L22 Chemistry Applied Power Stations II

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Little River Band (LRB) - Cool Change (1979)

Topics & Concepts

Fossil Fuels

1. Coal Fired Power Stations
2. Gas Turbines
3. Diesel Generators

Nuclear

4. Pressurized Water Reactors
5. Small Modular Reactors
6. Fusion Reactors

Renewables

7. Wind & Wave
8. Hydroelectric
9. Solar Voltaic
10. Solar Thermal
11. Geothermal
12. Tidal

Renewables

(Wind, Rain, Sunshine, Earth Heat & Gravity)

Wind Power

The Sun heats the air and creates the wind.

Capturing the wind for energy is hardly new, our ancestors did it thousands of years ago. Wind mills, which are flour mills powered by the wind, first appeared around 1,200 years ago. Wind pumps are still used today in the Netherlands to drain flooded wetlands.

In the old American west every farm had a wind pump to draw water up from under the ground. Many farms still have them today.

Wind is reliable, clean, free and everywhere.


Wind mill


Wind pump


Wind pump


Wind turbine

Wind Power at Sea

Using the wind as a source of energy is how we used to cross oceans. It is how the Spanish conquered the Americas, how the Dutch and Portuguese colonised the East Indies and how the British built a global Empire. It was all thanks to wind power.

Also, building wind turbines on land can be unsightly, noisy and they prove dangerous to birds and bats.

So if you want to capture the wind, the place to do that is at sea.

Duran Duran - Rio (1982)

Wind Power at Sea

Traditionally wind mills, wind pumps and more recently wind turbines were located on land.

But it is often far windier at sea. So it makes sense to put the wind turbines out at sea.

The United Kingdom leads the world in offshore wind farms. In recent years they have constructed farms with thousands of massive wind turbines off both the east and west coasts of Britain.

They closed and demolished their coal fired power stations decades ago and replaced them with free, clean, environmentally friendly wind power.

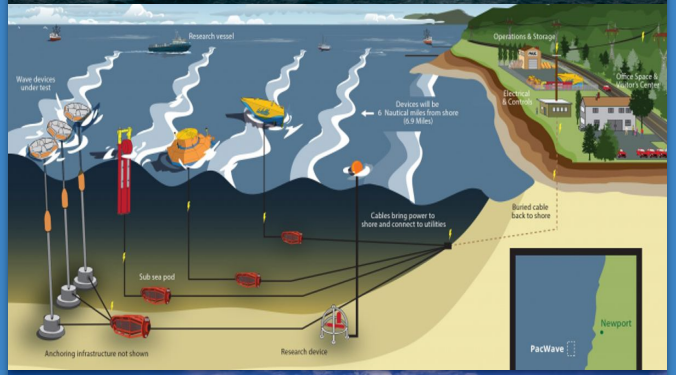
Wind Power

Wave Power

Wind creates waves at sea.

We can also capture wave energy close to shore from the seas. Wave energy is renewable, reliable, accessible, high-energy, clean, provides economic advantages and doesn't cause any land damage.

The United Kingdom has the maritime expertise, offshore engineering experience and supply chains to lead the world in harnessing wave energy. Sweden is also building wave power installations for themselves and other countries.



