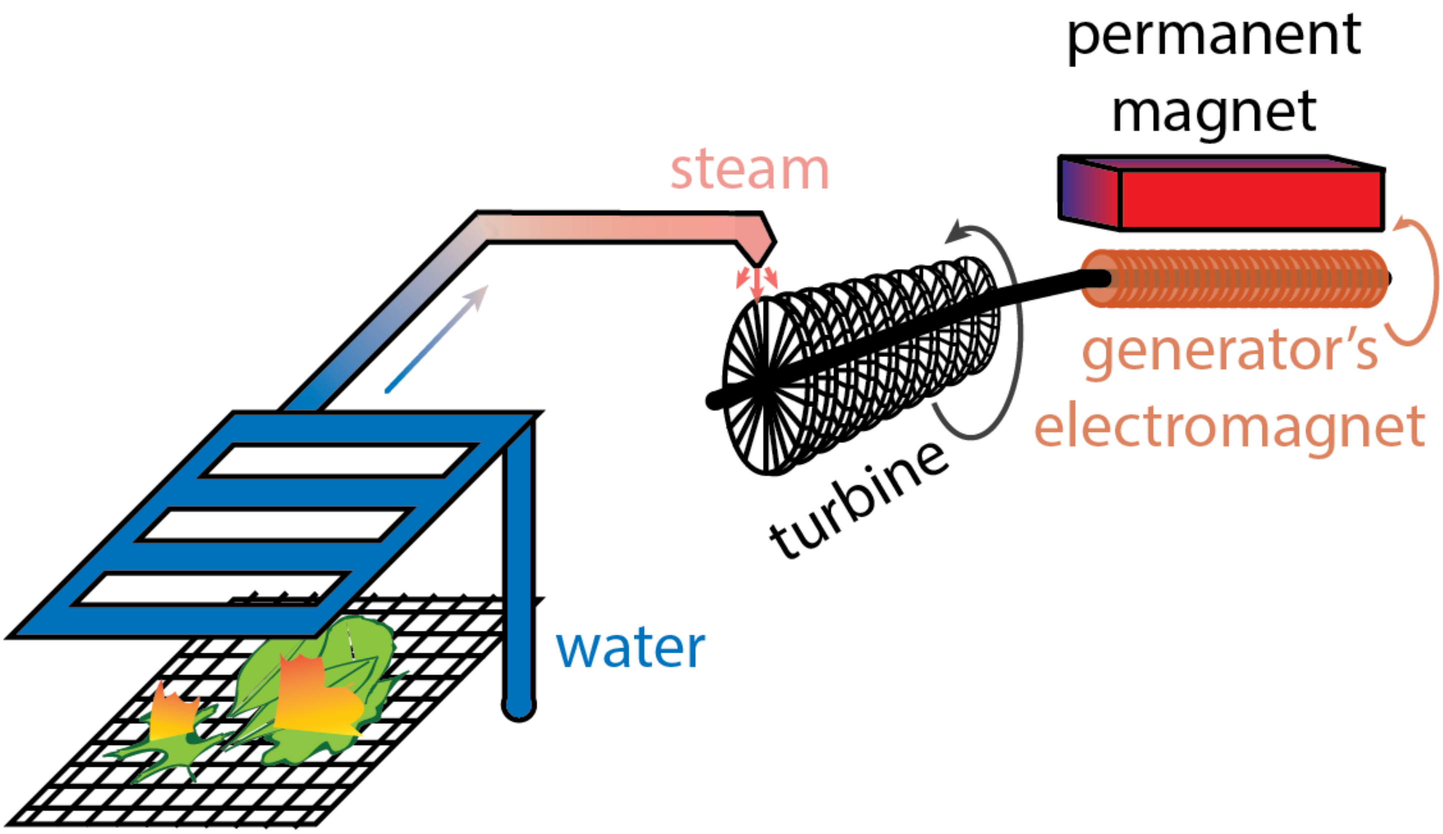
Biomass

Plants contain an incredible amount of energy, and while the term "biomass" is a new one, humans have been burning plants as a fuel source for a long time. You probably burn biomass (for example, grasses and wood) when you go camping! Of course, creating electrical energy from biomaterials is more complex than simply burning.

Yard waste, wood chips, or other plant materials are burned, creating heat, which turns water into steam. As the steam gains pressure, it moves through a valve and past the blades of a turbine. The turbine is attached to coils of wire which then rotate beneath the poles of a powerful permanent magnet. The coils of wire are an electromagnet, and as the wire coil spins beneath the magnet, the electrons in the wire are moved by the electrical field. This continuous movement of electrons results in electrical current.



