
OCEAN ENERGY
TIDAL ENERGY
&
WIND ENERGY

OCEAN ENERGY

Overview of Ocean Energy

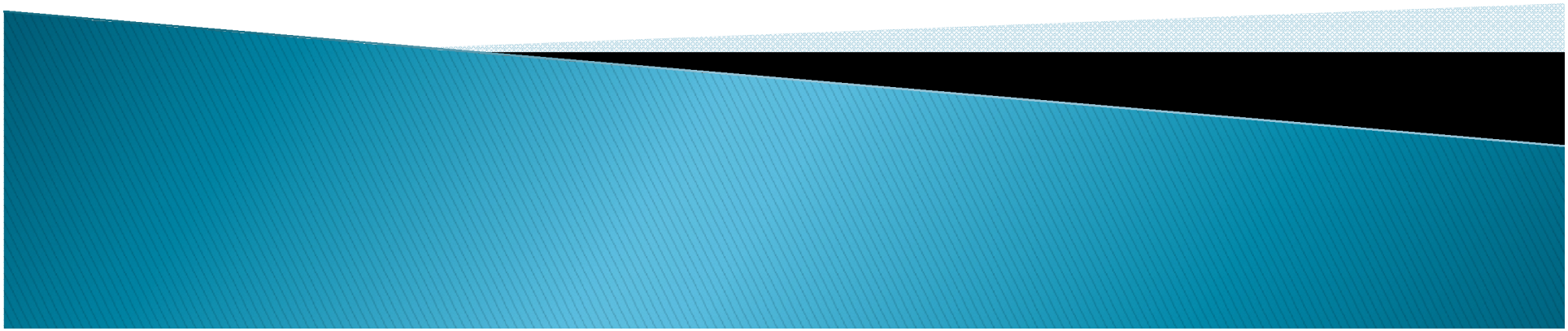
-ocean energy is replenished by the sun and through tidal influences of the moon's and sun's gravitational forces

-near-surface winds induce wave action and cause wind-blown currents at about 3% of the wind speed

-tides cause strong currents into and out of coastal basins and rivers

-ocean surface heating by some 70% of the incoming sunlight adds to the surface water thermal energy, causing expansion and flow

-wind energy is stronger over the ocean due to less drag, although technically, only seabreezes are from ocean energy



How much energy and what types?

-250 Billion barrels of oil worth of energy coming into ocean every day

-80 million barrels of oil per day produced

kinetic

potential

How much energy and what types?

-250 Billion barrels of oil worth of energy coming into ocean every day

-80 million barrels of oil per day produced

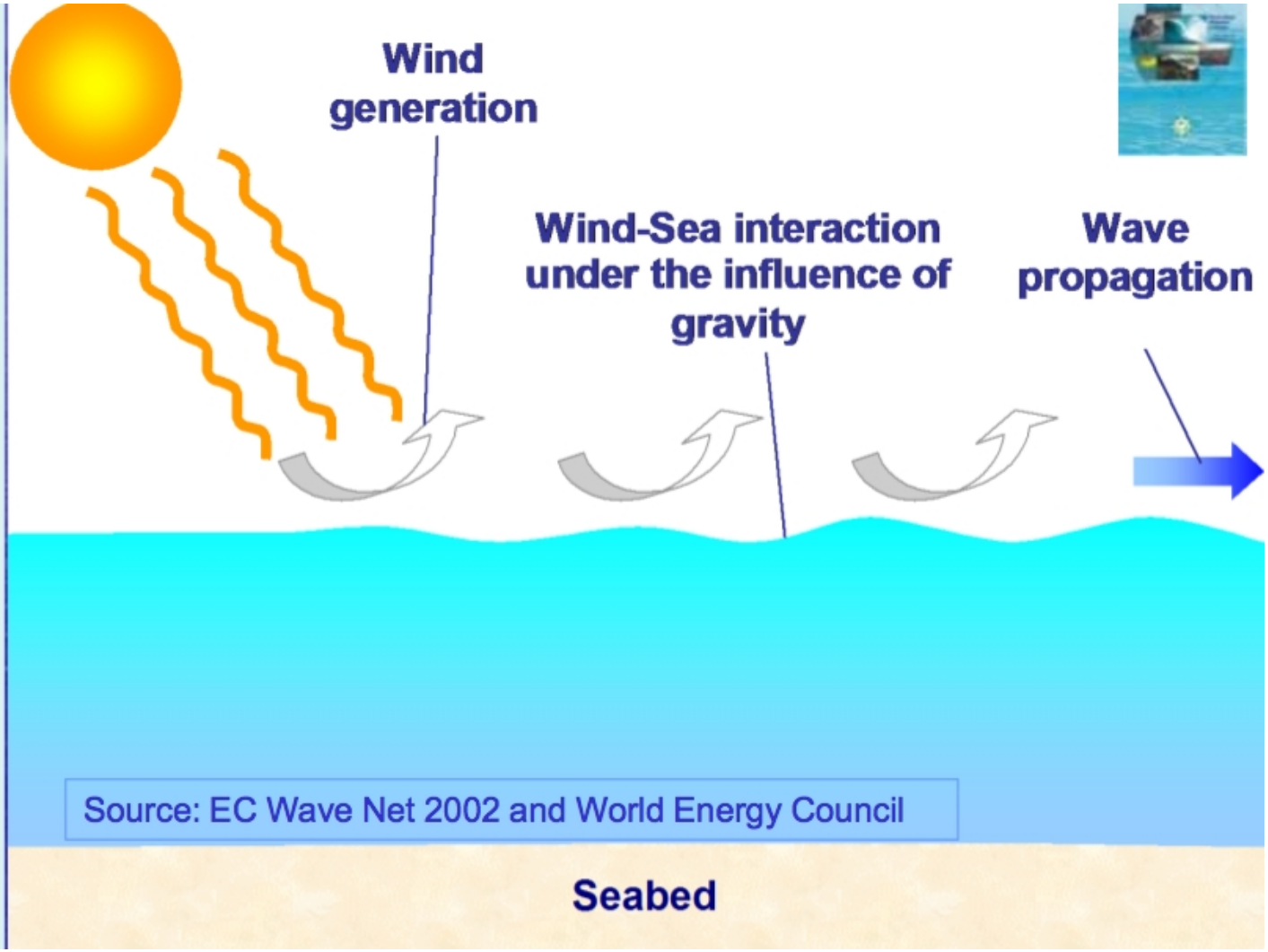
Theoretical global resource of ocean energy:

