

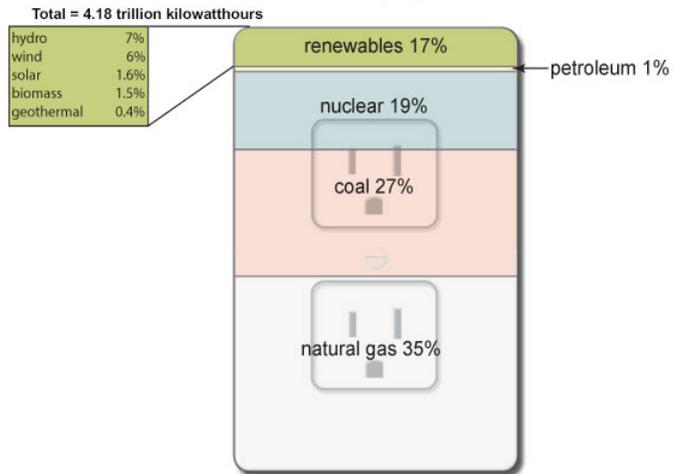
Activity 5.2: Group A Electricity Handout

Where does electrical energy come from?

We get most of our electrical energy from power plants. But power plants can't *make* electrical energy. They have to *convert* energy from some other source into electrical energy. Power lines carry electricity from power plants to homes, buildings, town, and cities. Most of the electricity we use in the United States comes from power plants that get their energy by burning fossil fuels like coal and natural gas. These power plants are the number one cause of carbon dioxide emissions in the United States.

Some power plants get their energy from sources, like sun, wind, moving water, and nuclear power, that do not burn fossil fuels. Below is a short overview of how we use different resources to make electricity.

Sources of U.S. electricity generation, 2018



Note: Electricity generation from utility-scale facilities.

Source: U.S. Energy Information Administration, *Electric Power Monthly*, February 2019, preliminary data



Natural Gas (35%). Natural gas is also a fossil fuel with energy-rich C-C and C-H bonds. Gas-powered plants generate electricity in a similar way to coal-fired power plants, except they burn gas to release heat to boil water instead of burning coal.

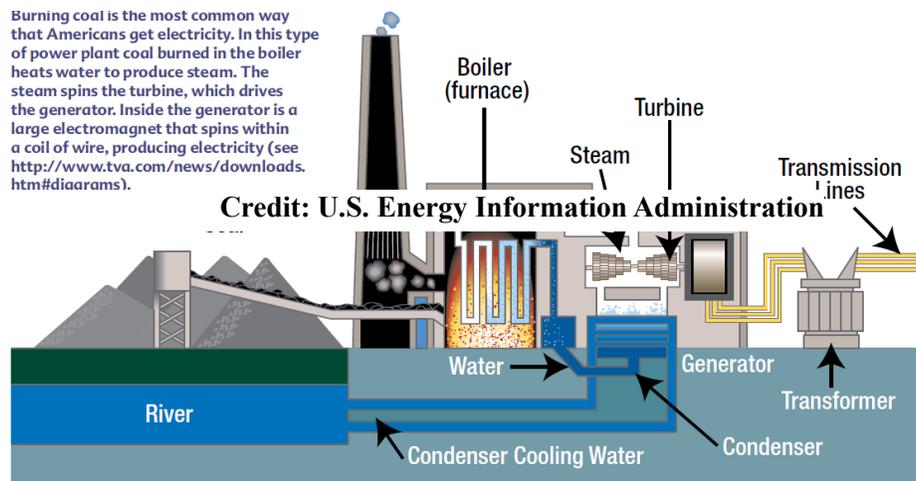
Coal (27%). Coal is a fossil fuel: Coal molecules have energy-rich C-C and C-H bonds. The heat energy from burning coal is used to boil water and produce steam. The steam spins a turbine, and the motion energy is transformed into electrical energy in the generator.

Nuclear (19%). Like coal and gas-fired power plants, nuclear plants also use a source of heat to generate electricity. However, nuclear power plants use a process called nuclear fission instead of combustion. This is the process of splitting of radioactive atoms (usually uranium) into two. This splitting of the uranium atoms releases energy, which is then used to boil the water in the power plant to generate electricity.

Hydropower (7%). Hydropower is a renewable resource. Hydropower generators are located in dams that direct water through a turbine. This movement of the turbine generates electricity.

Wind (6%). Wind is a renewable resource.

Burning coal is the most common way that Americans get electricity. In this type of power plant coal burned in the boiler heats water to produce steam. The steam spins the turbine, which drives the generator. Inside the generator is a large electromagnet that spins within a coil of wire, producing electricity (see <http://www.tva.com/news/downloads.htm#diagrams>).



Wind causes the blades of the turbine to spin, which generates electricity.

Solar (1.6%). Light energy from the sun is also a renewable resource. Photovoltaic panels contain semiconductor materials, which are engineered to activate electrons in a charged electrical field in the presence of sunlight. This transforms the sun's light energy into electricity.

Geothermal (less than 1%). Geothermal energy is renewable, and its energy source is the heat stored in the ground. Geothermal power plants collect heat escaping from the ground through geysers. The heat is then used to move turbines, which generates electricity.

Biomass (1.5%). Biomass is a renewable source that provides energy stored in organic materials of once-living things (like compost, switch grass, corn, wood, peat, and even human waste). Because these organic molecules contain energy-rich C-C and C-H bonds, their combustion releases heat, which is used to generate electricity in power plants.

What waste products are associated with different sources of electricity?

Source of Electricity	Waste products ¹	What happens to this waste?
Coal power plant	Carbon dioxide, sulfur oxides, nitrous oxides, mercury compounds; hot water	The carbon dioxide and other compounds are released into the air through tall smoke stacks. The hot water is released into nearby rivers, lakes, or oceans.
Natural gas power plant	Carbon dioxide and small amounts of sulfur oxides and nitrous oxides; hot water	Gases are released into the air. Hot water is released either as steam or into surrounding bodies of water.
Nuclear power plant	Radioactive nuclear waste; hot water	The nuclear waste is either stored on site or transported to another site and buried underground. Hot water is released either as steam out of cooling tanks or as water into nearby bodies of water (lakes, rivers, oceans).
Hydropower	There are no waste products associated with hydropower.	
Solar	There are no waste products associated with solar power.	
Wind	There are no waste products associated with wind.	
Geothermal	There are no waste products associated with geothermal.	
Biomass	Carbon dioxide and other compounds (depending on which biomass material is used); hot water.	Carbon dioxide is released into the atmosphere through smoke stacks; hot water is released either as steam or as water in surrounding lakes, rivers, or oceans.

¹ Any waste products associated with the 1) extraction of any raw materials used, or 2) construction or maintenance of the infrastructure used to generate electricity are not included.