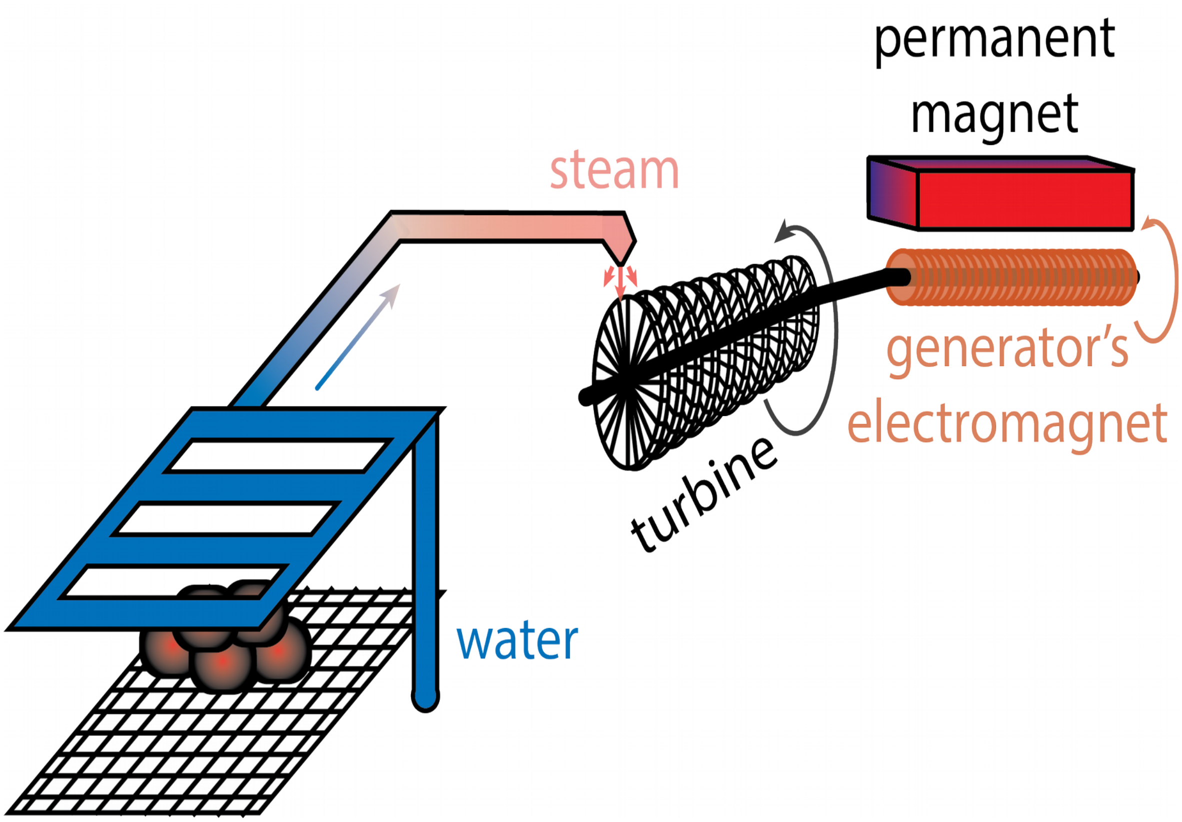
There is a lot of flexibility to what can be burned in a biomass plant, and it is wonderful to think that what might otherwise be considered waste (leaves, corn husks, etc.) can be used as a source of electricity. A problem occurs, however, when you think about the amount of pollution associated with burning such a wide variety of fuels.

Coal Power

Coal is one of the most common sources of energy throughout the world. According to the International Energy Agency, it is the source for 40% of the world's power.

How did it achieve such use? Coal has a long history as a source of energy, beginning around 2000 BCE when the Chinese first burned it. They were able to use coal to replace their supply of wood. Coal was used to heat and cook for thousands of years before it was put to work as part of a steam engine. The use of coal-powered engines eventually led to coal-powered electrical generation, made practical by Sir Charles Parsons in the 1880s.

While coal power may have a richer history than other power-generation technologies, it actually operates using the same equipment as oil, gas, and many alternative energy sources. Coal is burned, creating heat, which turns water into steam. As the steam gains pressure, it moves through a valve and past the blades of a turbine. The turbine is attached to coils of wire which then rotate beneath the poles of a powerful permanent magnet. The coils of wire are an electromagnet, and as the wire coil spins beneath the magnet, the electrons in the wire are moved by the electrical field. This continuous movement of electrons results in electrical current.



