

# What is a solar cell

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Solar power might seem strange or futuristic, but it's already quite commonplace. You might have a solar-powered quartz watch on your wrist or a solar-powered pocket calculator. Many people have solar-powered lights in their garden. Spaceships and satellites usually have solar panels on them too. The American space agency NASA has even developed a solar-powered plane! As global warming continues to threaten our environment, there seems little doubt that solar power will become an even more important form of renewable energy in future. But how exactly does it work?

Photo: NASA's solar-powered Pathfinder airplane. The upper wing surface is covered with lightweight solar panels that power the plane's propellers. Picture courtesy of NASA Armstrong Flight Research Center.

Solar power is amazing. On average, every square meter of Earth's surface receives 163 watts of solar energy (a figure we'll explain in more detail in a moment). [1] In other words, you could stand a really powerful (150 watt) table lamp on every square meter of Earth's surface and light up the whole planet with the Sun's energy! Or, to put it another way, if we covered just one percent of the Sahara desert with solar panels, we could generate enough electricity to power the whole world. [2] That's the good thing about solar power: there's an awful lot of it—much more than we could ever use.

Photo: The amount of energy we can capture from sunlight is at a minimum at sunrise and sunset and a maximum at midday, when the Sun is directly overhead.

But there's a downside too. The energy the Sun sends out arrives on Earth as a mixture of light and heat. Both of these are incredibly important—the light makes plants grow, providing us with food, while the heat keeps us warm enough to survive—but we can't use either the Sun's light or heat directly to run a television or a car. We have to find some way of converting solar energy into other forms of energy we can use more easily, such as electricity. And that's exactly what solar cells do.

A solar cell is an electronic device that catches sunlight and turns it directly into electricity. It's about the size of an adult's palm, octagonal in shape, and colored bluish black. Solar cells are often bundled together to make larger units called solar modules, themselves coupled into even bigger units known as solar panels (the black- or blue-tinted slabs you see on people's homes—typically with several hundred individual solar cells per roof) or chopped into chips (to provide power for small gadgets like pocket calculators and digital watches).

Photo: The roof of this house is covered with 16 solar panels, each made up of a grid of  $10 \times 6 = 60$  small solar cells. On a good day, it probably generates about 4 kilowatts of electricity.

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Just like the cells in a battery, the cells in a solar panel are designed to generate electricity; but where a battery's cells make electricity from chemicals, a solar panel's cells generate power by capturing sunlight instead. They are sometimes called photovoltaic (PV) cells because they use sunlight ("photo" comes from the Greek word for light) to make electricity (the word "voltaic" is a reference to Italian electricity pioneer Alessandro Volta, 1745–1827).

Photo: A single solar cell. Picture courtesy of NASA and Wikimedia Commons.

Silicon is the stuff from which the transistors (tiny switches) in microchips are made; and solar cells work in a similar way. Silicon is a type of material called a semiconductor. Some materials, notably metals, allow electricity to flow through them very easily; they are called conductors. Other materials, such as plastics and wood, don't really let electricity flow through them at all; they are called insulators. Semiconductors like silicon are neither conductors nor insulators: they don't normally conduct electricity, but under certain circumstances we can make them do so.

A solar cell is a sandwich of two different layers of silicon that have been specially treated or doped so they will let electricity flow through them in a particular way. The lower layer is doped so it has slightly too few electrons. It's called p-type or positive-type silicon (because electrons are negatively charged and this layer has too few of them). The upper layer is doped the opposite way to give it slightly too many electrons. It's called n-type or negative-type silicon. (You can read more about semiconductors and doping in our articles on transistors and integrated circuits.)

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Web: <https://kary.com.pl/contact-us/>

Email: [energystorage2000@gmail.com](mailto:energystorage2000@gmail.com)

WhatsApp: 8613816583346

