**DEFEND THE PLANET!**

**Renewable energy:**

Renewable energy is energy that comes from resources which are **constantly replenished**, such as **sunlight**, **water**, **wind**, **waves**, **tides**, and **Earth’s internal heat**. These sources naturally restore themselves and do not run out. They produce **little or no pollution** and are essential for reducing **climate change** and dependence on **fossil fuels**.

**Solar Power:**

Solar power is energy produced by the **sun**. Solar panels, made with **photovoltaic (PV) cells**, are placed on the roofs or walls of buildings and convert sunlight into electricity.

**Technical process:**

1. Sunlight reaches the PV cells.
2. The PV cells absorb solar energy and release electrons.
3. These electrons generate a direct current (DC).
4. The DC flows through wires to an inverter.
5. The inverter transforms DC into alternating current (AC).
6. The AC is used to power homes and devices.

In this system, the **inverter** acts as the **generator**, since there is no mechanical movement and no need for an alternator. Some solar panels operate using **PV electricity**, while others use **solar thermal energy**. PV electricity is used to power homes, while solar thermal energy is used to heat water. These two systems often work together to reduce **energy bills** and **carbon emissions**. Solar power is one of the most accessible and widely used renewable sources.

**Real-world example**: Solar panels are widely used across **northern Australia**, where solar exposure is high and ideal for installations.

**Hydroelectric Power:**

Hydroelectric power comes from **rivers**. Water is stored in **large dams** and used to generate electricity by harnessing the energy of moving water.

**Technical process:**

1. Water is channelled through pipes.
2. It flows at high pressure and spins turbines.
3. The turbines activate an alternator.
4. The alternator converts mechanical energy into electrical energy.
5. The electricity is then delivered by a generator.

Hydroelectric power uses the movement of water to generate electricity, often through dams. This massive infrastructure demonstrates how powerful and scalable hydroelectric energy can be.

**Real-world example**: The **Three Gorges Dam** in **China** is the **largest hydroelectric power station** in the world.

**Wind Power:**

Wind power uses the wind to drive a **turbine** with a **propeller**, similar to those found on airplanes. When the wind blows, it hits the blades of the wind turbine, causing them to rotate.

**Technical process:**

1. The wind pushes against the blades.
2. The blades rotate and spin a rotor.
3. The rotor activates an alternator.
4. The alternator converts mechanical energy into electrical energy.
5. The electricity is then delivered by a generator.

Wind turbines capture the wind’s **kinetic energy** and convert it into electricity. Wind power is one of the fastest-growing energy sources in the world due to its **efficiency** and **low environmental impact**.

**Real-world example**: Offshore wind farms like the **London Array** in the **Thames Estuary**, with **175 turbines**, benefit from strong, consistent winds and represent one of the **largest installations in Europe**.

**Tidal Power:**

Tidal power, also called **tidal energy**, is a form of hydro power that converts the energy of **tides** into electricity. It is more **predictable** than wind and solar energy.

**Technical process:**

1. Sea levels rise and fall with the tides.
2. Water is channelled through underwater tunnels or barrages.
3. The moving water spins turbines.
4. The turbines activate an alternator.
5. The alternator converts mechanical energy into electrical energy.
6. The electricity is then delivered by a generator.

Tides follow regular cycles, making this energy source highly **reliable**.

**Real-world example**: The **Sihwa Lake Tidal Power Station** in **South Korea** is the **largest tidal power installation** in the world.

**Wave Energy:**

Wave energy is created by the movement of **waves**, while tidal energy relies on **sea level changes**. Both use the motion of water to produce electricity, but wave energy focuses on **surface movement**.

**Technical process:**

1. Waves move floating or submerged devices in the sea.
2. These devices activate internal mechanical parts.
3. The motion spins a rotor.
4. The rotor powers an alternator.
5. The alternator converts mechanical energy into electrical energy.
6. The electricity is then delivered by a generator.

Wave energy offers powerful alternatives, especially in **coastal and oceanic regions**, though it is still **under development**.

**Real-world example**: Experimental wave energy devices are being tested in **Portugal**, **Scotland**, and **Australia**, particularly along **coastal zones**.

**Geothermal Energy:**

Geothermal energy comes from the **heat inside the Earth**. It is especially effective in **volcanic regions**, where underground temperatures are high.

**Technical process:**

1. Underground heat warms water stored in deep reservoirs.
2. The heated water turns into steam.
3. The steam spins turbines.
4. The turbines activate an alternator.
5. The alternator converts mechanical energy into electrical energy.
6. The electricity is then delivered by a generator.

Geothermal energy is a **renewable source** with **low emissions**, and it works continuously, day and night.

**Real-world example**: **Iceland** and **Italy** use geothermal energy extensively, especially in areas with volcanic activity.

**Fossil Fuels (Non-Renewable):**

Fossil fuels include **coal**, **oil**, and **natural gas**, which are formed from ancient organic matter over millions of years.

**Technical process:**

1. Fossil fuels are burned to produce heat.
2. The heat turns water into steam.
3. The steam spins turbines.
4. The turbines activate an alternator.
5. The alternator converts mechanical energy into electrical energy.
6. The electricity is then delivered by a generator.

Fossil fuels are **non-renewable** and release **carbon dioxide**, contributing to **climate change** and **air pollution**.

**Real-world example**: Many countries still rely on **coal-fired power stations**, such as those in **India**, **China**, and parts of **Eastern Europe**.

**Nuclear Energy (Non-Renewable):**

Nuclear energy is produced by **fission**, and in the future, possibly by **fusion**. Fission is the process of splitting atoms to release energy.

**Fission technical process:**

1. Atoms like uranium are split to release heat.
2. The heat turns water into steam.
3. The steam spins turbines.
4. The turbines activate an alternator.
5. The alternator converts mechanical energy into electrical energy.
6. The electricity is then delivered by a generator.

Fission produces **no carbon emissions**, but it creates **radioactive waste** that must be safely stored.

**Real-world example**: Countries like **France**, **USA**, and **China** use nuclear power extensively in their energy mix.

**Fusion Energy (Potentially Renewable):**

Fusion combines **light atoms** like **deuterium** and **tritium** to release energy — the same process that powers the **sun**.

**Fusion technical process (future):**

1. Light nuclei fuse under extreme heat and pressure.
2. Fusion releases massive amounts of energy.
3. The heat produced could be used to turn water into steam.
4. The steam spins turbines.
5. The turbines activate an alternator.
6. The alternator converts mechanical energy into electrical energy.
7. The electricity is then delivered by a generator.

Fusion is **clean**, **abundant**, and **renewable**, but it is still **experimental**.

**Real-world example**: The **ITER Project** in **France** is the world’s largest fusion research facility, aiming to demonstrate large-scale fusion energy.