Hydroelectricity: Traditional Dams

Hydropower has been around for a very long time. As early as 200 BCE, at the end of the Roman era, Europeans used waterwheels to power mills, crush grain, full cloth, tan leather, saw wood, and more. The fact that waterwheels could be used for so many different tasks draws a comparison to electrical power – we use electrical power because it can be applied in so many ways!

Waterwheels capture the water's energy by transforming the movement of the water into the movement of machinery. As water flows against the paddles of the waterwheel, the turning wheel also turns the machinery inside the mill. While the same technique is used to generate electricity, more advanced turbines are now installed in dams which stretch across the whole length of the river. As water flows through the dam, it spins the turbines. Those turbines are attached to coils of wire which are mounted beneath powerful permanent magnets. The coils of wire are an electromagnet, and as the wire coil spins beneath the permanent magnet the electrons in the wire are moved by the electrical field. This continuous movement of electrons results in electrical current.

Hydropower is a reliable source of energy. Its flow rate is controlled by capturing water behind the dam, so the amount of power generated can be easily changed and the turbines can operate 24 hours a day and 7 days a week.

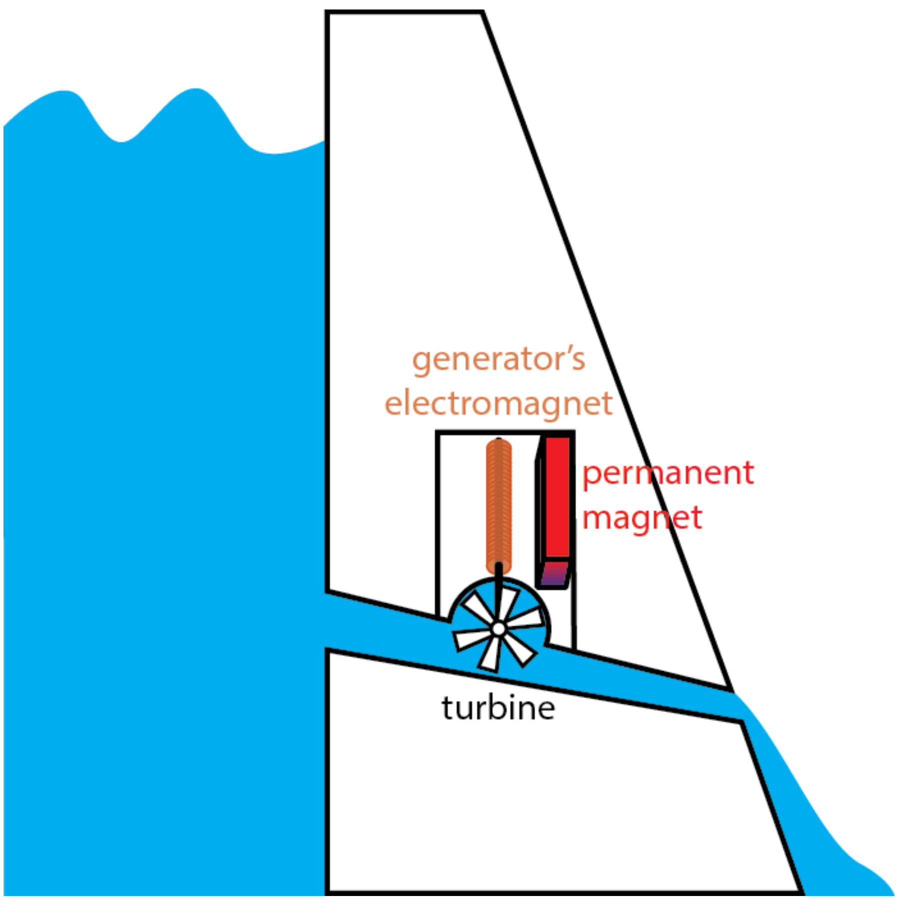


Figure 1: Water moves the turbine as it flows past. (Through a series of gears not pictured,) the electromagnet spins beside a permanent magnet. As the electromagnet moves, electrons are transmitted to homes and businesses.

Since dams block off the river and create a reservoir (lake) behind it, they do have an environmental impact. They create a different environment for aquatic animals, and they get in the way of fish like salmon who swim upstream in order to return to their birthplace each season. To help remedy this problem, some dams have installed "fish ramps," with a small slide of constantly-flowing water to allow fish a turbine-free path in either direction.

Hydroelectricity: Wave Action Power Generators

While we commonly think of hydroelectricity as being generated by a river, another form of hydroelectricity is generated in oceans and lakes. As wind blows, waves are formed in oceans, lakes, and other bodies of water. While the movement and energy within waves changes with the wind, there are always waves of some size. Electricity can be generated 24 hours a day and 7 days a week.