8,000-80,000 TWh/yr for wave energy
800 TWh/yr for tidal current energy
2,000 TWh/yr for salinity gradient energy
10,000 TWh/yr for ocean thermal energy

World's electricity consumption 17,000 TWh/yr

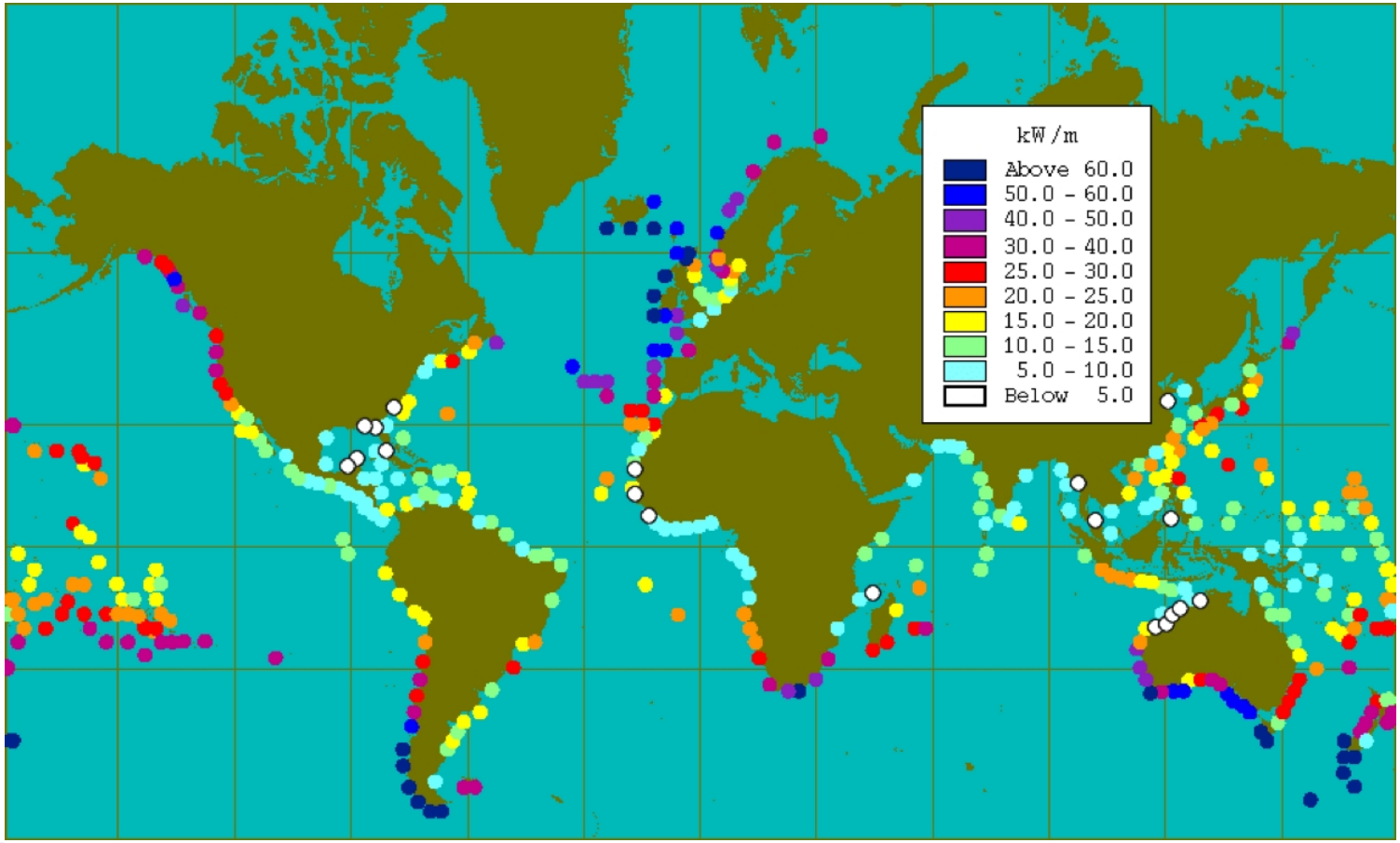
Source of Ocean Wave Energy

- Oceans cover 3/4 of earth's surface
- 0.1% ocean renewable energy is equivalent to 5 times world demand
- 50% of the worlds electricity consumption can be covered by wave energy



