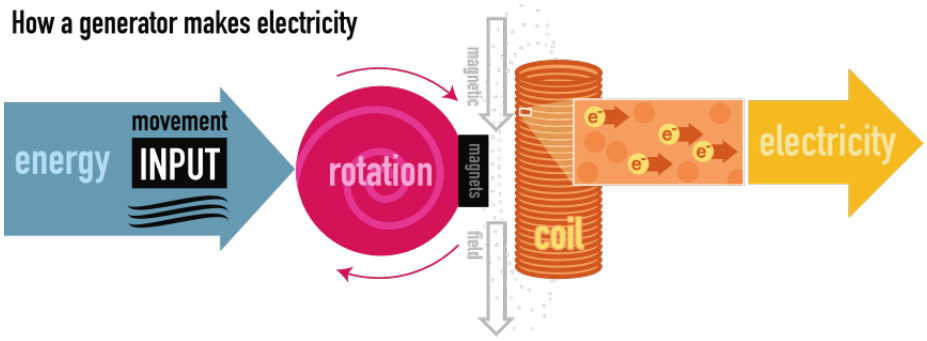
Teacher Tune-up

Quick Content Refresher for Busy Professionals

How do generators convert rotary motion into electrical power?

There is a fundamental connection between electric currents and magnetism, which is why scientists refer to *electromagnetic* forces. An electric current exerts a force on nearby magnets, and moving a magnet exerts a force on nearby electrons, causing an electric current. This connection between electricity and magnetism is the basis for many methods of electrical-power generation.



One important electricity-magnetism connection is *electromagnets*, in which the natural magnetism of iron is organized and reinforced by an electric current through a coil of wire wrapped around an iron core. This process makes it possible to make large, strong magnets cheaply.

Having more wire moving rapidly relative to a strong magnet generates more electricity. Here are some strategies to move lots of wire past a magnet:

(1) wind the wire into coils to fit a long wire in a compact space,

(2) mount the coils on a rotating spindle so they move continuously as a *rotor*,

(3) surround the rotor with stationary electromagnets (sometimes called *stators*), and/or

(4) apply some external source of rotary power so the rotor moves relative to the stators.

The relative motion of the coil and the magnets pushes electrons along the wire. The moving electrons also push back on the magnet, which is why an external force is required to sustain the motion of the generator rotor. Special sliding connectors are used to collect the current produced in the rotor so electric power can be distributed to users.

Sources of Power

Direct sources of rotational power used in electricity generation:

- Windmill blades rotated by the force of wind. The blades are directly connected to the rotor.
- Water-turbine blades moved by falling water. The blades are also directly connected to the rotor.
- In emergency backup power systems, internal-combustion motors use gasoline or diesel to directly rotate the generator rotor, similar to the way a car motor works.

Indirect sources of rotational power used in electricity generation:

Steam turbines use heat from several sources to produce steam that moves generator rotors.

- Burning fuels such as coal, oil, and natural gas are important sources of turbine heat.
- Nuclear-power plants generate heat by accelerating the break-up of radioactive elements.
- One kind of solar-power plant focuses sunlight to produce steam for generating turbines.
- Geothermal plants make use of heat from inside the earth to make steam for turbines.

Other forms of electrical-power generation without rotary motion:

- In solar photovoltaic cells, an electric current is created when sunlight directly knocks electrons loose from a thin layer of semiconducting material in the cells.
- In batteries and fuel cells, chemical reactions separate electrons to use as a current.

Free fact: *Once you understand how generators work, you know how electric motors work, too!* Generators and motors both work in exactly the same way, but input and output are switched.

- ❖ In a generator, rotational motion creates an electric current.
- ❖ In an electric motor, an electric current creates rotational motion.