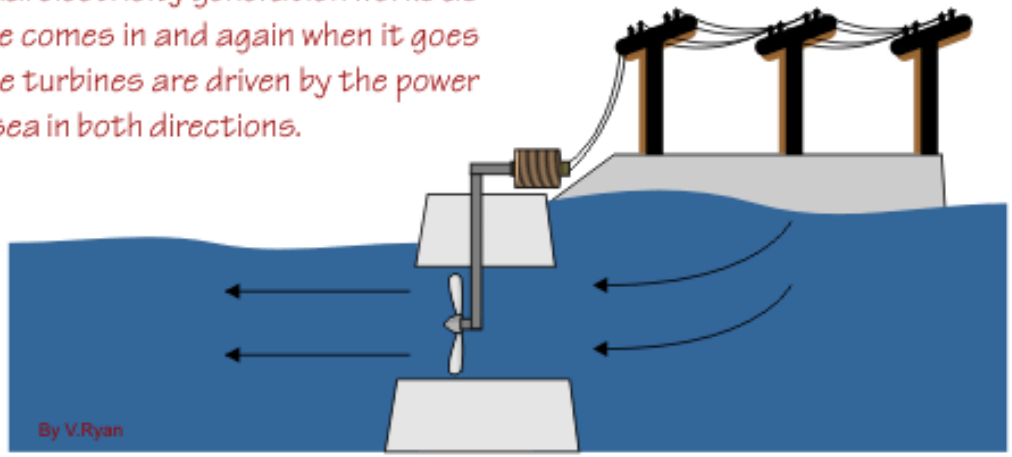


Tide Going Out

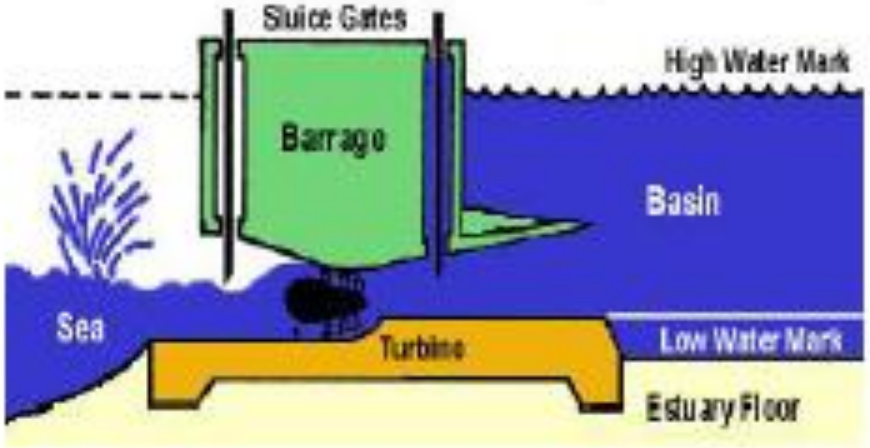



TIDE COMING IN

This tidal electricity generation works as the tide comes in and again when it goes out. The turbines are driven by the power of the sea in both directions.




TIDE GOING OUT




(a) Tidal barrage


(b) Tidal stream turbine

# Tidal power plant potential in India

Table 10: Assessment of tidal power potential in India by MNRE

| Location | Reported Potential (MW) | Technology |
|---|---|---|
| Kalpasar (Khambat) | 7000 | Tidal barraging |
| Kutch / Khumbat | 1200 | Tidal barraging |
| Durga Duani Creeks | 100 | Tidal barraging |