Power From Ocean Waves

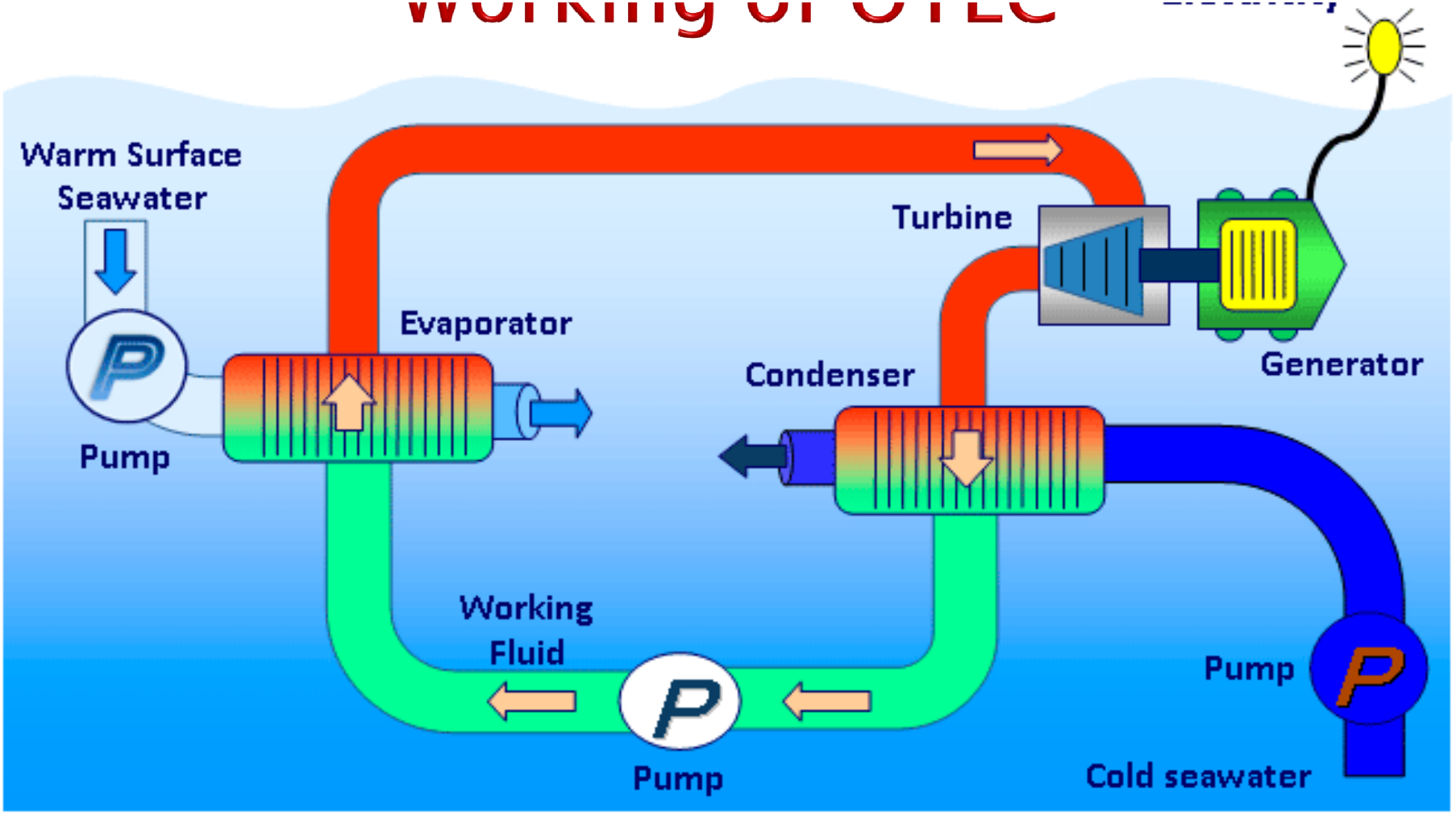
- Wave energy is strongest on the west coasts and increases toward the poles.
- At approx. 30 kW/mcl in the Northwest (yearly avg.), a single meter (3.3 feet) of wave has the raw energy to power about 23 homes.



OCEAN THERMAL ENERGY

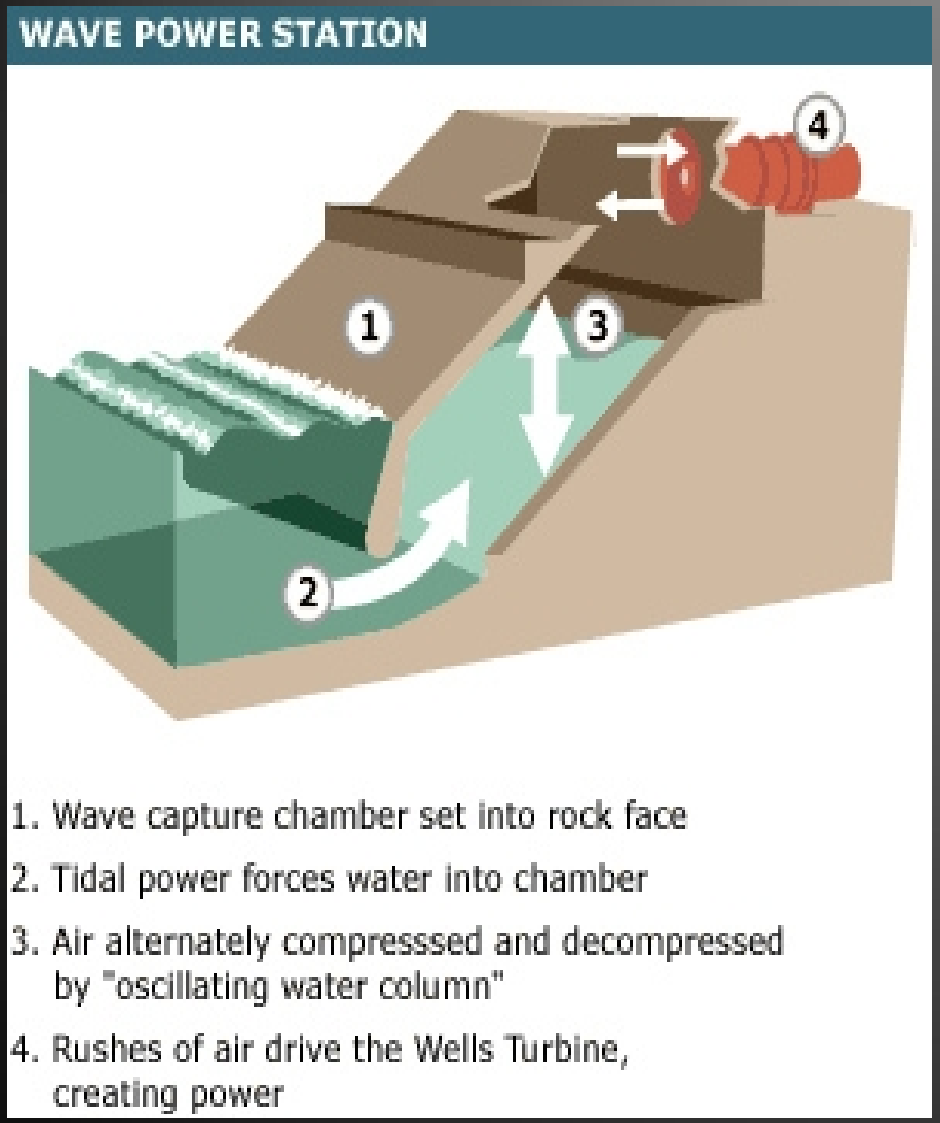
- The temperature difference between the surface water and the deep ocean water provides the exploitation of ocean thermal energy.
- This process is normally called Ocean Thermal Energy conversion (OTEC). Best works when the temperature difference is about 20 °C.
- The Natural Energy Laboratory of Hawaii Authority is one of the world's leading test facilities for OTEC technology.

