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Photovoltaic Cells: common power source for tomorrow?

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The word "photovoltaic" combines the scientific terms "photo", meaning light, and "voltaic", meaning voltage. Together, the terms mean voltage generated by light energy. Specially treated silicon, or another substance, is manufactured in such a way that when light strikes it electricity is produced. The cells have no moving parts, and they are durable. They are commonly called solar cells.

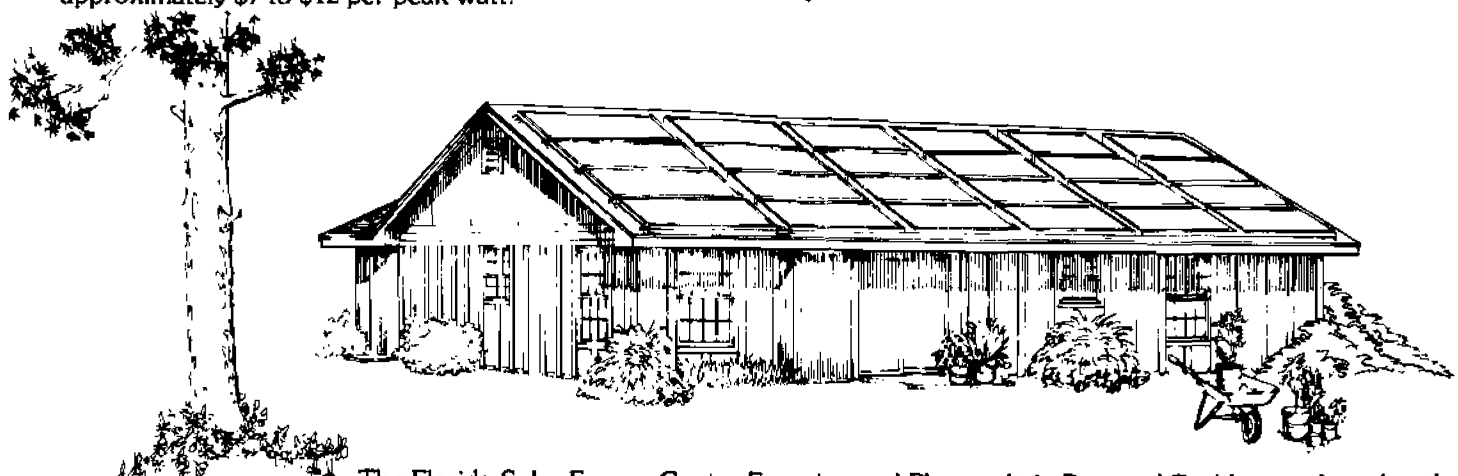
While silicon is not the only material used in making solar cells, it has undergone the most development since its first use in 1954. Many space satellites have used silicon solar cells to provide their energy needs for the last two decades. If they are so good, why aren't we using them to power our homes today? The answer is cost. Since the major demand for them has been for spacecraft, large-scale mass production techniques have not been developed to meet a large commercial market demand.

Today, as costs of conventional energy sources such as oil and coal continue to rise, solar cells appear more and more attractive for a variety of applications, including electricity for most of a modern home's needs. The federal government has sought to create a new market for solar cells by funding both basic cell research and photovoltaic experimental projects involving concentrating (sun-tracking) and non-concentrating collector arrays. It is hoped that before 1990 the photovoltaic market will have developed enough to make cell prices competitive with conventional forms of electricity generation. A competitive price goal (in 1980 dollars) is considered to be between 50¢ and $1 per peak watt. Current prices are approximately $7 to $12 per peak watt.

Assume then that solar cells could be produced at a cost making them economically attractive for home use. The next step is to connect enough of them to produce sufficient electrical power. When sunlight strikes the cell's surface, direct current (DC) electricity is produced. By wiring a large number of cells together, a photovoltaic array is created which can generate as much electricity as desired. However, since most home appliances use alternating current (AC), the direct current produced by the cells must be converted to AC. An electric device known as an inverter performs that function. When sunlight hits the photovoltaic array, the direct current electricity generated is converted to 240/120-volt, 60-cycle alternating current by the inverter. This is the standard operating voltage for most home appliances.

In order to supply adequate electricity for household needs, photovoltaic arrays ranging from 500 to 1,000 square feet in size would be required. One possible approach is to cover a south-facing roof with the cells. The array could be made to resemble roofing shingles; thus, in outward appearance the house would not look much different than one conventionally powered. If sufficient roof area were not available, the array could be mounted on the ground. Cells are normally arranged in the form of flat rectangular panels facing south and tipped at an angle equal to the site latitude.

What happens when the sunlight is weak, or there is no sunlight at all? Clouds cause variations in the amount of solar intensity, or insolation, and since the photovoltaic array's output depends on how much light strikes it, obviously the electricity supply will not be steady. And at night or during rainy weather it will, of course, produce no power at all.



The Florida Solar Energy Center Experimental Photovoltaic-Powered Residence: three-fourths of the building's needed power is provided by the photovoltaic panels on the roof.

There are solutions to this problem. Since the photovoltaic array output is direct current electricity, it can be used to charge storage batteries. By designing the photovoltaic system properly, batteries could be kept charged sufficiently to supply power to the home at any time. To generate the required AC electricity, the batteries would be connected to an inverter. Another approach is to use a utility synchronized inverter without batteries. The AC output would be variable but the utility service would instantaneously supply any extra needed power. Obviously, at night or during overcast periods, the utility would supply all of the power. However, on sunny days it is possible that the solar system would supply **more** power than the house requires. Under this condition the utility meter will run **in reverse** and yield an energy credit for the homeowner! Because of the high cost of storage batteries, this concept might be the most economical approach. In fact, the Center's experimental photovoltaic house operates in just this manner today.

This has been only an exploration into what might happen a few years from now--dispersed photovoltaic systems on individual homes (or larger residential and commercial structures, for that matter.) On the other hand, it is possible that we may also see central photovoltaic utility plants serving whole communities. More information on photovoltaic systems may be found in:

--**Non-Technical Summary of Distributed Solar Power Collector Concepts,** Document No. SE-102, Stock No. 060-000-00008-5, Government Printing Office, Washington, D.C. 20402.

--**Solar Electricity: From Dream to Scheme,** by John H. Douglas, Science News, May 15, 1976, pp. 316-318.

--**New Ways to Make Solar Cells, Trim Costs of Future Power for Your Home,** by Edward Edelson, Popular Science, May 1976, p 74.

--**Photovoltaics, an Overview--Solar Cells: State of the Art,** by David Norris, Solar Age, April 1976, pp. 8-14.

--**Electricity From the Sun!--Solar Photovoltaic Energy,** by John M. Fowler, Order No. EDM-1043-4, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

--**Solar Electricity From Photovoltaic Conversion,** Order No. DOE/OPA-0011, Technical Information Center, P.O. Box 62, Oak Ridge, TN 37830.

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