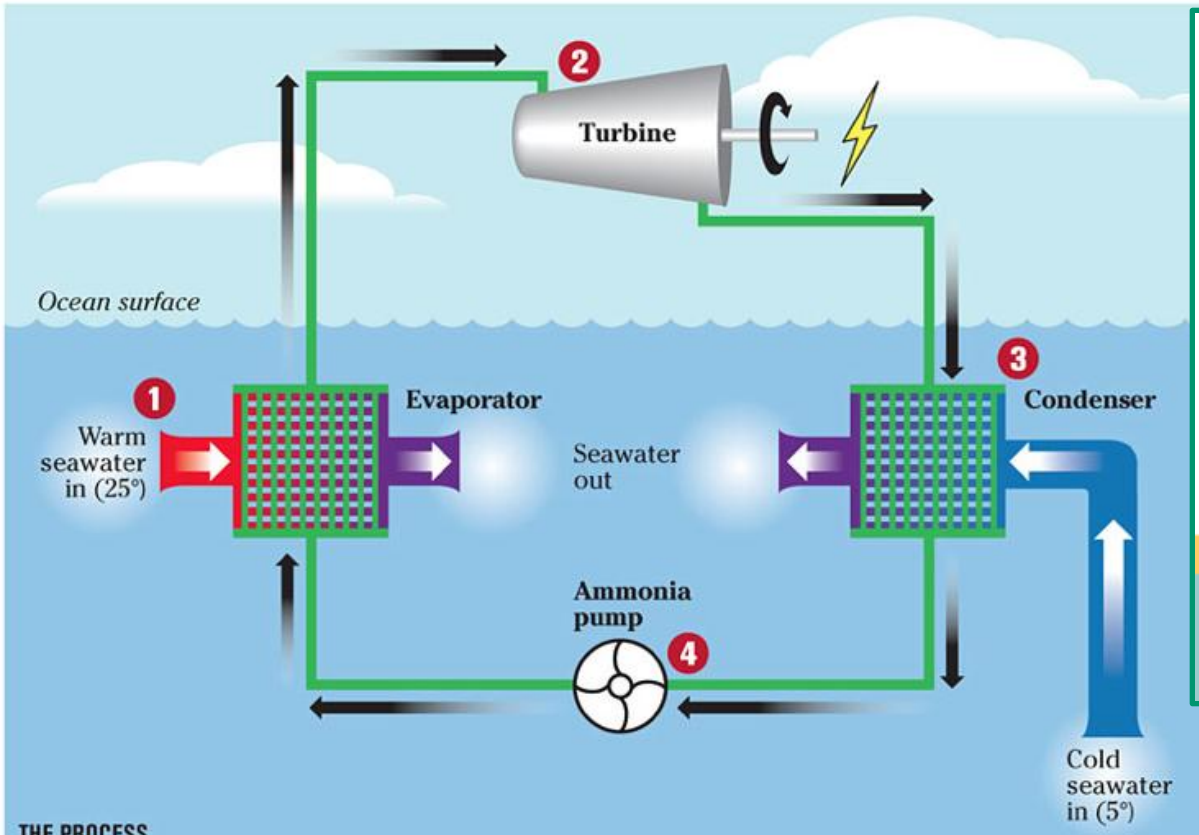
# Benefits of Tidal and Wave energy

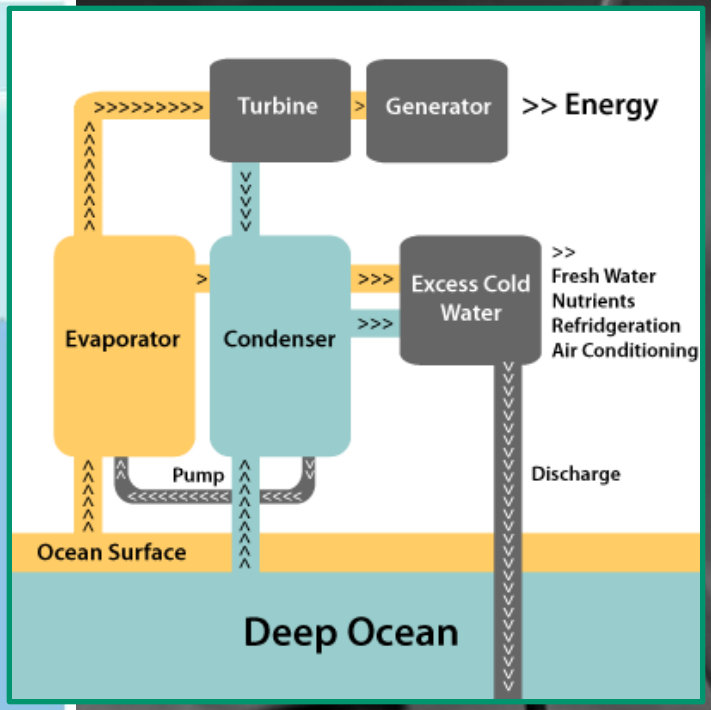
| | |
|---|---|
| **Predictable** | •Produce energy at different known time periods and more consistently than other RE sources<br>•Will add to overall stability of networks |
| **Less Visual/noice impact** | •Tidal turbines are located beneath the ocean surface and cannot be seen or heard<br>•Reduction in carbon emission |
| **Protection of shores** | •Helps in protection of banks & reduce the risk of floods<br>•Attract lots of tourist & promote trade through development of harbours, and easy transportation |