Working of OTEC



1. Warm seawater and Cold seawater are pumped to the evaporator and condenser.
2. The cold working fluid is pumped to the evaporator
3. The evaporator uses the warm sea water to vaporise the working fluid
4. The vapor rotates the turbine thereby generating electricity
5. The vapor then enters the condenser where the cold seawater cools it to a fluid
6. The fluid returns to the pump and the cycle is repeated

Working of OWC

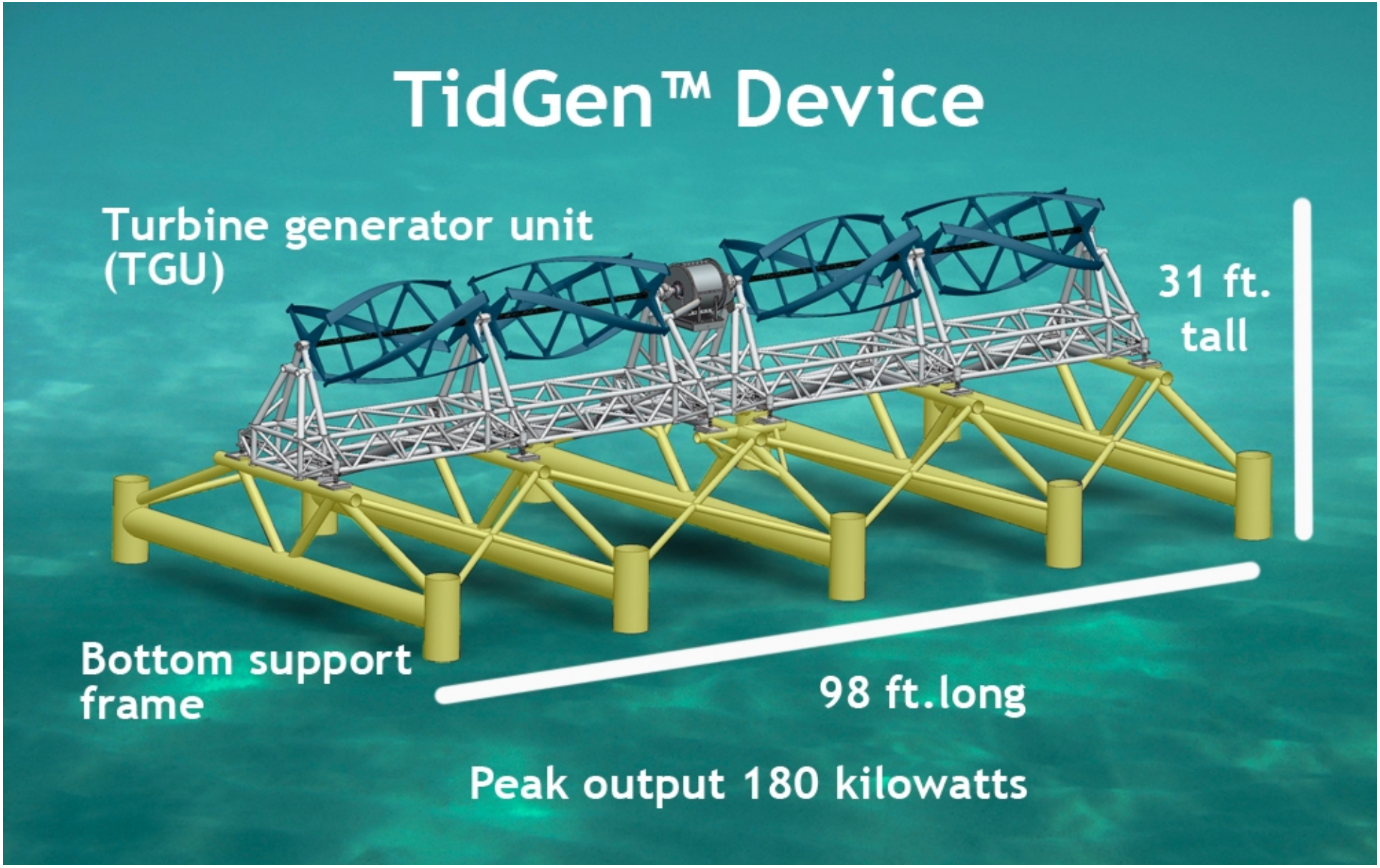


- An oscillating water column (OWC) is a wave energy converting technology that can be installed onshore preferably on rocky shores; nearshore in up to 10m of water; or offshore in 40-80m deep water. The device consists of a large wave capture chamber, a platform for an air turbine, a lip, wing walls, and an air chamber. When waves approach the device, they enter under the partially submerged lip that traps air in a piston type system, forcing the air upwards through the air turbine. This pressure forces the turbine to spin, which is how the energy is harnessed by the waves. As the waves retreat, air enters back into the air chamber from the other side of the turbine.

