Renewable Energy

What is renewable energy?
Renewable energy uses energy sources that are not "used up". For example, solar power from the sun is renewable as we won't "use up" all the sunlight from the sun. Examples of non-renewable energy sources include fossil fuels like coal and oil. Once we use or burn these resources, they are gone forever.

Why is renewable energy important?
Much of the world relies on non-renewable energy to heat their homes, power their electronic devices, and power their cars. Once these energy sources are used up, they will be gone forever. Developing technologies that can efficiently use renewable energy sources is critical to our future.

Many renewable energy sources are also better for the environment than burning fossil fuels. They produce less pollution which will help protect the environment and provide us with cleaner air and water.

Major Types of Renewable Energy

1. Wind power
Wind power is energy, such as electricity, that is generated directly from the wind. It is considered a renewable energy source because there is always wind on the Earth and we aren't "using up" the wind when we make energy from it. Wind power also does not cause pollution.

Wind Turbines and Wind Farms
In order to make electricity from wind, energy companies use large windmills called wind turbines. They are called this because they use turbine generators to generate the electricity. In order to create a lot of energy capable of powering thousands of homes, energy companies build large wind farms with lots of wind turbines. They usually build these in consistently windy places. Some companies build wind farms out in the ocean. These are called offshore wind farms.

How tall are wind turbines?
Wind turbines are really big structures. The tower itself is typically between 200 and 300 feet tall. When you add in the height of the blades, some turbines tower 400 feet high! The blades are quite big, too. There are typically three wind blades on a wind turbine. Each blade is usually between 115 and 148 feet long.

How does a wind turbine work?
A wind turbine works the opposite of a fan. Instead of using electricity to turn the blades to make wind, it uses the wind to turn the blades to make electricity. When the wind turns the blades, the blades turn a shaft inside the turbine. This shaft is big, but turns slowly. The shaft, however, is connected to a number of gears which causes a smaller shaft to turn much faster. This smaller shaft drives the electrical generator which generates the electricity that can be used by homes and businesses.

What if there isn't any wind?

If there isn't any wind, then no energy will be generated by the wind turbine. However, engineers do a lot of measurements and calculations to figure out the best areas to place the wind turbines. The wind won't be blowing all the time, but the important thing is how much the wind blows on average.

Drawbacks to wind power

One major issue some people have with wind power is how the wind turbines mess up the view or landscape. Other drawbacks include the large blades killing birds and noise pollution from the turbine. Most people agree that the positives of a fully renewable and clean energy resource far outweigh the negatives.

2. Solar power

The primary source of all energy on planet Earth is from the sun. Solar power is power generated directly from sunlight. Solar power can be used for heat energy or converted into electric energy.

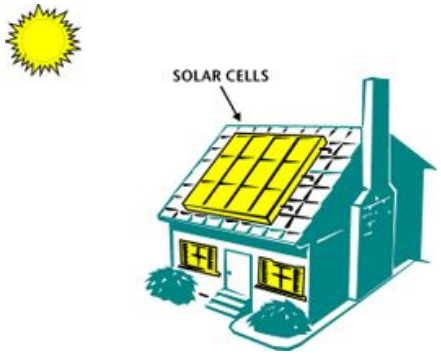
When we use solar power, we don't use any of the Earth's resources like coal or oil. This makes solar power a renewable energy source. Solar power is also clean power that doesn't generate a lot of pollution.

Solar Power for Heat

Solar power can be used for heating up homes and other buildings. Sometimes solar power for heating can be passive. This is when there are no mechanical components used to move the heat around. Passive heating helps to keep houses warm in the winter, to heat up swimming pools, and even makes our car warm when we park it outside (which is nice in the winter, but not so much on a hot summer day). Active heating is when there are mechanical components to help move the heat around. The sun could be used to heat up water or air that is then pumped around a building to provide even heat in all the rooms.

Solar Power for Electricity

When most of us think of solar power, we think of the solar cells that turn rays of sunshine into electricity. Solar cells are also called photovoltaic cells. The word "photovoltaic" comes from the word "photons", which are particles that make up sunlight, as well as the word "volts", which is a measurement of electricity. Today solar cells are commonly used in small handheld devices like calculators and wrist watches. They are becoming more popular for buildings and homes as they become more efficient. One nice thing about solar cells is that they can be placed on the roof of a building or home, not taking up any extra space.



