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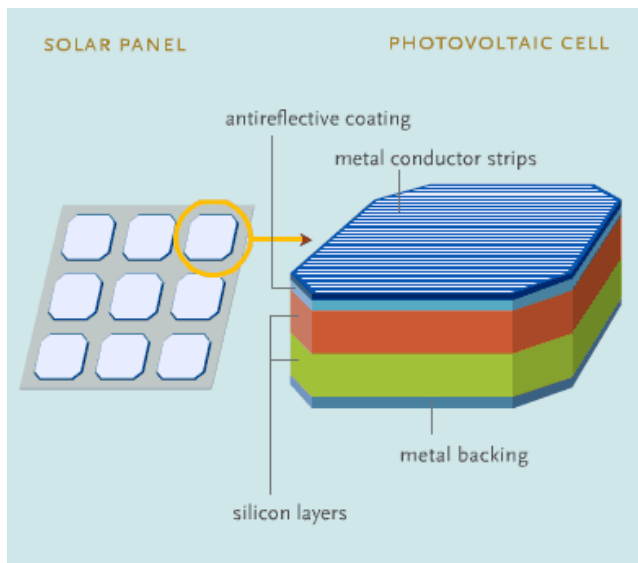
SEARCH



INSIDE A SOLAR CELL

We've seen them for years on rooftops, atop highway warning signs, and elsewhere, but how many of us know how solar panels actually work? How do the photovoltaic cells that lie at the heart of them turn sunlight ("photo") into electricity ("voltaic")? Below, familiarize yourself with the parts of a basic photovoltaic cell, and find out how it goes about harnessing the free energy of the sun.—*Stephanie Chasteen and Rima Chaddha*

1. ANATOMY OF A SOLAR CELL

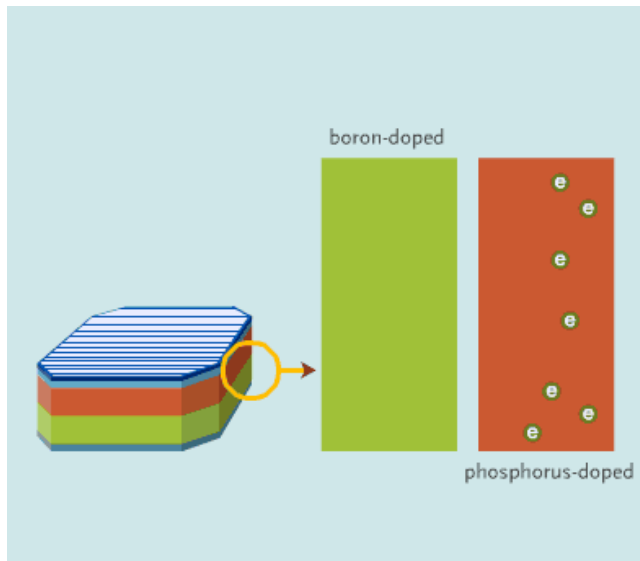


Solar panels capture sunlight and convert it to electricity using photovoltaic (PV) cells like the one illustrated above. Such cells, which can power everything from calculators to cars (our example will be a house), have several components. First, and most obviously, are two layers of silicon. These make up the bulk of the cell, and, as we'll see, the plane where they meet is where much of the key action takes place. The cell also has metal strips that conduct the flow of electrons (the electricity that the cell produces) through wires into the house, where it powers electrical appliances. Electrons also flow back out of the house and return to the cell through the cell's metal backing, in order to make a closed loop. Finally, the cell bears an antireflective coating, which ensures that photons—the particles of sunlight needed to generate solar power—are absorbed by the silicon layers and not reflected away.

2. THE SILICON LAYERS

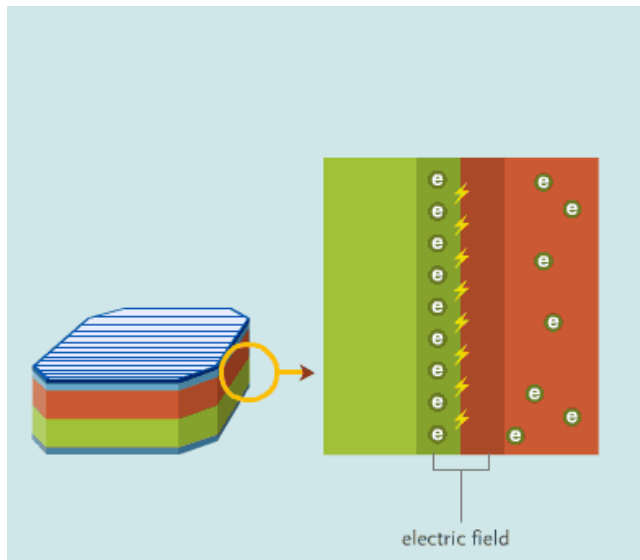
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Silicon is a strong and stable building material for PV cells, but on its own it makes for a poor conductor. So manufacturers beef up or "dope" the cell's two silicon layers with trace amounts of additives, typically phosphorus and boron. The top, phosphorus-doped layer contains more electrons, or negatively charged particles, than pure silicon does, while the bottom, boron-doped layer contains fewer electrons. This difference is crucial, as the next entry reveals.