Unlike dams, which disrupt the habitat and movement of fish, wave generators are not generally considered to be a hazard for wildlife. After installation, wave generators are no different from other natural obstacles.

How does it work? As a buoy floats on the surface, it rises and falls with the waves. The buoy is held in place by a rope or rod so the buoy does not float back to the shore. As the buoy rises and falls, it pulls on its tether (the rope or rod), which has a magnet attached. This permanent magnet (which has permanent positive and negative poles), slides past an electromagnet (where the magnetic field of the permanent magnet produces electrical current). Every time the magnets slide past one another, energy is produced which is sent via an underground cable to a power station on the land.

While this technology was first patented in 1979, it has changed and improved over time. Wave power generators are able to produce much more power now than they used to, and less maintenance is required. Some wave generators have no underwater moving parts, so water leaks cannot easily affect them. Some wave generators are able to move in order to best-orient themselves and capture the most energy.

Many wave generators are needed in order to provide enough power for a home, but with a large amount of ocean and a very low environmental impact, wave action power generators may be the "wave" of the future.

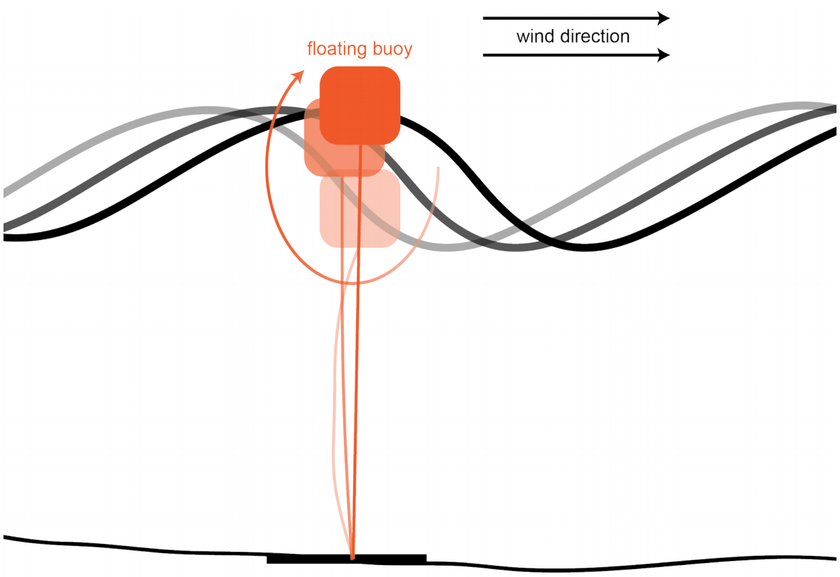


Figure 1: The floating buoy, which is tethered to the ocean floor, rises and falls as waves pass by. Faded colors show the location of the wave and buoy as time passes.

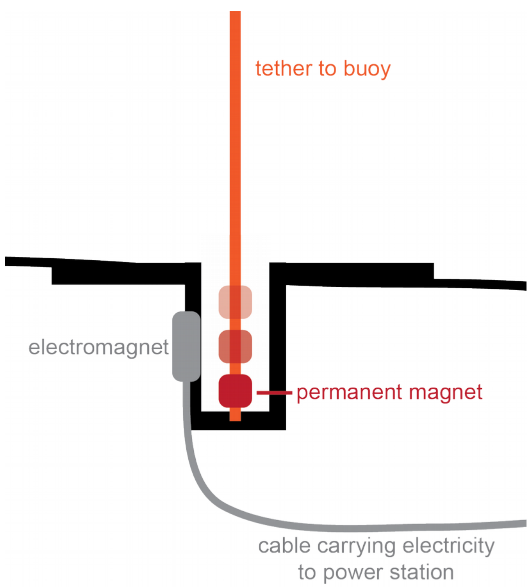


Figure 2: As the permanent magnet is pulled up and down, the electromagnet sends electrical energy to a power station.

Natural Gas

When oil forms below the ground as a result of natural processes, natural gas forms as well. This is the primary source of natural gas today, but we can also gather methane (natural gas) from other sources. Landfills produce methane as some wastes decay, and animals like cattle also produce a large amount of methane.

Regardless of the source, natural gas is burned, creating heat, which turns water into steam. As the steam gains pressure, it moves through a valve and past the blades of a turbine. The turbine is attached to coils of wire which then rotate beneath the poles of a powerful permanent magnet. The coils of wire are an electromagnet, and as the wire coil spins beneath the magnet, the electrons in the wire are moved by the electrical field. This continuous movement of electrons results in electrical current.