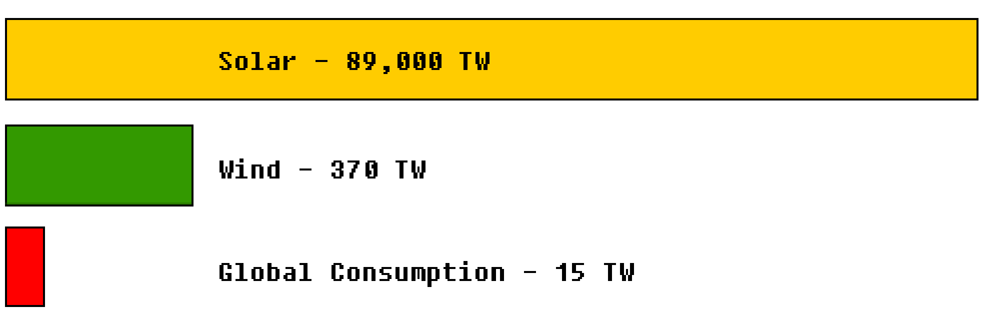
• The Sun

It is the star at the center of the solar system, which has a surface temperature of approximately 5505°C, and generates its energy by nuclear fusion of hydrogen nuclei into helium. In fusing hydrogen into helium, around 0.7% of the fused mass is released as energy. The sun, therefore, releases energy at the mass-energy conversion rate of 4.26 million metric tons per second (3.83 x 10^{26} watts. The high energy particles of solar energy, called photons, released in fusion reactions, escape as visible light. The energy of this sunlight supports almost all life on earth. The enormous effect of the sun on the earth has been recognized since prehistoric times, and as recently as the 19^{th} century, prominent scientists had little knowledge of the sun's physical composition and source of energy. This understanding is still developing.

• Solar energy

The Earth receives 174 petawatts of incoming solar radiation at the upper atmosphere. Approximately 30% is reflected back to space while the rest, which approximately composes 3,850,000 exajoules, is absorbed by clouds, oceans and land masses per year . The amount of solar energy reaching the surface of the planet is so vast that in one year it is about twice as much as will ever be obtained from all of the Earth's non-renewable resources of coal, oil, natural gas, and mined uranium combined.

Available power from solar and wind compared with today's consumption of electricity



* ## Electrical Generation from Solar Energy

The Photovoltaic Cell

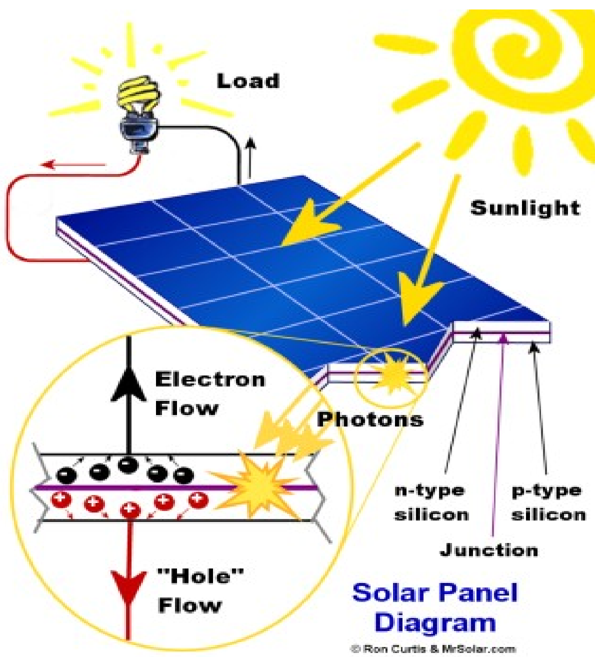
A photovoltaic cell is a type of photoelectric cell that uses the photovoltaic effect to generate electrical energy using the potential difference that arises between materials when the surface of the cell is exposed to electromagnetic radiation.

Photovoltaic cells individually only produce small voltages, typically 0.7 volts for a silicon cell. To raise the voltage, cells are linked up in series, forming a solar panel, so the voltages add up. In a typical silicon solar panel, 36 cells are linked in series to produce about 25 volts (36 times 0.7).

The Photovoltaic Effect

The "photovoltaic effect" is the basic physical process through which a solar cell converts sunlight into electricity. In 1839, nineteen-year-old Edmund Becquerel, a French experimental physicist, discovered the photovoltaic effect while experimenting with an electrolytic cell made up of two metal electrodes. Becquerel found that certain materials would produce small amounts of electric current when exposed to light. Sunlight is composed of photons, or "packets" of energy. These photons contain various amounts of energy corresponding to the different wavelengths of light. When photons strike a solar cell, they may be reflected or absorbed, or they may pass right through. When a photon is absorbed, the energy of the photon is transferred to an electron in an atom of the cell (which is actually a semiconductor). With its newfound energy, the electron is able to escape from its normal position associated with that atom to become part of the current in an electrical circuit. By leaving this position, the electron causes a hole (ie, A mobile electron vacancy in a semiconductor that acts like a positive electron charge (+1.6 x 10-19 coulomb) with a positive mass) to form.