Solar cells on a house used for making electricity

How do solar cells work?

Solar cells convert the energy of photons from the sun into electricity. When the photon hits the top of the cell, electrons will be attracted to the surface of the cell. This causes a voltage to form between the top and the bottom layers of the cell. When an electric circuit is formed across the top and the bottom of the cell, current will flow, powering electrical equipment. It takes a lot of solar cells to power a building or a home. In this case, a number of solar cells are connected into a large array of cells that can produce more total energy.

Drawbacks to solar power

Solar power has two major drawbacks. One drawback is that the amount of sunshine in a specific place changes due to the time of day, the weather, and the time of the year. The other drawback is that with current technology it takes a lot of expensive photovoltaic cells to produce a decent amount of electricity.

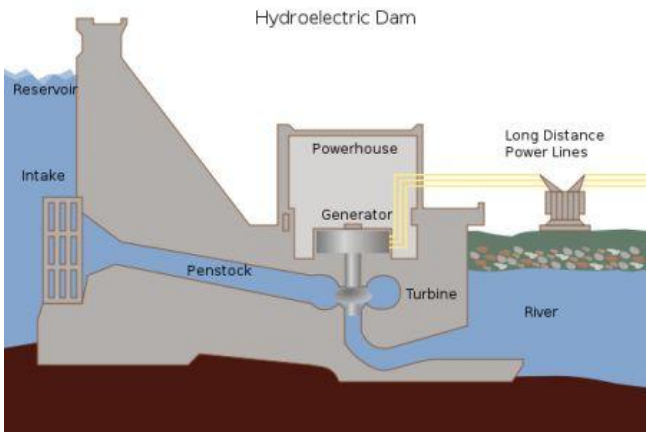
3. Hydropower

Hydropower is power that is generated from moving water such as rivers.

Hydropower is a renewable energy source. This means that using a dam or a river to generate electricity doesn't use up any limited resources like coal or gasoline.

How do we get power from water?

Falling or flowing water from a big river has a lot of energy. We can harness this by forcing the water through a pipe called a penstock. As the water flows through the pipe it turns the blades of a turbine which spins an electric generator. As long as the water is flowing, the generator will be able to provide electricity.



Electricity can be generated by water moving through a dam.

There are three main ways that engineers design hydroelectric power plants:

⁎Storage System: The storage system uses a dam. The dam slows the flow of a river and stores up water in a lake. A portion of the water is released into the river at the bottom of the dam. The fall of the water, and the water pressure from the lake, forces the water through the dam and spins turbine generators. Dams are expensive to build, but they also help control flooding, can create a large recreational lake, and can provide fresh water for surrounding towns.

⁎Run-of-the-river System: In a run-of-the-river system the turbines are spun by the natural flow of the river. These systems have the advantage of not creating a huge lake and flooding the area above the dam. As a result, they have less overall impact on the environment. However, in order to provide continuous electricity, the river they use must stay full throughout the year, as the flow is not regulated by a dam.

∗Pumped Storage System: This system is like the storage system except it uses pumps to pump used water back up into the reservoir. The way this works is that during the night, when electricity use is much less, it uses the extra electricity to pump the water back up to the top of the dam and refill the reservoir. This improves the overall efficiency of the hydropower plant. Go here to read about the ocean power technologies tidal and wave power.

Drawbacks to hydropower

Like any power source there are some drawbacks to hydropower. One drawback is the loss of land and the damage to the local ecosystem caused when a lake is created by a dam. This can also cause people to have to relocate and leave their homes. Another disadvantage is methane emissions generated by the reservoirs. Dams and turbines can also hurt fish and disrupt their migration to spawning grounds.

4. Wave and Tidal Energy

Turning the energy of the ocean's waves and tides into power that we can use is a new and unproven technology. However, the potential is there for a significant renewable and environmentally clean energy source.

What is wave energy?

Wave energy is energy harnessed from the waves of the ocean. Waves are formed by wind moving across the surface of the ocean. A large amount of energy is stored in waves.

Wave and tidal power is considered renewable energy because we don't "use up" anything when we convert their energy to something usable like electricity.

A wave power device

How do we get power from waves?