Oscillating Water Column Installations:OCEAN

OceanLynx, Australia
2004, 450 kW

OE Buoy, Ireland
2008, 15 kW



Ocean Renewable Power Company installed first grid-connected tidal device in Cobbscook Bay, Maine in June, 2012. Powers 25 homes.

TIDAL ENERGY

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).

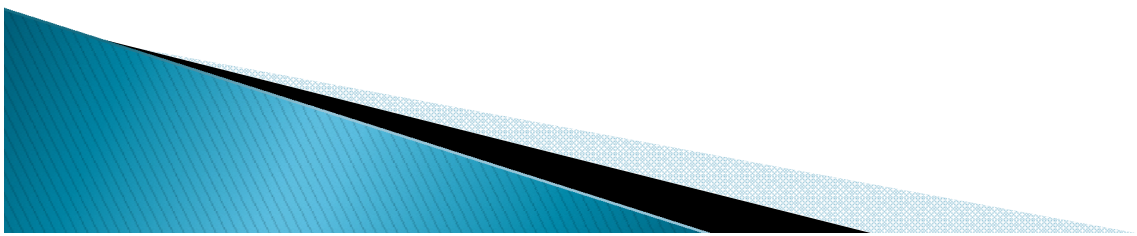
During high tide, the water flows into the dam and during low tide, water flows out which result in turning the turbine.

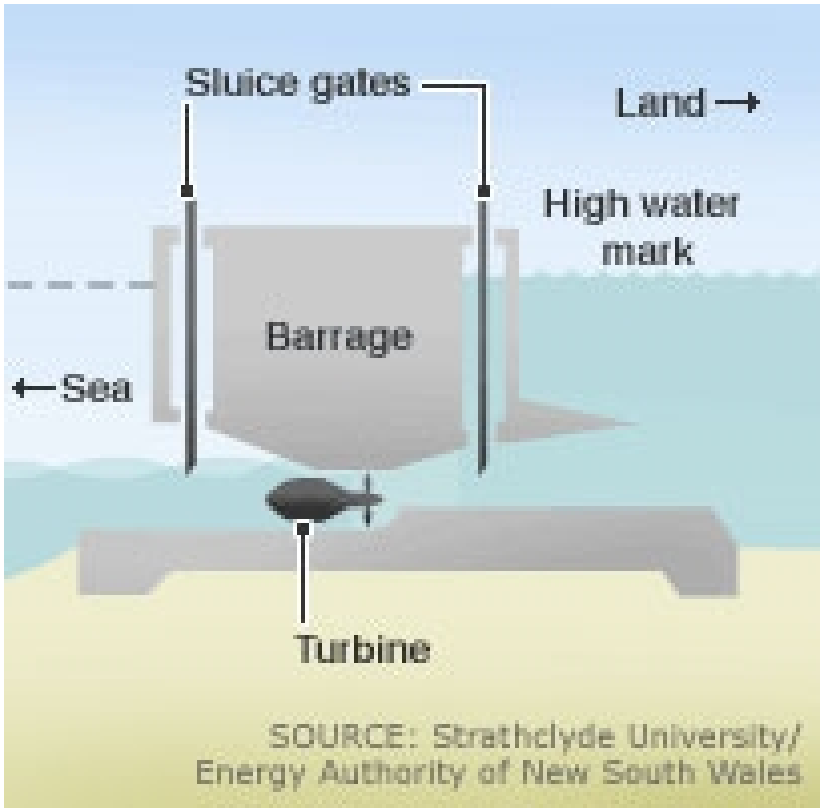
Ocean tides are the periodic rise and fall of ocean water level occurs twice in each lunar day.

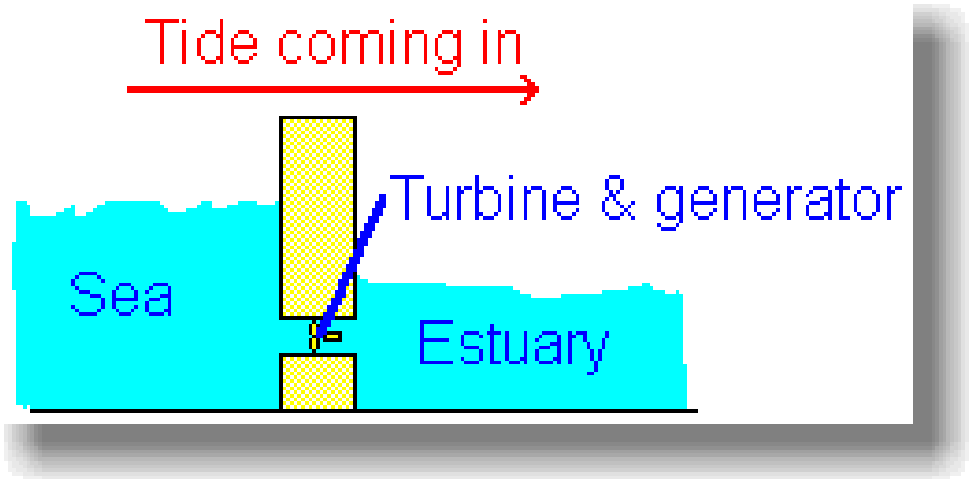
During one lunar day (24.83 H) the ocean water level rises twice and fall twice.