| **Higher energy density** | •Water is ~800 times denser than air<br>•For a given electricity output, tidal turbines can be much smaller than wind turbines |
| **Off-grid electricity generation** | •Best source in coastal areas for off-grid electricity generation<br>•Improvement in standard of living at coastal areas |
| **Improvement in Socio-Economic Factors** | •Creation of jobs/small scale allied industries<br>•Helps in development of marine industry in India |

# OTEC (Ocean thermal energy conversion)

## ENERGY FROM THE OCEAN

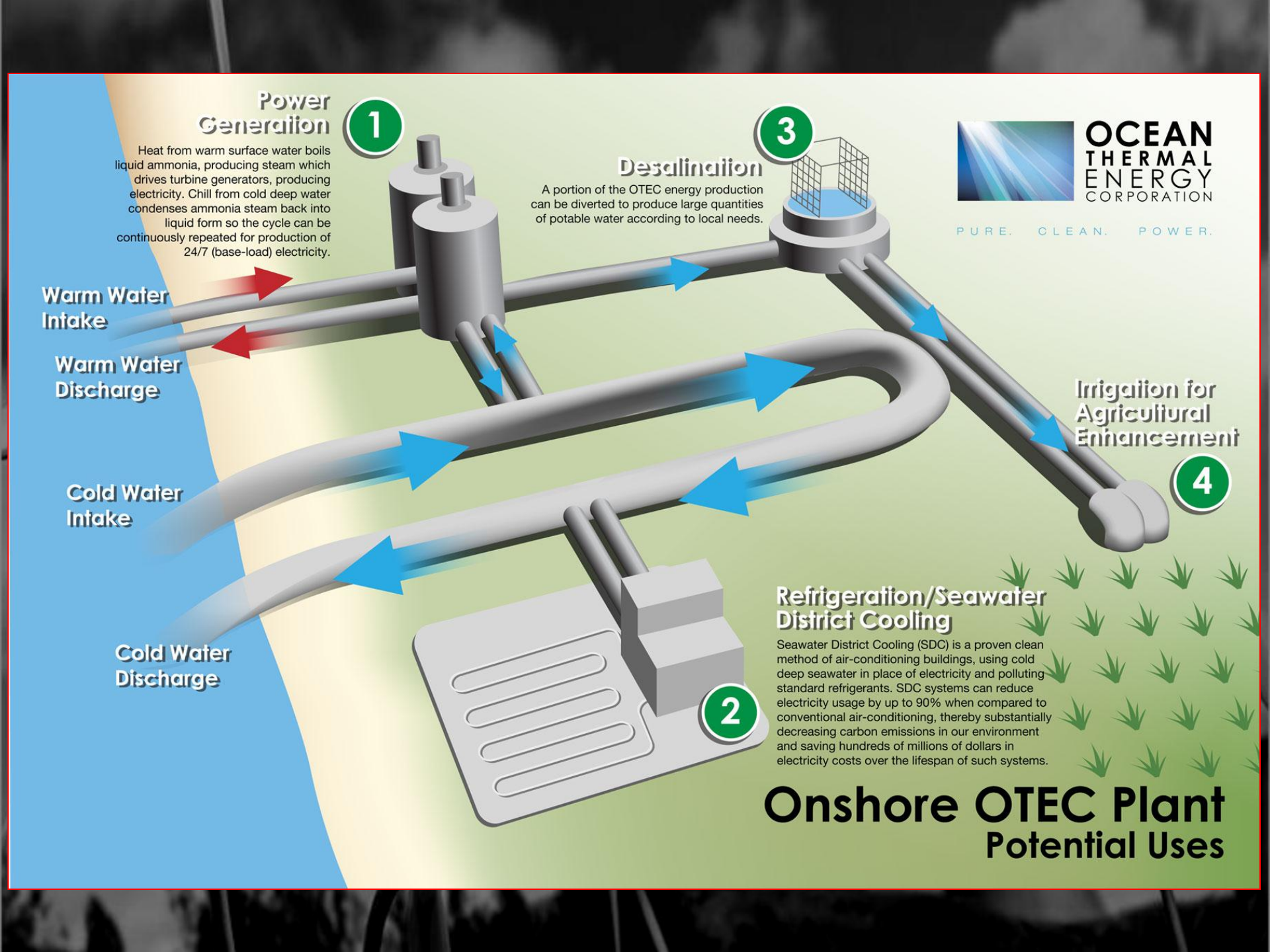
*Ocean thermal energy conversion (OTEC) is a process that produces electricity by exploiting the temperature differences between deep cold ocean water and warm surface water.*