There are three main ways that scientists think we can capture the power of waves:

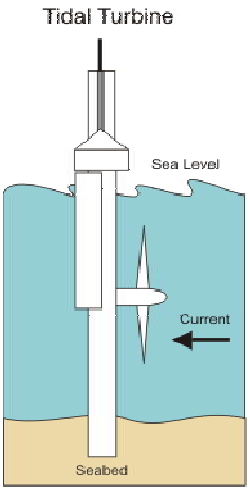
∗Surface devices: These devices gain power from the waves moving them up and down on the surface of the ocean.

∗Underwater devices: These devices range from balloon type objects attached to the ocean floor to long tubes that stretch over a long distance. When the waves cause them to oscillate, they move a turbine and create electricity.

∗Reservoir: These devices take advantage of the waves moving water into a reservoir on the coastline. As water moves back out into the ocean it is forced down a tube and turns the blades of turbine. The turbine then converts the energy into electricity.

How do we get power from the tides?

There are also three main ways that tidal energy is harnessed:



∗Tidal Barrages: A tidal barrage works like a dam. When the tide goes high, the reservoir fills up. When the tide drops, the dam lets the water out. In both directions the moving water can spin the blades of turbines to create electricity.

∗Tidal Fences: These are smaller structures than a barrage. A number of vertical turbines form a fence between two land masses. When the tide moves in or out, the turbines spin and generate electricity.

∗Tidal Turbines: These are individual turbines placed anywhere there is a strong tidal flow.

Drawbacks to wave and tidal energy

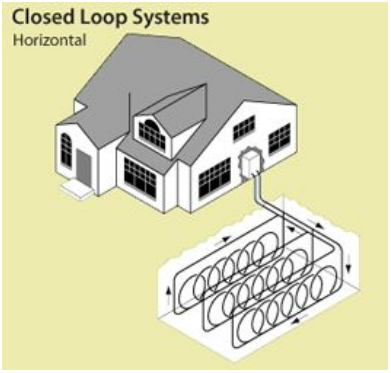
The main disadvantage to these technologies today is cost. The cost of installing and maintaining a large wave or tidal power plant is too expensive versus other alternatives such as wind farms. Another drawback is the limited number of locations where current technologies can be economically installed. Both wave and tidal energy can also have some effect on the environment. Large tidal barrages can make it difficult for migrating fish. Also, spinning turbines can injure animals and fish.

5. Geothermal energy

The inside, or core, of the Earth is very hot. This heat sometimes breaks through to the surface of the Earth through volcanoes or geysers. When we use heat from the Earth to generate energy it's called geothermal energy. The name geothermal is a combination of the word "geo", which means earth, and "thermal", which means heat.

Sustainable Energy

The Earth is constantly being warmed by its core. When we use geothermal energy we don't use up resources like we do when we burn gas or coal. Although we do use up a tiny bit of the Earth's heat, it is a very little amount in comparison to the overall heat of the Earth. This makes geothermal energy a type of sustainable energy. Geothermal power plants are very clean and have little negative impact on the environment.



Geothermal heat pumps can keep homes warm

How do we get power from the Earth?

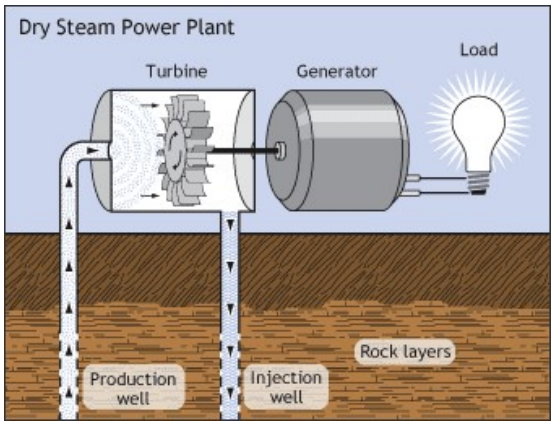
There are three main ways that we harness and use geothermal energy:

∗Geothermal heat pumps: About 10 feet below the surface of the Earth, the ground is a consistent temperature between 50 and 60° F throughout the year. Geothermal heat pumps take advantage of this constant temperature to heat or cool water. By moving water through the Earth it can be heated in the winter or cooled in the summer. This water can then be used

by a heat exchanger to heat or cool the air in a home. This can be a very efficient and inexpensive way to heat or cool buildings.