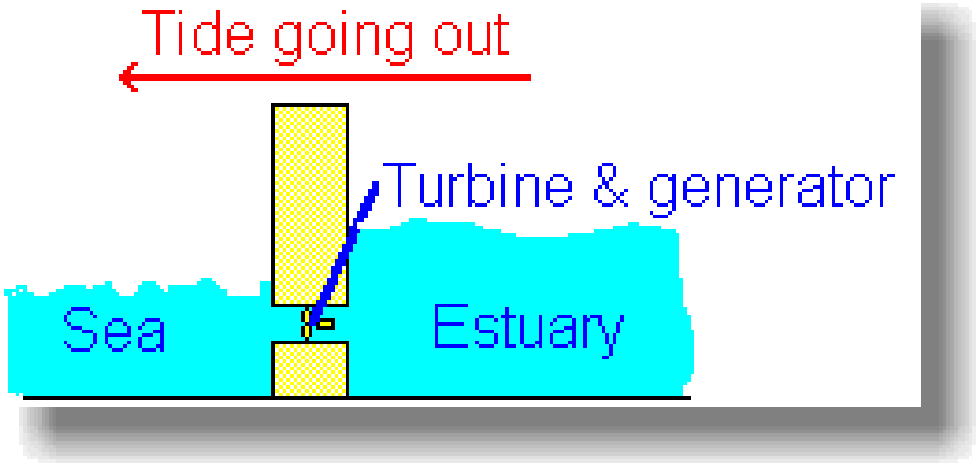
Time interval between a consecutive low tide and high tide is 6.207 hrs.

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



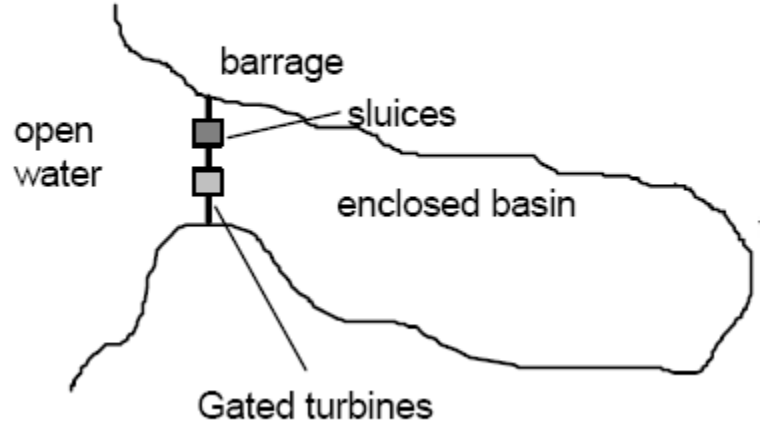

Sluice gates
Land
High water mark
Barrage
Sea
Turbine
SOURCE: Strathclyde University/
Energy Authority of New South Wales

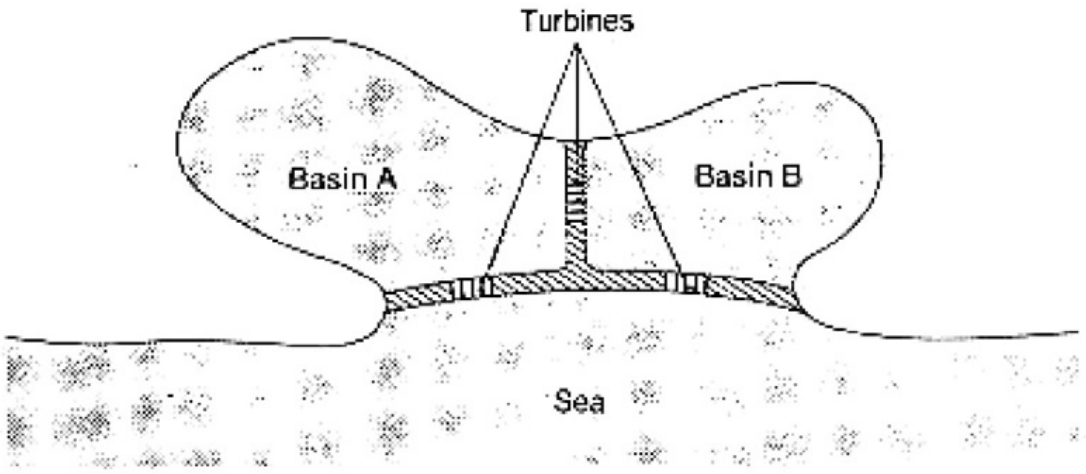

Tide coming in
Turbine & generator
Sea
Estuary


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





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.

WIND ENERGY

Wind in action:

When wind strikes an object, it exerts a force in an attempt to move it out of the way. Some of the winds' energy is transferred to the object, in this case the windmill, causing it to move.

Wind Today!!!

✓Windmills are used for pumping water from deep underground.

✓Modern wind turbine is the result of design and material advances made during the 1980s and 1990s, which enabled wind turbines to become increasingly efficient.

✓Today, wind turbines are size same as the traditional European windmill. It can generate 250 to 300 kilowatts of power- a nearly tenfold increase in efficiency.

History of Wind usage:

✓ one of the earliest energy resources.

✓Recorded in history, first to power boats and grind grain, later to pump water, press oil, saw lumber and make paper.

✓Windmills were developed in Persia and used paddles made of bundled reeds.

✓Egyptians may have been the first to go up the Nile river around 4th century B.C, powered by wind.

✓Ancient Chinese used vertical axis windmills to grind grain and pump water.