Wave Power

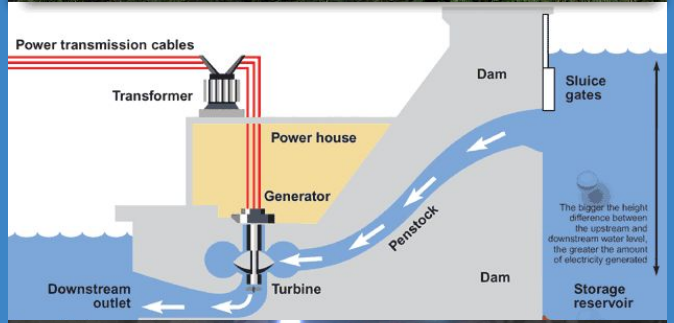
Hydroelectric Power

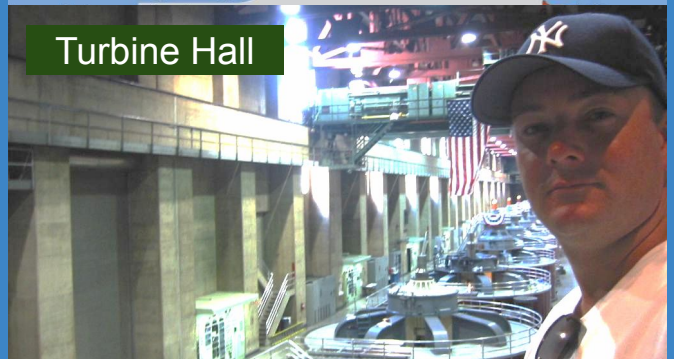
Hydroelectric power relies on rain.

The rain falls on the mountains and flows down through streams and collects in small rivers which feed larger rivers. You can build a dam wall across the smaller rivers to create a reservoir where you store the water. Damming smaller rivers has a far smaller impact on the environment compared with damming the larger rivers.

Then when you need electricity you allow the water to flow past the turbines, which turn the generators which make electricity.


Dam Wall




Turbine Hall

Hydroelectric Power

Solar Voltaic

A solar cell or photovoltaic cell (PV cell) is an electronic device that converts the energy of light directly into electricity by means of something called the photovoltaic effect.

We have come a long way in recent decades. They are now very efficient, relatively inexpensive and used extensively all over the world. They can be used to power a single device, a home, a business, a hotel or entire farms can be established to power a town or even a city. Many countries around the world are including photovoltaics into their power mix. China leads the world in both production and installation.

Solar Voltaics

Solar Thermal

Solar thermal plants uses a large number of mirrors to direct the sunlight to a single point.

The heat of the Sun then heats up and melts salt. This liquid salt then heats water to make steam. The steam then turns a turbine, which turns a generator to make electricity.

It uses heat to make steam, like a coal fired plant would do, but creates no emissions and requires no mining or transport. There are currently around 100 solar thermal plants worldwide with many more on the way.

Solar Thermal

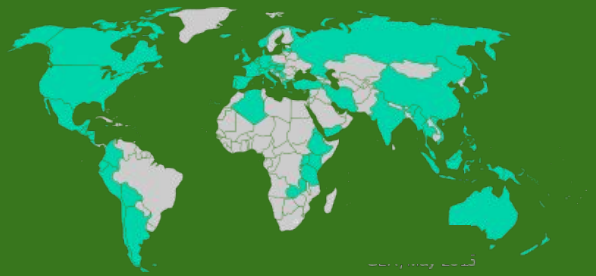
Geothermal Power

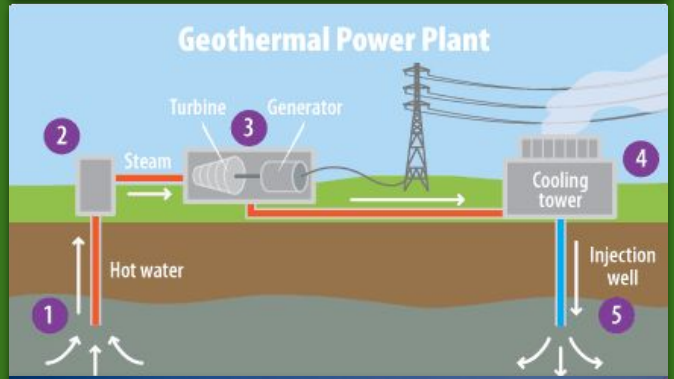
Geothermal power uses the hot magma in the Earth to boil water to make steam.

It was thought that only a handful of countries, such as Italy, Iceland, Japan and New Zealand had the right geology for this.

But in recent years, after exploration and study it has become possible to produce electricity from geothermal sources all over the world.

