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Harnessing the Power of
Mother Nature

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GLOBAL WARMING

Global warming is the biggest threat being faced by mankind today. It occurs when the earth heats up. It happens when greenhouse gases¹ trap heat and light from the sun in the earth's atmosphere, which increases the temperature. This hurts many people, animals, and plants. Many cannot take the change, so they die.



GREENHOUSE EFFECT



Photo courtesy of Woods Hole Research Center

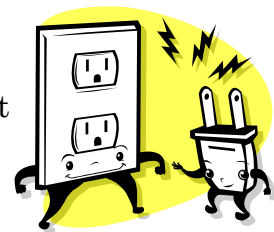
The greenhouse effect occurs as the heat from the sun is trapped in the earth's atmosphere, causing temperature to rise.

Singaporeans experience this greenhouse effect frequently when they park their car directly under the sun. On a hot day, the car gets hotter because the heat from the

sun can get into the car through the windows, but it can't get back out. This is what the greenhouse effect does to the earth. The heat and light can get through the atmosphere, but it can't get out. As a result, the temperature rises.

WHAT CAUSES GLOBAL WARMING?

Many things cause global warming. One thing that causes global warming is electrical pollution. Electricity



¹ The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

causes pollution in many ways, some worse than others. In most cases, fossil fuels² are burned to create electricity. Many pollutants, including greenhouse gasses are sent into the air when fossil fuels are burned. The burning of fossil fuels and deforestation plays a large role in global warming.

GREEN ENERGY

Green energy is the term used to describe sources of energy that are considered to be environmentally friendly and non-polluting. The goal of green energy is generally to create power with as little pollution as possible produced as a by-product. Let us examine the different types of green energy that are currently being considered as alternative sources of power.

SOLAR ENERGY

You've probably seen calculators with solar cells that do not need batteries. As long as there's enough light, they seem to work forever. The hope for a "solar revolution" has been floating around for decades -- the idea that one day we'll all use free electricity from the sun. On a bright, sunny day, the sun's rays give off approximately 1,300³ watts of power per square meter of the planet's surface, which could easily power our homes and offices for free.



The solar cells⁴ that you see on calculators are also called photovoltaic (PV) cells, which as the name implies (photo meaning "light" and voltaic meaning "electricity"), convert sunlight directly into electricity. Photovoltaic cells are made of special materials called semiconductors such as silicon. When light strikes the cell, a certain portion of it is absorbed within the semiconductor material. This means that the energy of the absorbed light is transferred to the semiconductor. The energy

² Fossil fuels are hydrocarbons, primarily coal, fuel oil or natural gas, formed from the remains of dead plants and animals.

³ A typical Laptop uses 40 – 85 watts of power; Average power consumption of LCD TV is 111 watts (actual consumption depends upon the brand and size if TV)

⁴ A solar cell (also called photovoltaic cell or photoelectric cell) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect

knocks electrons loose, allowing them to flow freely. This flow of electrons is a current, and by placing metal contacts on the top and bottom of the PV cell, we can draw that current off for external use, say, to power a calculator. This current, together with the cell's voltage, defines the power (or wattage)⁵ that the solar cell can produce.

How much sunlight energy does our PV cell absorb? Unfortunately, not an awful lot. In 2006, most solar panels only reached efficiency⁶ levels of about 12 to 18%, and up to a maximum of 40% on the most cutting-edge solar panel system. Hence is a challenge for engineers to make the most of a sunny day.

WIND POWER



Wind power is one of the first green energy used by human, to propel sailing boats across rivers and oceans.

Wind power is the conversion of wind energy into a useful form of energy. One useful application is using wind turbines to make electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. So how do wind turbines make electricity? Simply stated, 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.

Utility-scale wind turbines range in size from 100 kilowatts to as large as several megawatts⁷. Larger turbines are grouped together into wind farms, which provide bulk power to the electrical grid.