✓Windmills were introduced to Europe by the crusaders around 1300 A.D

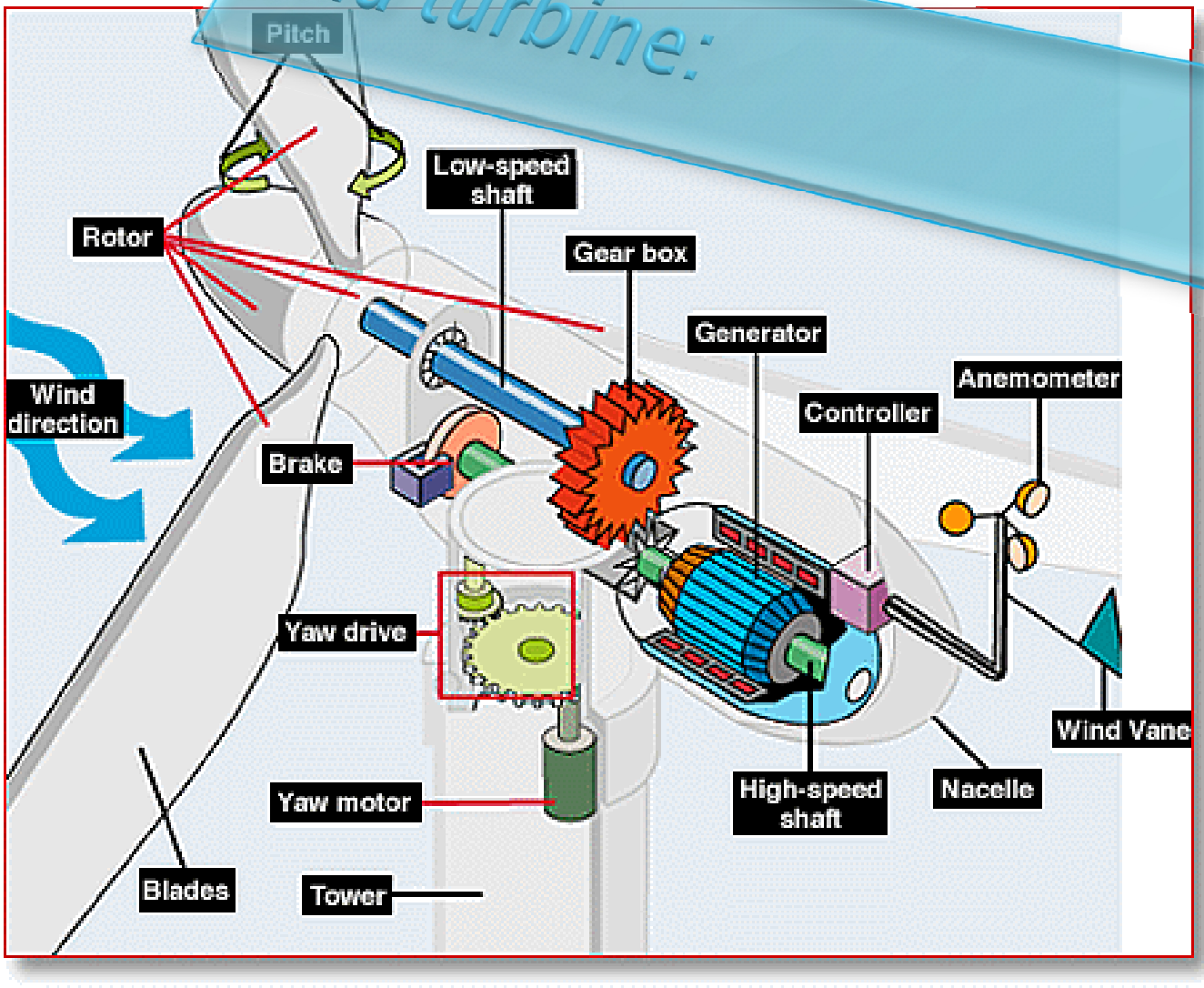
*windmills used for pumping water.

Wind turbines convert **the kinetic energy** in the wind into **mechanical power.**
This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity.

A wind turbine works the opposite of a fan.
Instead of using electricity to make wind, like a fan, wind turbines use **wind to make electricity**. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity.

The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity.
Wind turbines are mounted on a tower to capture the most energy. At 100 feet (30 meters) or more above ground, they can take advantage of faster and less turbulent wind.

wind turbine:



