Solar Energy: Unsung Potential for Wind and Biomass

Government-sponsored studies seem to be converging toward the conclusions that solar power could supply substantially more than 1 to 2 percent of the country's energy by 2000, and that the most promising types of solar energy are ones that have been largely unheralded.

The most optimistic assessment of solar energy's future prospects is that it could provide 25 percent of U.S. energy needs by the end of the century. This figure is argued, in a new report by the Council on Environmental Quality, to be attainable with accelerated solar development and a serious effort to conserve energy. The technologies included under the heading of solar are not only those that capture sunlight directly but also those that would use it indirectly, such as wind systems, hydroelectric systems, and systems that extract energy from wood, fiber, and grain (collectively called biomass). Using this broad but technically accurate definition of solar energy, the country already extracts 5 percent of its energy from solar sources, since biomass currently provides 1.3 quads of energy and hydroelectric 3 quads. (National energy use is about 75 quads.)

Two reports prepared for the Department of Energy are less expansive than the Council on Environmental Quality, but they are optimistic, projecting solar power's share of the future energy market to be 6 to 9 percent by 2000.

Market penetration studies by SRI International* and the Mitre Corporation† indicate that solar power will play a substantial role, particularly in the form of wind and biomass. These two technologies are sleepers that will come on very strong in the next two decades to equal or surpass the contribution of solar heating and cooling systems by 2020. According to the SRI analysis, the three solar technologies are in a particularly good position to make large energy contributions because of their current status of development and economics. In the near and intermediate term, solar heating and cooling of buildings was ranked highest by the SRI methodology, which relied heavily on market penetration projections. In the longer term SRI concluded that wind power would become dominant because the potential market for wind is larger (Table 1). Biomass was given high marks because production could accelerate rapidly, although it would eventually level off as the available land was used up. Both wind and biomass were found favorable because they can function as fuel savers, replacing scarce oil and gas. The Mitre report paints a similar picture, projecting that by 2020 wind, solar heating and cooling, and various forms of biomass will produce 6.6, 3 to 5, and 4.4 quads of energy, respectively.

Table 1. Solar technologies ranked by total benefits on the basis of 100 possible points. [Source: SRI International]

1985		2000		2020	
Heating/cooling	79	Heating/cooling	86	Wind	90
Biomass	68	Wind	78	Heating/cooling	73
Wind	67	Biomass	49	Photovoltaics	65
Photovoltaics	21	Photovoltaics	36	Biomass	48
Thermal power	12	OTEC	17	OTEC	40
Industry/ agriculture	10	Thermal power	16	Thermal power	35
OTEC	1	Industry/ agriculture	11	Industry/ agriculture	21

*"Solar Energy Research and Development: Program Balance," HCP/M2693 (2 volumes), February 1978.
†"Solar Energy, A Comparative Analysis to the Year 2020," ERHQ/2322-78, March 1978.

In considering other solar technologies, the two studies came up with contradictory conclusions. The SRI study projected that photovoltaic (solar cell) systems used in either large or small applications would eventually prove cheaper than centralized solar thermal generating stations (power towers), while the Mitre study came to the opposite conclusion. In each case, the winner produced about 3 quads in 2020 and the loser close to none. The two reports also came to conflicting conclusions about the merits of solar energy for supplying process heat for industrial purposes. The Mitre group projected the industrial market to be the largest user of solar power of all (13 quads in 2020), while SRI found that in spite of many attractive features (year-round heat demand and the presence of a trained maintenance staff), the institutional barriers, particularly tax disincentives, would inhibit the industrial use of solar energy in the foreseeable future. The Department of Energy has already convened one workshop to try to reconcile this difference, with little progress so far.

The SRI analysis was commissioned under the aegis of the general advisory committee of the Energy Research and Development Administration (*Science*, 17 December 1976) and was completed under the direction of the same committee, renamed the Solar Working Group after the Department of Energy was created and the general advisory committee was discontinued. The task of the group was to analyze the balance of the solar energy program, which it did in a 30-page report based on the SRI analysis.

The working group made unqualified recommendations for changes in two of the seven solar subprograms: biomass and ocean thermal energy conversion (OTEC). It advised that the biomass total effort "should be greatly increased" with particular emphasis on new production technologies, while saying that the OTEC program's costs were quite uncertain and its commitment to large demonstration projects was "premature." In addressing the power tower, to which more than one-fourth of the solar budget is now allocated, the committee hedged its recommendation, saying that the large budget was not consistent with the prospects of success, but that the expensive 10-megawatt demonstration plant being built at Barstow, California, should nevertheless continue because of the importance of utility participation in the solar program.

Photovoltaic systems were given a mixed recommendation. Research on single-crystal silicon cells was singled out for decreased emphasis because the panel concluded the expensive cells would not reach their cost reduction goals, while research on thin-film cells (made of such materials as amorphous silicon or cadmium sulfide) was recommended for greater support. The working group also turned thumbs down on photovoltaic concentrator systems because of their limited price reduction potential.

The results of the working group evaluation were presented to DOE management almost 3 months ago. Whether a study by an institutionally disenfranchised committee will have any impact is open to question. The slim study is of significance, however, because it is the first comprehensive review of the solar energy research program.

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