- How a Solar Panel Works

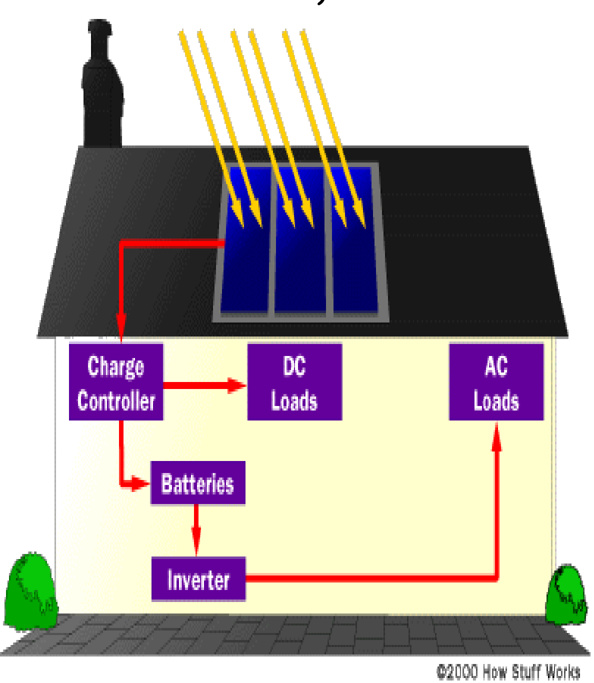


1.) Rays of sunlight hit the solar panel and are absorbed by semi-conducting materials such as silicone.

2.) Electrons are knocked loose from their atoms, which allow them to flow through the material to produce electricity. This process whereby light is converted into electricity is called the photovoltaic effect.

3.) An array of solar panels converts solar energy into direct current electricity.

4.) The DC electricity then enters an inverter which turns dc into ac



electricity

7.) The electricity (load) is then distributed to appliances or lights in the house.

8.) When more solar energy is generated that what you're using - it can be stored in a battery as DC electricity, which supplies electricity in the event of a power blackout or at nighttime.

9.) When the battery is full the excess electricity can be exported back into the utility grid.

10.) Utility supplied electricity can also be drawn from the grid when not enough solar energy is produced and no excess energy is stored in the battery, i.e. at night.

11.) The flow of electricity in and out of the utility grid is measured by a utility meter, which spins backwards (when you are producing more energy that you need) and forward (when you require additional electricity from the utility company). The two are offset ensuring that you only pay for the additional energy you use from the utility company. Any surplus energy is sold back to the utility company. This system is referred to as "net-metering".

- How to Create a Solar Panel

Tools needed	Parts
Saw for cutting	plywood sheeting
Plywood	plexiglass
Soldering iron gun	tin wire

Paint brush

Rosin flux pen

Wire cutters

Screwdriver

Caulking gun

Volt meter

Plexiglass cutters Drill

solder

silicon caulk

uv ray protective varnish

solar cells

Instructions:

1.) Once all the plywood has been cut, use the paintbrush to apply the UV-ray protective varnish. While waiting for the varnish to dry, start working on the solar cells.
2.) Begin by using the Rosin flux pen to apply flux to the bus strips on the solar cells. This will ensure that when you solder your tab ribbons to your solar cells, they will adhere completely, and your wiring will be connected correctly. Connect the solar cells together.
3.) Using as little silicon as you can, affix the solar cells securely to the plywood panel. You'll have two unattached wires hanging from the connected solar cells, requiring that you drill two holes in the plywood and feed the wires through them. Then seal any gaps around the holes with silicon.
4.) Next you'll make a "frame" for the panel, because you need to cover the solar cells with Plexiglas. Adhere the frame to the plywood with more silicon and wood screws, ensuring that it's waterproof. Then secure the Plexiglas to the frame, first with silicon and then with screws. Be sure, however, to drill the screw holes into the Plexiglas before attaching it to the frame. Otherwise it could crack.

5.) Inspect every inch of your solar panel for gaps which could allow moisture to penetrate it. If you find any, no matter how small, seal them with silicon.
6.) Drill a small hole close to the bottom of the panel but away from all the wiring. This will allow air in to the panel to keep moisture from building up. By placing the hole at the bottom of the panel, you'll also keep rain from collecting inside.

- Solar Energy's Drawbacks

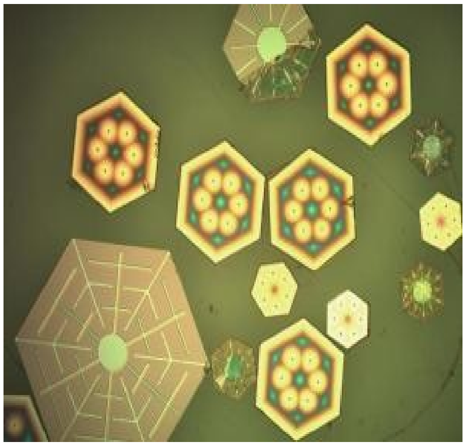
1.) The initial cost is the main disadvantage of installing a solar energy system, largely because of the high cost of the semi-conducting materials used in building one.
2.) Solar panels require quite a large area for installation to achieve a good level of efficiency.
3.) The production of solar energy is influenced by the presence of clouds or pollution in the air.