Countries with geothermal power generation as of 2015





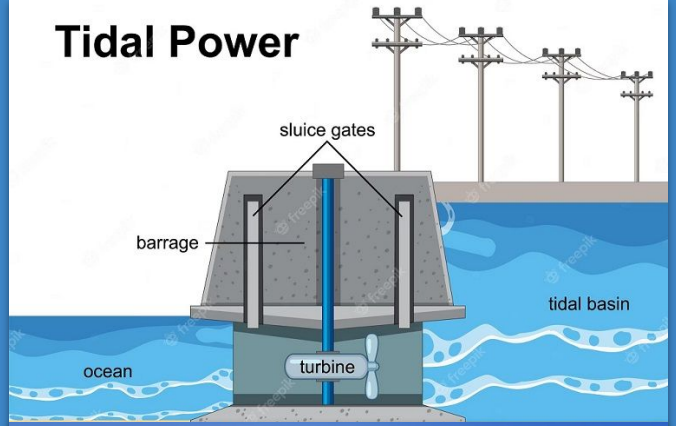
Geothermal Power

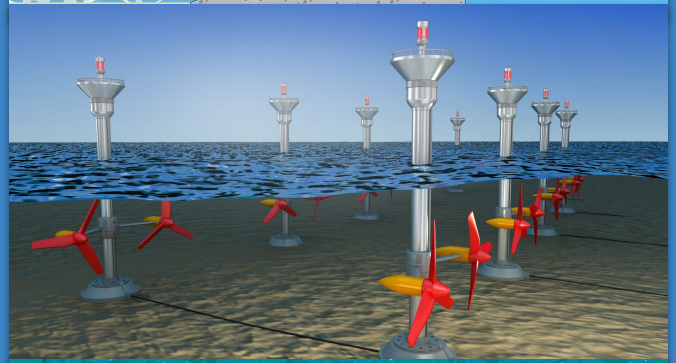
Tidal Power

Tidal stream power systems take advantage of ocean currents to drive turbines, particularly in areas around islands or coasts where these currents are fast.

They can be installed as tidal fences, where turbines are stretched across a channel, or as tidal turbines, which resemble underwater wind turbines.

There are currently only 11 tidal plants worldwide in South Korea, France, the United Kingdom, Denmark, Russia and China.





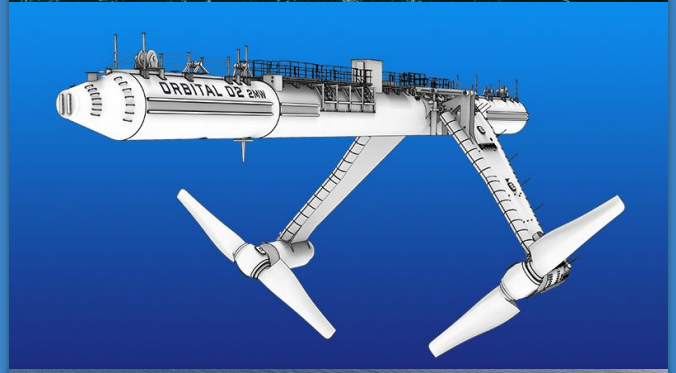
Tidal Power

Tidal Power

There are many differing designs for tidal power capturing systems around the world. One such successful one is built by Orbital Marine Power in Scotland, in the United Kingdom.

