

## Magnetic Fields & Magnetism

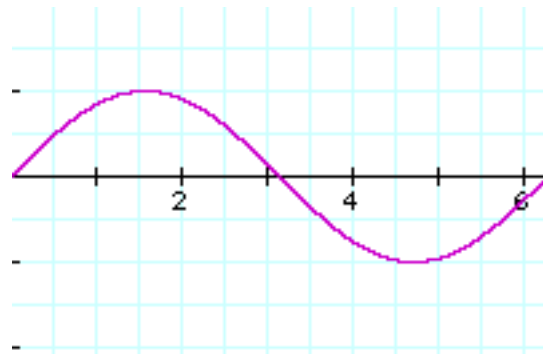
One part of the process of many alternative energy forms is the conversion of mechanical energy to electrical energy. This process may be completed by a turbine driven generator, a machine that operates under the properties of magnetism and magnetic fields. A generator is the "back end" of any alternative energy power system. What varies between alternative power forms is the force that drives the turbine. The work that is done on the turbine causes a transfer of energy to the turbine.

This energy transfer is in the form of kinetic energy, the energy of motion. While a turbine is spinning, an attached generator will also be spinning. A generator's blades look like they are the blades of a motor on a speedboat, long and oval shaped.

The rotation of the generator's central metal piece, called the armature, is the beginning of the magnetic field process that eventually produces electrical energy from mechanical energy. The magnets inside the generator form a magnetic field around the armature. As the armature spins it intersects the magnetic field, and causes an induction of electromotive force (EMF). Electromotive force is another name for voltage. If you are unfamiliar with voltage, review the [electricity](#) help page. This voltage is equal to the length of the armature times the magnetic induction times the speed of a loop structure on the armature. This equation is shown below, where B is the amount of magnetic induction of a field, v is the velocity it is moving, and L is the length of the armature (or wire):

$$EMF = BLv$$

Because the armature is rotating, the amount of electric current that can be induced from the armature changes. The following picture is a graph that represents the current that can be taken from an alternating current generator:



When the formula taken from the electricity page for voltage is substituted into the above equation, where  $V = I \cdot R$ ,

$$IR = BLv$$

When manipulated, this equation becomes  $I = BLv / R$ . This last equation is important because it tells us how much current is generated through the generator. By also substituting the equation of energy equaling power \* time and current being equal to power divided by voltage, the formula for determining the amount of energy that can be generated according to certain factors:

$$P = VI \rightarrow I = P / V, E = Pt \rightarrow P = E / t$$

$$I = E / t * 1/V = E/tV, \text{ substituting into } IR = BLv,$$

$$ER / tV = BLv, \text{ then solving for energy,}$$

$$E = BLv * tV / R$$

You can now take a [quiz](#) on magnetism and these formulas.