⁎Direct use: Another way to take advantage of the Earth's heat is to directly use hot water from hot springs. This water can be used with heat exchangers to heat up homes and buildings. It also can be used to heat pools.

⁎Generating electricity: Finally, geothermal energy can be used by power plants to create electricity. Power plants take advantage of extremely hot water that is between one and two miles deep in the Earth. Some power plants pipe the steam directly up to the generator. They are called dry steam power plants. Other power plants, called flash steam plants, use high pressure from deep in the Earth to create steam to drive the generator.



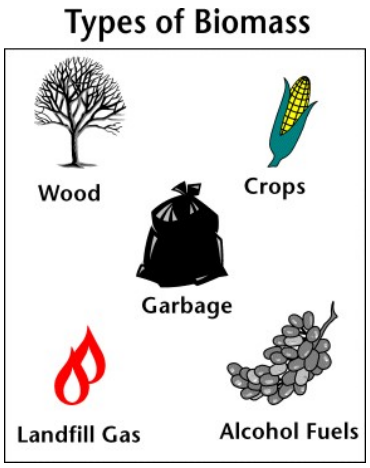
Generating electricity using a geothermal power plant

Drawbacks to geothermal energy

Probably the main disadvantage to geothermal energy is the cost. It can be very expensive to build a geothermal plant. Building a plant can also be risky for a power company as the steam can potentially run out at a given site. The main environmental disadvantage is the possibility of releasing toxic gasses when the well is drilled into the ground.

6. Biomass energy

Biomass sounds like a complicated word, but it really isn't. Biomass is just any material made by plants and animals that we can convert into energy. Biomass has energy stored in it from the sun. Plants get energy from the sun through a process called photosynthesis. Animals get their energy indirectly from the sun by eating plants.



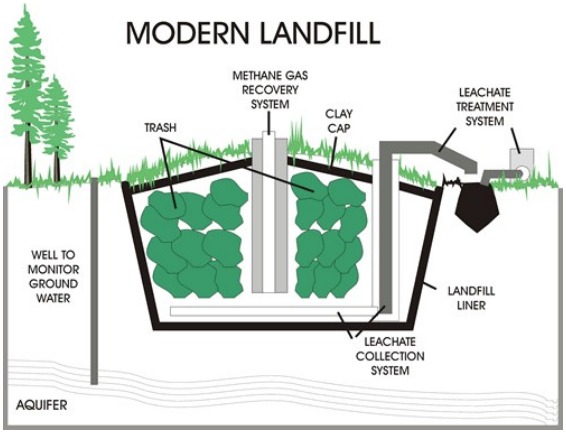
Biomass energy is considered a renewable energy source because we can always grow more plants and trees. It is not an infinite resource, however, as there is only so much land and water to grow plants.

How do we get power from biomass?

⁎Burning: One way to release the energy from biomass is to burn it. The heat from burning biomass can be used to heat homes or to create steam which can then generate electricity. One example of this is burning a fire in your home. You burn the wood, which is the biomass, and it releases energy which heats your home.

⁎Methane gas: When biomass rots it produces methane gas. Methane gas can be used to make natural gas which is a common source of energy. This means that when garbage rots in landfills, that stinky gas can be used for energy!

⁎Biofuels: Some crops, like corn and sugar cane, can be converted into a biofuel called ethanol. Ethanol can be used instead of gasoline in many cars. Another type of biofuel is biodiesel. Biodiesel can be made from vegetable oils and animal fats. Biodiesel can be used as heating oil and also to power cars and busses.



Methane gas from landfills can be used to generate electricit

Drawbacks to biomass energy

Some of the negatives to using biomass energy include:

⁎Air pollution from burning
⁎Releasing green house gasses such as carbon dioxide into the atmosphere
⁎Burning trash and waste can release harmful chemicals and gasses into the environment
⁎The land cleared for growing corn and sugar cane can reduce habitats and destroy ecosystems
⁎The land used for growing biomass could be used to grow other crops for food
⁎Growing biomass can use fertilizers and other chemicals that can cause water pollution

Despite all the negatives associated with biomass energy, many people believe that it is a better and cleaner alternative to burning fossil fuels such as oil and coal.