- Latest Breakthroughs

1.) Self-washing Solar Panels and Windows

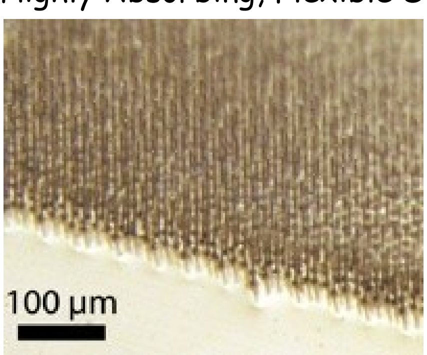
A little-known fact is that solar panels can become up to 30 percent less effective when they accumulate dust and grime. A more widely known fact is that homeowners climbing up on roofs to fix shingles, clean gutters or wash solar panels can lead to some very unpleasant injuries. For those performing the latter, listen up: Researchers at Tel Aviv University recently discovered a new nano-material that repels dust and water. Once commercialized, the material could be applied as a sheer coating, creating self-washing windows and solar panels.Researchers discovered the miraculous little material accidentally as they were working on a cure for Alzheimer's disease. By placing peptides (short polymers) in a vacuum under high pressure, researchers created self-assembling nanotubes. The end result were tiny nanotubes about one-billionth of a meter in length that all together resemble a small forest of grass. Because the nanotubes are resistant to water and heat, researchers figure that the nano-material would be an ideal coating for windows and solar panels, essentially creating products that clean themselves. As a bonus, the new nano-material also acts as a supercapacitor, meaning it could also be used to prodive extra energy for batteries in electric vehicles or incorporated into existing lithium batteries.

2.) Glitter-sized PVs



Sandia National Laboratories scientists have developed tiny glitter-sized photovoltaic cells, which are fabricated using microelectronic and microelectromechanical systems (MEMS) techniques common to today's electronic foundries; and which could revolutionize the way solar energy is collected and used.The solar particles, fabricated of crystalline silicon, hold the potential for a variety of new applications; and are expected eventually to be less expensive and have greater efficiencies than current photovoltaic collectors that are pieced together with 6-inch- square solar wafers. A potential cost reduction comes about because microcells require relatively little material to form well-controlled and highly efficient devices. From 14 to 20 micrometers thick (a human hair is approximately 70 micrometers thick), they are 10 times thinner than conventional 6-inch-by-6-inch brick-sized cells, yet perform at about the same efficiency. Since they are much smaller, they have fewer mechanical deformations for a given environment than the conventional cells, thereby making them also more reliable over the long term. Furthermore, the shade tolerance of a unit composed of these PVs to overhead obstructions is better than conventional PV panels, because portions of its unit not in shade will keep sending out electricity where a partially shaded conventional panel may turn off entirely.

3.) Highly Absorbing, Flexible Solar Cells



Using arrays of long, thin silicon wires embedded in a polymer substrate, a team of scientists from the California Institute of Technology (Caltech) has created a new type of flexible solar cell that enhances the absorption of sunlight and efficiently converts its photons into electrons. The solar cell does all this using only a fraction of the expensive semiconductor materials required by conventional solar cells. These solar cells have, for the first time, surpassed the conventional light-trapping limit for absorbing materials. The light-trapping limit of a material refers to how much sunlight it is able to absorb. The silicon-wire arrays absorb up to 96 percent of incident sunlight at a single wavelength and 85 percent of total collectible sunlight. The silicon wire arrays are able to convert between 90 and 100 percent of the photons they absorb into electrons—in technical terms, the wires have a near-perfect internal quantum efficiency. High absorption plus good conversion makes for a high-quality solar cell which is considered an important advancement. Each wire measures between 30 and 100 microns in length and only 1 micron in diameter. The entire thickness of the array is the length of the wire. But in terms of area or volume, just 2 percent of it is silicon, and 98 percent is polymer. In other words, while these arrays have the thickness of a conventional crystalline solar cell, their volume is equivalent to that of a two-micron-thick film. Since the silicon material is an expensive component of a conventional solar cell, a cell that requires just one-fiftieth of the amount of this semiconductor will be much cheaper to produce. The composite nature of these solar cells means that they are also flexible which means that they can be manufactured in a roll-to-roll process, an inherently lower-cost process than one that involves brittle wafers, like those used to make conventional solar cells.

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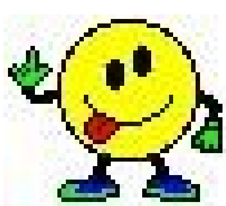

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