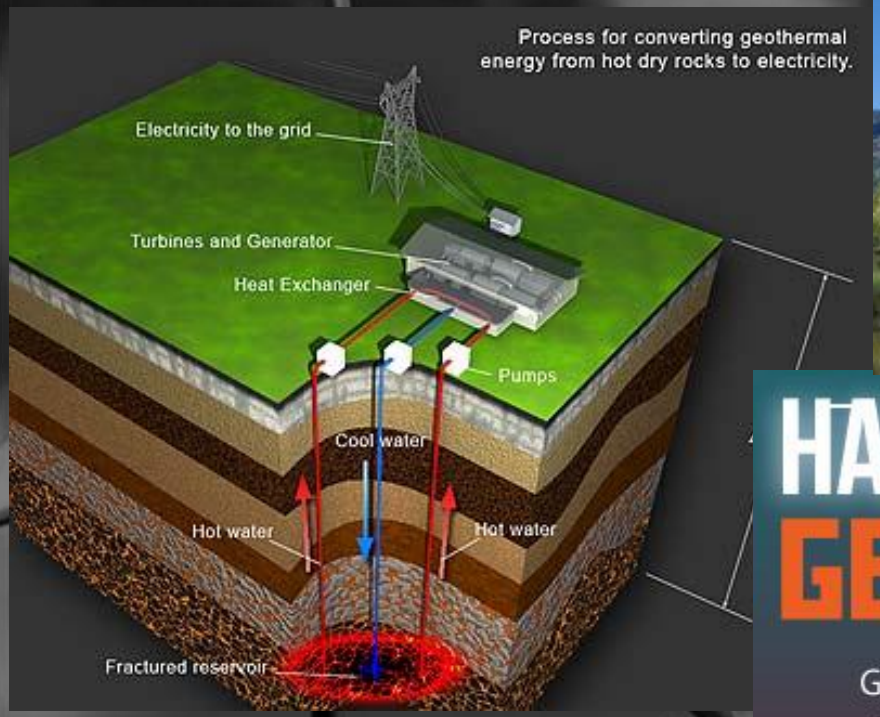



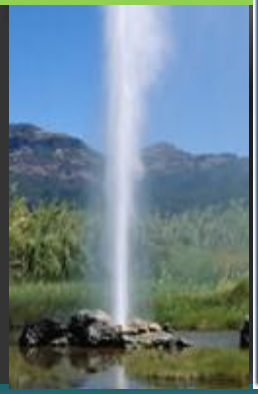

### THE PROCESS

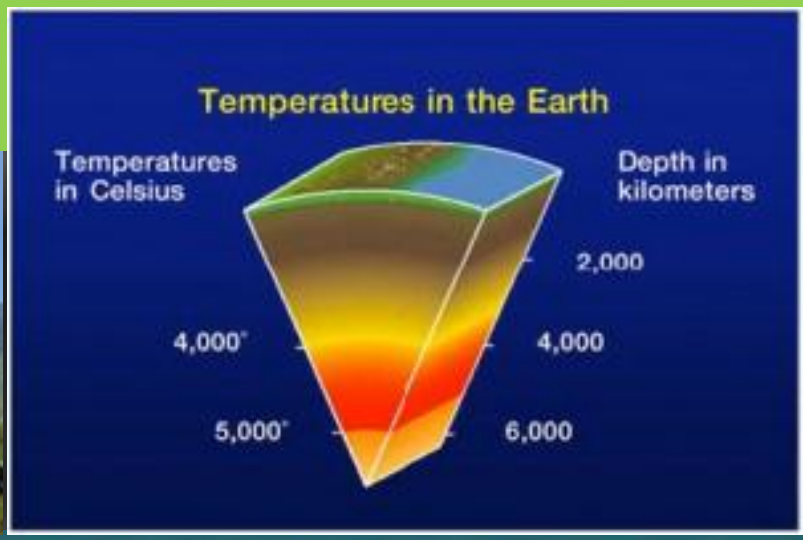
1. Warm seawater passes through an evaporator and vaporizes a working fluid, in this case ammonia
2. The ammonia vapor passes through a turbine, which turns a generator to make electricity
3. The lower pressure vapor passes through a condensor and returns to a liquid after being chilled by cold water
4. The liquid ammonia leaves and is pumped back to the evaporator to repeat the cycle

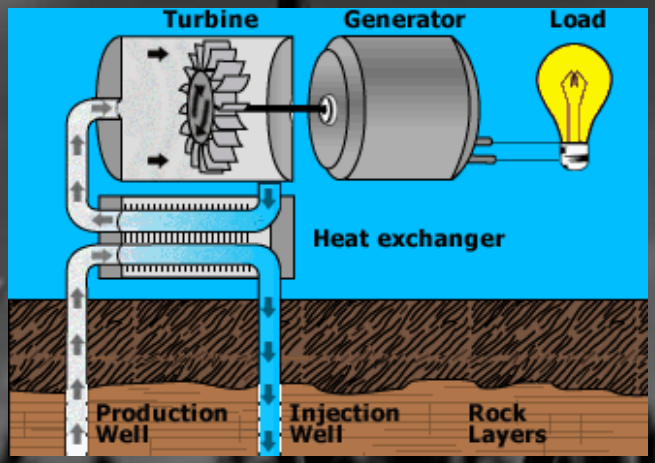

Power Generation
1
Heat from warm surface water boils liquid ammonia, producing steam which drives turbine generators, producing electricity. Chill from cold deep water condenses ammonia steam back into liquid form so the cycle can be continuously repeated for production of 24/7 (base-load) electricity.
Desalination
3
A portion of the OTEC energy production can be diverted to produce large quantities of potable water according to local needs.
OCEAN THERMAL ENERGY CORPORATION
PURE. CLEAN. POWER.
Warm Water Intake
Warm Water Discharge
Cold Water Intake
Cold Water Discharge
Irrigation for Agricultural Enhancement
4
Refrigeration/Seawater District Cooling
2
Seawater District Cooling (SDC) is a proven clean method of air-conditioning buildings, using cold deep seawater in place of electricity and polluting standard refrigerants. SDC systems can reduce electricity usage by up to 90% when compared to conventional air-conditioning, thereby substantially decreasing carbon emissions in our environment and saving hundreds of millions of dollars in electricity costs over the lifespan of such systems.
Onshore OTEC Plant
Potential Uses

