American Physical Society Panel Gives a Long-Term Yes to Electricity from the Sun

Breakthroughs needed before solar cells can compete with coal

Advocates of solar energy heard one of those "good news–bad news" stories last month when members of an American Physical Society (APS) study group presented the conclusions of their year-long examination of solar photovoltaic energy conversion.

The good news is that the physicists found no fundamental reasons why solar cells could not eventually be a significant source of electrical power in the United States. The bad news is that the know-how for generating electricity at a price competitive with coal or nuclear power does not now exist and will not without significant advances in solar cell technology. Hence, the panel, which presented its findings at the APS annual meeting in New York, concluded, the main focus of federal solar cell R & D should be on basic research, and efforts to stimulate the growth of a solar cell industry are still premature. Not surprisingly, at least one solar energy organization, the Solar Lobby, immediately vigorously protested the physicists' report, characterizing it as "distorted" and "unbalanced" and labeling the APS as "irresponsible" for releasing such a document at a time when federal budget-making activity is intense.

In a press conference, Harvard University physicist Henry Ehrenreich, chairman of the 12-member panel (none of whom are directly involved in solar cell research) outlined the principal conclusions of the report.* Ehrenreich explained that the APS study originated in a request from the White House Office of Science and Technology Policy (OSTP) to the society to evaluate the conditions under which solar cells could be a major energy option for the United States. The panel limited its investigation to the production of electricity by terrestrial solar cells, and it did not make any recommendations for funding of specific Department of Energy (DOE) programs. (DOE and OSTP jointly funded the study.)

Ehrenreich portrayed the future of solar cells as bright, predicting a decrease in their costs by a factor of 5 in 5 years and citing the prospects for further advances. At present, however, there is no clear technical choice among the many alternative solar cell technologies, none of which is now competitive with coal-generated electricity. In the absence of an obvious front-running technology, the panel said, large-scale deployment of any one candidate is premature. Technology demonstrations should be limited to those needed to gain field engineering experience. The first item of priority, said Ehrenreich, is a program of intense R & D to lower the costs of solar cells, but the effort should be spread across a wide diversity of candidate technologies.

Looking into the future, the panel foresaw that even by the year 2000, only 1 percent of the nation's electricity could come from solar cells. Achieving this penetration would nonetheless require an outlay of $1 billion to $2 billion per year for 10 years to build the capacity to produce the large areas of solar cells needed.

In part because the U.S. power distribution system is based on the use of grids that span large areas of the country, and in part because they felt the costs might be less, the panel considered that solar cells would be most useful in the long run as part of a centralized electrical power plant, in contrast to the popular notion of a distributed network of rooftop solar panels. To be competitive with coal-fired plants, the panel calculated, solar cells would have to cost in the range of 10 to 40 cents per peak watt. Present costs, said Ehrenreich, are in the neighborhood of $5 to $10 per peak watt. (Peak watt refers to the power generated when the sunshine is brightest.)

The panel found that the price of electricity from solar cells is now determined principally by the costs of the cells themselves, but as these decrease the associated costs of land, structures, and related items will grow increasingly important. Therefore, it is important to also reduce the costs of the noncell portions of an electricity-generating system.

Although solar cells made of silicon single crystals are the proved technology for use in space, the panel concluded that the cost of such cells for use on Earth would be unlikely to drop below 50 cents per peak watt, regardless of the successes that might yet be achieved with options for low-cost production of silicon. At best, then, silicon could be of value as a backup or insurance technology if the cost of electricity from other sources were to jump unexpectedly, or for important but low-volume applications such as power generation at remote sites or in developing countries.

An alternative the panel found worth considering was the use of concentrators, optical devices that collect sunlight and focus it onto the surface of solar cells. Concentrators can reduce costs because a much smaller cell area is required, but the reduction is heavily dependent on the price of the concentrators. The panel believes that low-cost plastic concentrators used in conjunction with high-efficiency silicon solar cells could just compete with coal at the high end of the range of projected costs of coal-generated electricity. Use of more efficient solar cells made from gallium arsenide or other new materials seemed to hold even more promise.

Reliance on large areas of very inexpensive thin-film devices is an alternative the panel found intriguing because there are so many options. But important problems remain to be overcome in their long-term chemical stability (films must stand up to the environment for as long as 20 years) and in the ability to reproducibly manufacture thin-film materials. Moreover, said Ehrenreich, the thin-film cells must demonstrate an efficiency of at least 10 percent or else the noncell costs alone would make them too expensive to compete with coal.

All in all, panel members seemed very upbeat about the long-term prospects of solar cells for electricity production in the United States. For those who want to see solar energy developed immediately, the panels's findings are less than encouraging. In the light of the remarkable harmony between the physicists' conclusions and President Carter's recently submitted budget, which came down hard for increased expenditures on solar cell R & D but reduced funding for measures designed to stimulate the growth of the infant solar cell industry, it is easy to see why the Solar Lobby, which worked hard for a different distribution of funds, would attack the APS report.

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**Principal Conclusions of the American Physical Society Study Group on Solar Photovoltaic Energy Conversion*. American Physical Society, 335 East 45 Street, New York 10017, $5.00.

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