However, there are some disadvantages for wind energy, which may put a dampener in its popularity. Firstly, wind can never be predicted. Therefore, in areas where a large and continuous amount of electricity is needed, one cannot depend completely on wind. Secondly, many potential

⁵ Mathematically, Power (Watt) = Voltage (Volt) x Current (Ampere)

⁶ Solar efficiency refers to the ratio of output power to input power. In other words, how much electricity can a solar panel produce from a certain amount of sunlight. So if a solar panel creates a hundred watts of power from a thousand watts of sunlight, it has an efficiency of 10%

⁷ 1 Megawatt = 106 Watts; 1 kilowatts = 103 Watts

wind farms are located where wind energy can be produced on a large scale. These locations are usually secluded places. Therefore, the economical nature of wind energy may take a beating in terms of costs of new transmission lines⁸. Another problem seen with wind turbines is noise pollution. Windmills are very noisy and this can hamper the atmosphere of a house and cause disturbances.

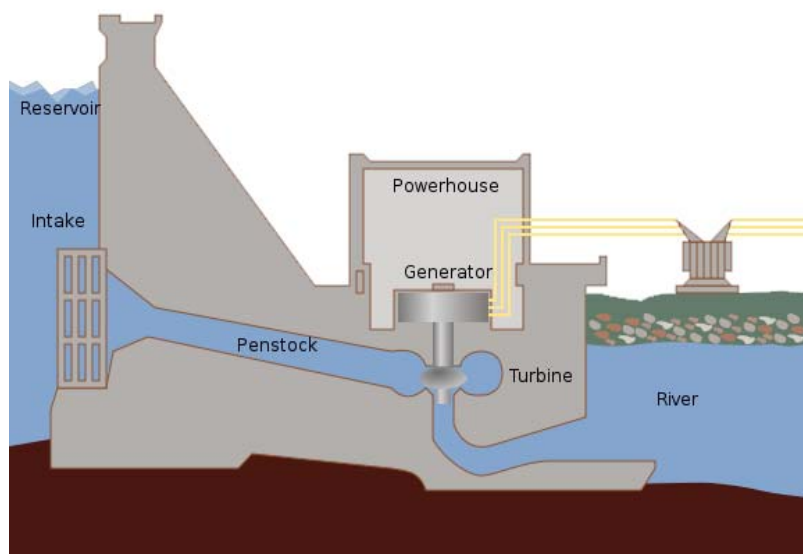
The goal of Green Energy Engineers is to overcome these cons to make wind energy a viable solution to be used all over the world.

HYDROPOWER

Hydro power is generated by using electricity generator which extracts energy from moving water. Historically people used the power of rivers for agriculture and wheat grinding. Today, rivers and streams are re-directed through hydro generators to produce energy. Flowing water creates energy that can be captured and turned into electricity. This is called *hydroelectric power* or *hydropower*.



Hydropower is capable of storing large quantities of electrical energy for almost instant use. This is done by holding water in a large reservoir behind a dam with a hydroelectric power plant below. The dam



creates a height from which water flows. The fast-moving flow of water from the dam pushes the turbine blades that turn the rotor part of the electric generator. When the coils of wire on the rotor sweep past the generator's stationary coil, electricity is produced. Whenever power is needed at peak times, water valves are opened and, in a short amount of time, turbine generators produce extra power.

⁸ Transmission lines carry electric energy from one point to another in an electric power system

While hydropower offers advantages over other energy sources, it faces unique environmental challenges. Hydropower dams disrupt the natural flow of rivers. This alters and destroys the river and riverside habitat. Hydropower plants can be impacted by drought. When water is not available, the hydropower plants can't produce electricity. Finally, dams are extremely expensive to build and must be built to a very high standard. The high cost of dam construction means that they must operate for many decades to become profitable.

GREEN AND RENEWABLE ENERGY

With increasing global warming and the depletion of fossil fuels, there is a pressing need to look for alternative clean and green energy sources. While there is currently no clear substitution to fossil fuels, any breakthrough by engineers will be greatly appreciated by the human race and, of course Mother Earth.

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