3. THE ELECTRIC FIELD



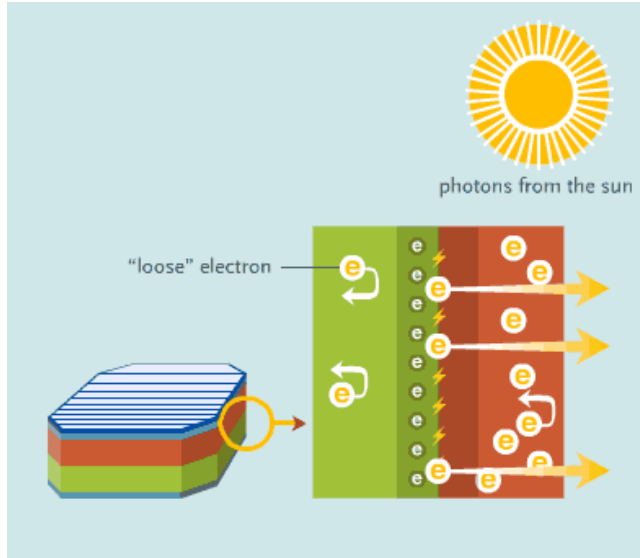
To generate electricity, we first need to establish an electric field. It's like a magnetic field: just as the opposite poles of two magnets attract each other, so do the positive and negative charges in an electric field. This "opposites attract" electric field is created in the cell when its two different silicon layers are first brought together in the factory. The "extra" electrons in the phosphorus-doped top layer naturally move into the boron-doped bottom layer—a process that occurs in a fraction of a second and only very close to the junction (the point at which the two layers meet). Once the bottom layer has gained extra electrons, it becomes negatively charged at the junction; at the same time, the top layer has gained a positive charge there. Now the cell is ready for the sun.

SAVED BY THE SUN



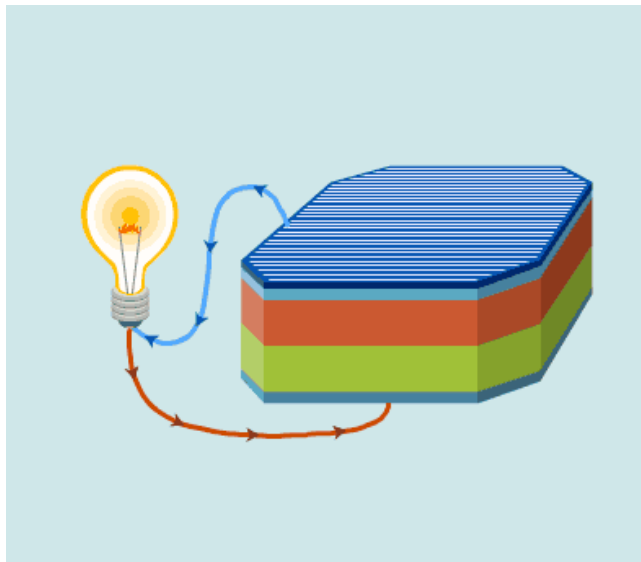
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4. GENERATING ELECTRICITY



As sunlight hits the cell, its photons begin "knocking loose" electrons in both silicon layers. These newly freed electrons dart around each layer but are useless for generating electricity unless and until they reach the electric field at the junction. (This relative inefficiency compared to that of fossil fuels is part of the reason why solar cells still only account for less than 0.1 percent of the energy used in the U.S.) The electric field pushes electrons that do reach the junction towards the top silicon layer. This force essentially slingshots the electrons out of the cell to the metal conductor strips, generating electricity.

5. POWERING THE HOUSE



Electrons flow as electricity via the metal conductor strips into a wire and thence to an inverter inside the house. This device converts the direct current coming from the PV cell into the alternating current our appliances can use. As noted earlier, electrons also flow *out* of the house and back to the solar panel, creating the closed loop necessary to maintain the flow of electricity. The cell keeps generating electricity, even on cloudy days, until the sun goes down at night. To see solar power in action, check out [This Solar House](#). ■

Stephanie Chasteen is a postdoctoral fellow in physics at the Exploratorium in San Francisco. She earned a Ph.D. in physics at UC Santa Cruz, where she researched ways to generate solar energy from semiconducting plastics. Rima Chaddha is an assistant editor of NOVA online.

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