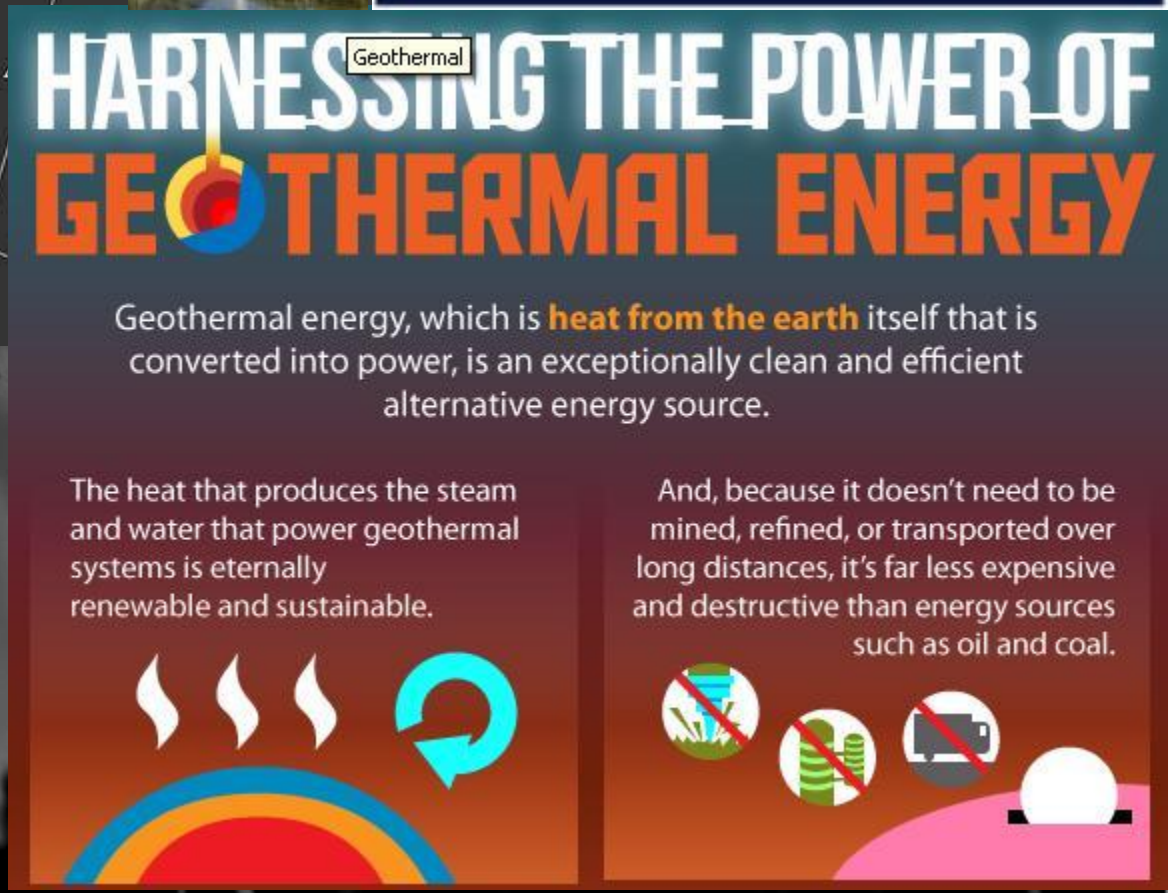
# Geothermal power

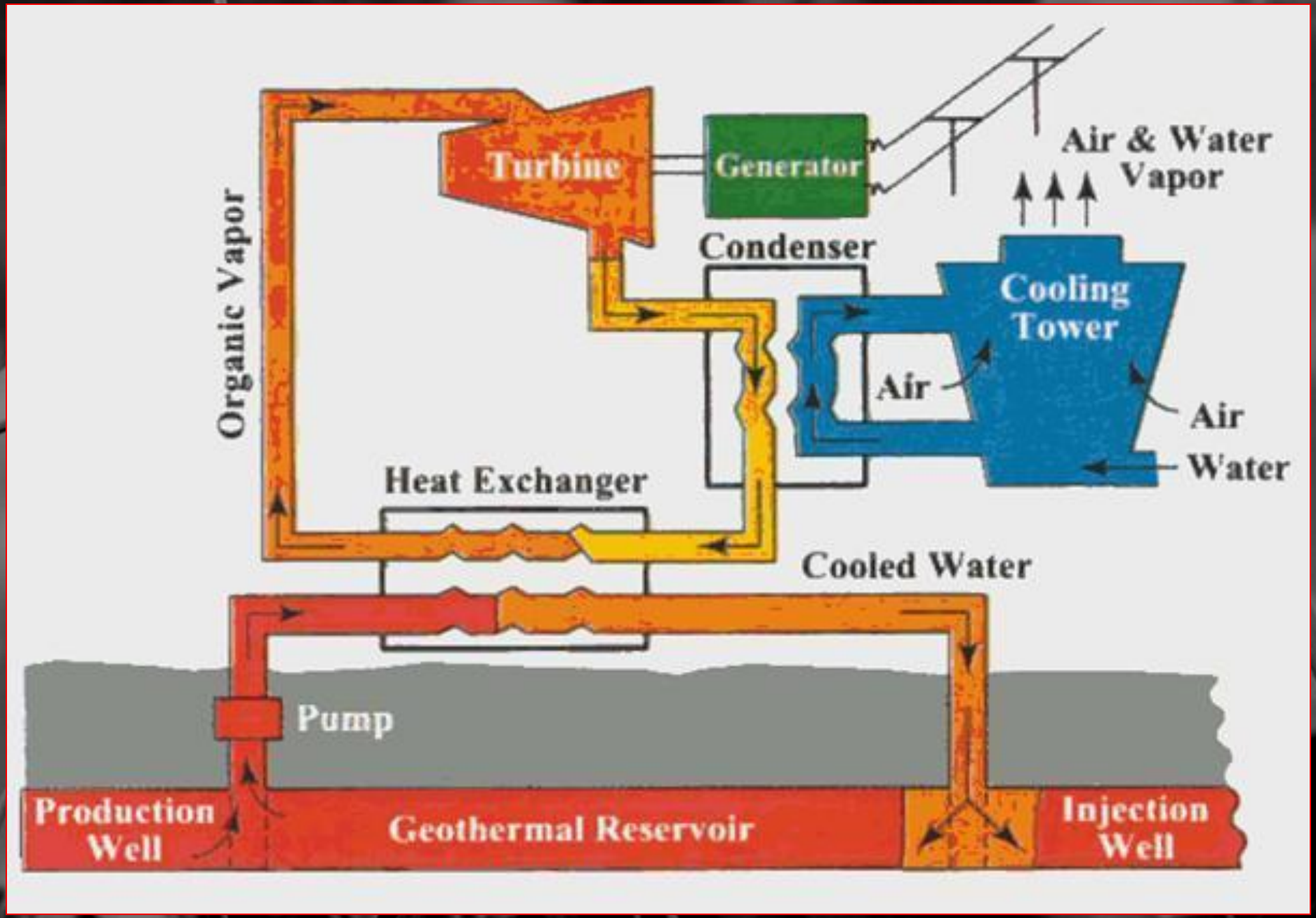





Turbine
Generator
Air & Water Vapor
Organic Vapor
Condenser
Cooling Tower
Air
Air
Water
Heat Exchanger
Cooled Water
Pump
Production Well
Geothermal Reservoir
Injection Well