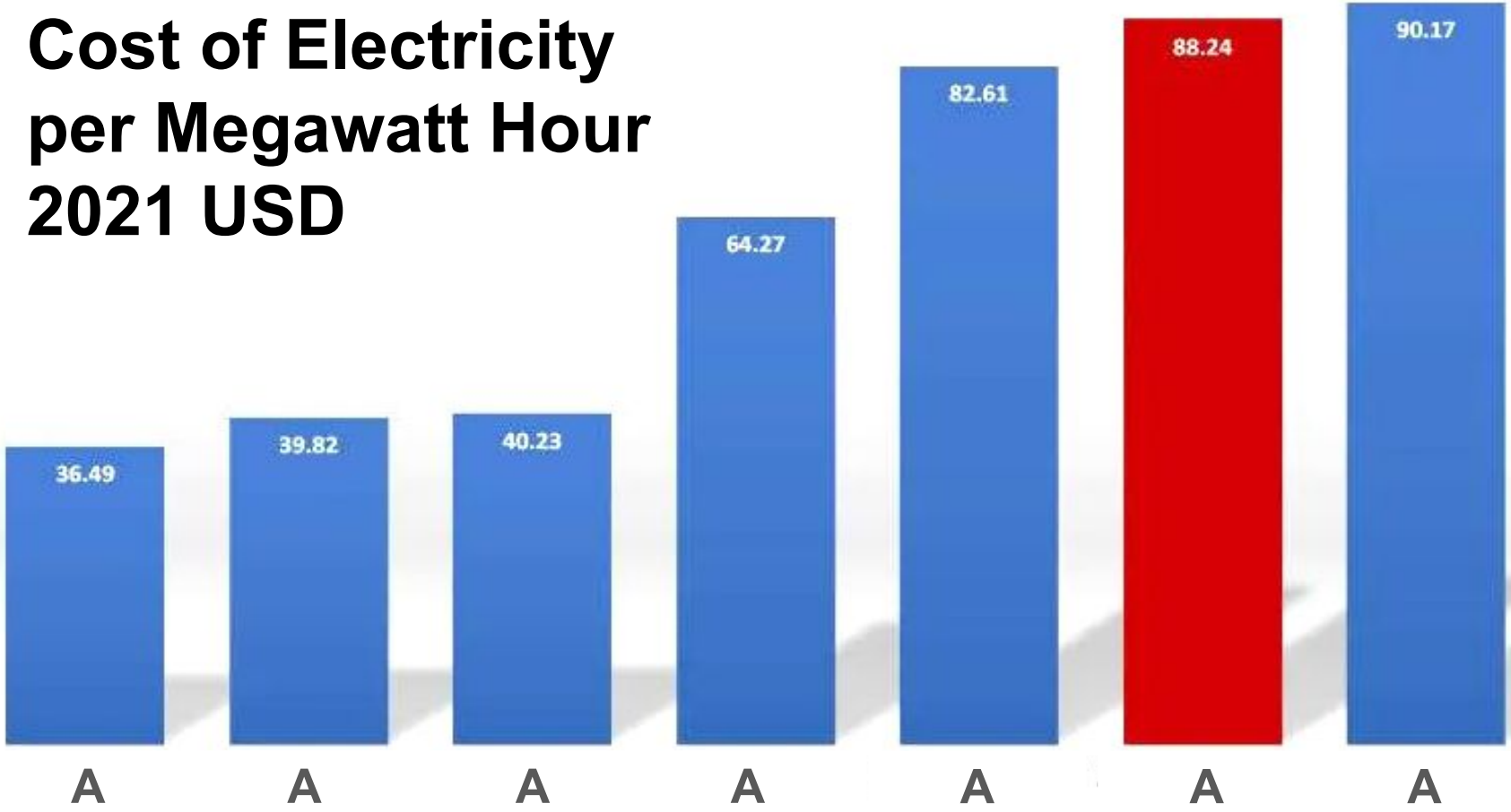
The O2 is Orbital's first commercial twin turbine and represents the culmination of more than 15 years of world leading product development in the UK, commissioned in 2021.

Each unit produces around 2.4 MW and can serve around 2,000 homes. Therefore an array of units is planned to for installation providing clean, free electricity to the mainland.



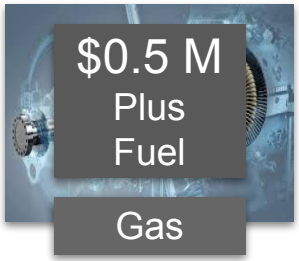
Tidal Power

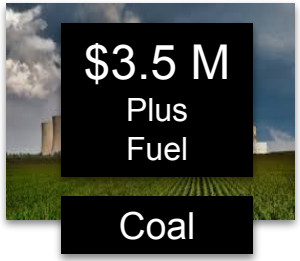
Cost of Electricity per Megawatt Hour 2021 USD



Cost of Construction per Megawatt Hour 2021 USD

1. Coal
2. Gas
3. Nuclear
4. Wind
5. Wave
6. Hydro
7. Solar PV
8. Solar Thermal
9. Geothermal
10. Tidal






English with
2 Little Pigs
The End