# Wŏrd Pow ́ ẽr

## Renewable Energy Terms

# Alternating Current (AC): Two-Way Electron Flow

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*Derivation: From Latin* alternare, *from* alternus, *by turns, and Latin* currere, *to run.*

Direct current is relatively simple to understand (see *Word Power, HP85,* page 118). Electrons (charged particles or "charges") flow in one direction through a circuit. The charge flow is from the negative terminal of the battery through the circuit wiring, to the positive terminal, through the battery, and back around. Alternating current (AC) is different.

In an AC circuit, the electrons flow one way and then the other. They move back and forth, and don't travel down the wire from the source to the load. This can be confusing to people new to electrical concepts. I remember when I first tried to wrap my brain around the idea. I thought, "If the electrons move a little one way and then a little the other way, don't they cancel each other out? How does anything get done?"

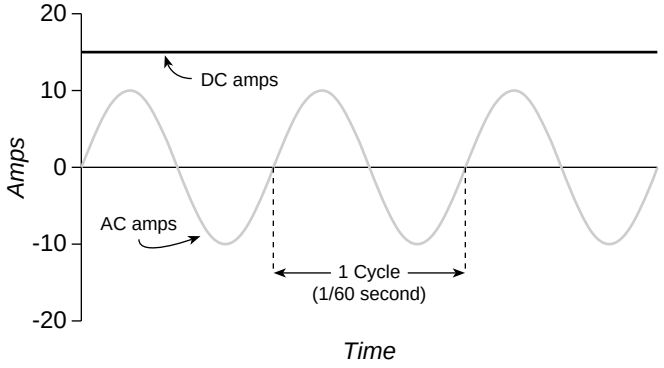
This misconception is probably rooted in the assumption that the electrons are "energy," and that they move down the wire and are "used up" by your appliances. But electrons are not energy; they are matter—part of the wire in the circuit. Electrons, or charges, are one of two things that flow in electrical circuits. The other is energy. Energy is the capacity to do work. Electrical energy is in the form of electromagnetism—an electromagnetic field.

Energy flows from source to load on a one-way trip. Its flow can be facilitated by direct current (roundtrip unidirectional flow of charges) or alternating current (back and forth flow of charges). To help you understand how this back and forth, alternating current can perform work, think about an old, crosscut saw. My wife and I used one of these to cut firewood years ago. If you focus on the saw blade, and have the goal of it "going" somewhere, you'd think that my wife and I were doing nothing when she pulled one way and I then pulled the saw right back to where it started.

But with each pull, a bit more wood got cut. The saw blade is like charges flowing back and forth, and the wood getting cut is the work being done. The energy flowed from the muscles in our arms and backs into the cut in the wood. The saw blade, like the charges in alternating current, just goes back and forth.

The diagram here shows direct current and alternating current graphs. The vertical axis shows amplitude—in this case, amps. The horizontal axis shows time.

**AC and DC Waveforms**




The direct current graph is not very exciting. Once you turn the switch on to a single, constant load, the charge flow is constant and in one direction. Your flashlight batteries, PVs, automotive batteries, and RE system batteries put out this steady, unidirectional type of charge flow.

In the alternating current graph, you can see that the amplitude is constantly changing. The center (zero) line of the graph represents no charge flow. The upper extreme of the "wave" shows the charge flow at its peak in one direction (10 amps in this case). The lower extreme shows the peak in the other direction.

In alternating current, the amplitude goes from the peak charge flow in one direction, through zero charge flow, to the peak in the other direction. By convention, we call the peaks "positive" and "negative." This reversing of direction happens many times a second. In North America, the standard is 60 hertz (Hz), which means 60 complete cycles per second. In many other places, it is 50 Hz. A cycle is from zero to the positive peak, through zero again to the negative peak, and back to zero.

Understanding alternating current is not simple. And the nature of this form of charge flow makes for a lot of complication and nuances in the design of electrical wiring systems and electronic components. The basic thing to remember is that the electrons are moving back and forth in the wires, and all that motion is moving energy along to your appliances.

**Access**
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