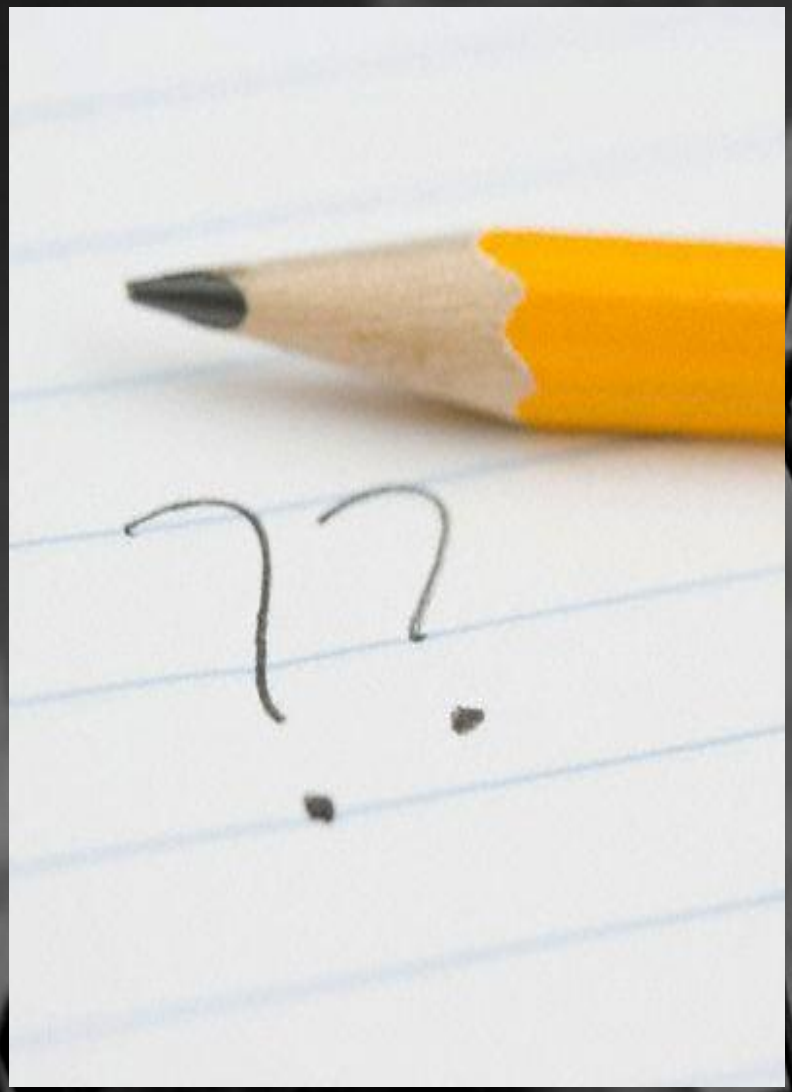
# Geothermal Projects in India

- http://www.eai.in/ref/ae/geo/geo.html

| Geothermal Field | Estimated (min.) reservoir Temp (Approx) | Status |
|---|---|---|
| Puga geothermal field | 240°C at 2000m | From geochemical and deep geophysical studies (MT) |
| Tattapani Sarguja (Chhattisgarh) | 120°C - 150°C at 500 meter and 200 Cat 2000 m | Magnetotelluric survey done by NGRI |
| Tapoban Chamoli (Uttarakhand) | 100°C at 430 meter | Magnetotelluric survey done by NGRI |
| Cambay Garben (Gujrat) | 160°C at 1900 meter (From Oil exploration borehole) | Steam discharge was estimated 3000 cu meter/ day with high temprature gradient. |
| Badrinath Chamoli (Uttarakhand) | 150°C estimated | Magneto-telluric study was done by NGRI<br>Deep drilling required to ascertain geothermal field |
| Geothermal Field | Reservoir Temp (Approx) | Status |
| Surajkund Hazaribagh (Jharkhand) | 110°C | Magneto-telluric study was done by NGRI.<br>Heat rate 128.6 $mW/m^2$ |

# SUMMARY

- What are the differences between nonrenewable and renewable resources?
- Different types of fuels & properties?



# REFERENCES


- http://www.petroleumbazaar.com/hsd/hsdappli1.html
- http://www.rgchandak.com/low_sulphur_heavy_stock_lshs.html
- http://en.wikipedia.org
- http://solarpower.com/how-does-solar-power-work/
- http://www.iorane.watervigorous.com/
- http://www.surviveclimatechange.com/geothermal-energy.html


Thank you!