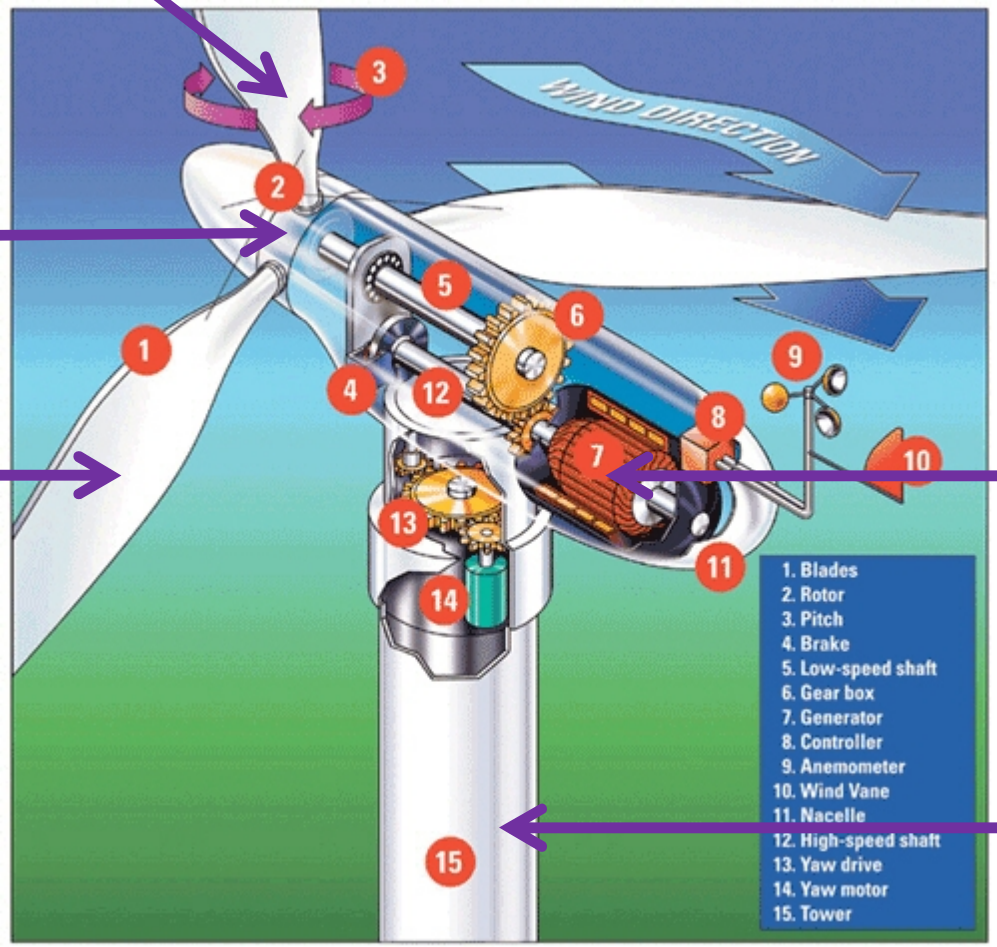
A Wind Turbine

A Wind Turbine

Pitch

Rotor

Blades

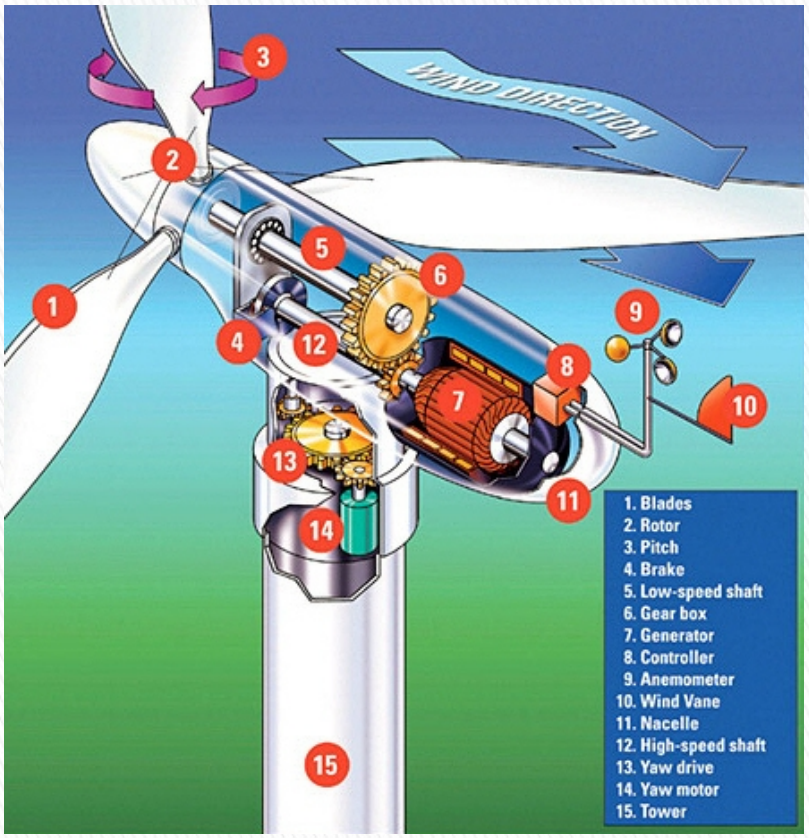


Generator

Tower

Specific components

Wind turbine



Description

2. Is the rotor. The rotor provides the blades to rotate. 4. This is brake. It's very important to have a brake in a wind turbine, if something is wrong or it is going to fast. Then it will brake and stop the wind turbine. 5. is a low-speed shaft, it goes into a big cog wheel and this goes into a smaller cog wheel. The small cog wheel rotates faster than the big cog wheel. 7. This is the generator. It's almost like a generator in a car. 13. It's a yaw draw, it makes the wind turbine rotate in the wind direction.

How the does a wind turbine works?

Wind turbines operate on a simple principle:

The energy in the wind turns the propeller-like blades around a rotor. The pitch of the blades makes optimum use of the wind direction.

The rotor is connected to the main drive shaft, which spins a generator to create electricity.

Wind turbines are mounted on a tower to capture the most energy. At 30 metres or more above ground, they can take advantage of faster and less turbulent wind.

Wind turbines can be used to produce electricity for a single home or building, or they can be connected to an electricity grid for more widespread electricity distribution.

ADVANTAGES & DISADVANTAGES

Advantages:

- No pollution.
- Lowest prices renewable resources
- Don't produce atmospheric emissions that cause acid rains and green house effects.

Disadvantages:

- Depending on how energetic a wind site is, the wind farm may or may not be cost competitive.
- Wind energy cannot be stored (unless batteries are used)
- Good wind sites are often located in remote locations
- Wind resource development may compete with other uses for the land and those alternative uses may be more highly valued than electricity generation.
- sometimes birds have been killed by flying into the rotors


Jaisalmer wind farm
[The 2 largest off shore wind farm in the world]


London Array
[Worlds largest on shore wind farm]

GENERAL ADVANTAGES

- Wind energy is friendly to the surrounding environment, as no fossil fuels are burnt to generate electricity from wind energy
- Wind turbines requires less space than average power stations.
- When combined with solar electricity, this energy source is great for developed and developing countries to provide a steady, reliable supply of electricity

GENERAL DISADVANTAGES

- The main disadvantage regarding wind power is down to the winds unreliability factor. In many areas, the winds strength is not enough to support a wind turbine
- Wind turbines generally produce allot less electricity than the average fossil fuelled power station, which means that multiple wind turbines are needed to make an impact.