Harnessing the Sun

Of the three energy sources often touted as long-term solutions to the energy needs of man—solar energy, fission (breeder) reactors, and controlled fusion—the first may offer the most pollution-free option if it can be harnessed. But paradoxically, the funding priorities of the federal government do not reflect this fact. At the present time the United States is spending about $200 million a year on fission reactors, $30 million a year on development of controlled fusion power, and essentially nothing on the direct harnessing of solar energy.

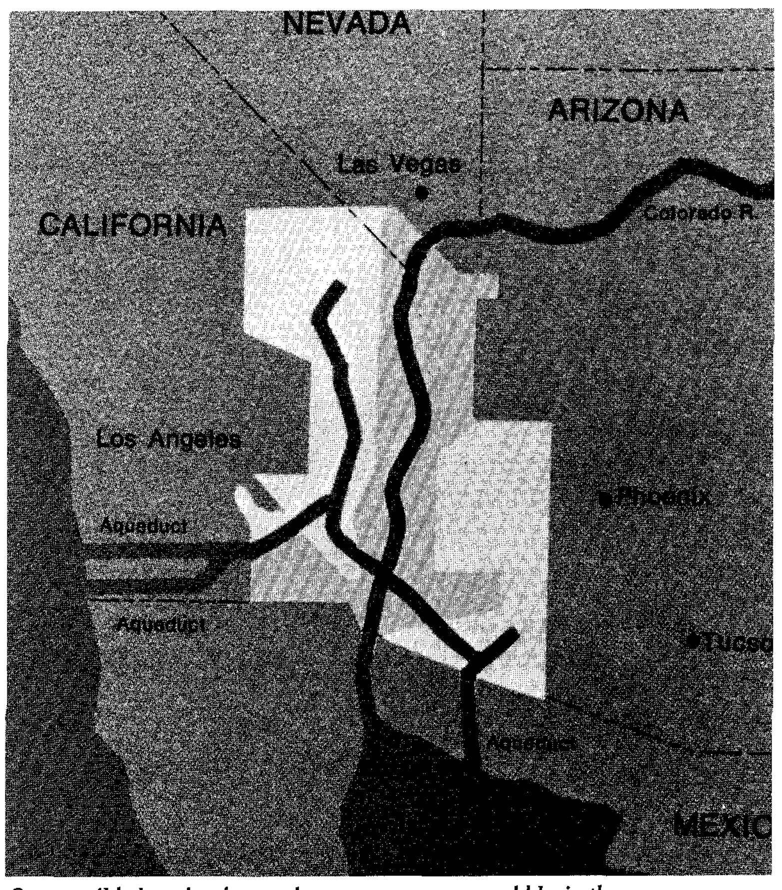
There are those—among them Jerome Weingart, senior engineer at the Jet Propulsion Laboratory and senior research fellow in Caltech's Environmental Quality Laboratory—who believe these priorities should be modified.

Weingart was recently appointed to a joint National Aeronautics and Space Administration-National Science Foundation committee formed to create a national program in solar energy technology research and development. In February he was program director of a three-day working conference at Caltech on solar energy applications.

It is his opinion that with proper funding solar energy could generate 10 to 25 percent of this country's national energy budget. While solar energy conversion as a primary source of energy (more than 50 to 60 percent) would be feasible within 100 years, he feels that *no* single source of energy should be dominant, since such a situation is less stable than one in which there are a large number of energy options.

Almost all of our energy needs are currently supplied by some form of fossil fuels. As the ways we use them at present become less acceptable to society, the more acceptable or cleaner uses become expensive. The only alternate large-scale energy option we *now* have is the fission reactor, which has a number of unresolved technical issues associated with its use. Weingart feels that we must work out a large menu of energy alternatives for society, even though development and large-scale implementation of some of these options will require several decades. One of these options—solar energy—must be looked at from the point of view that we live in an energy-intensive, affluent, and high technology society. Keeping these factors in mind, we must develop solar energy to the point where it can be evaluated as a serious energy option.

Until the last few years interest and activity in the solar energy field has been confined to small-scale demonstration projects, such as solar-heated homes, small solar stills, and solar-powered steam engines. The conversion of sunlight to electricity has been confined to very special applications requiring only small amounts of power, or, more recently, for supplying power to spacecraft. But while future large-scale solar utilization systems on earth may employ some aspects of these developments, the economic, environmental, and ecological facets of the use of solar energy for terrestrial purposes have no counterparts in space endeavors.



One possible location for a solar energy reserve would be in the desert areas of California and Arizona near the Colorado River. Other lands suitable for large-scale conversion of the sun's energy to electricity are in Nevada, Texas, and New Mexico.

Residential dwellings and commercial buildings may be the first areas where solar energy can be effectively used. Already the technology for solar heating of houses is well developed and would be cheaper than all-electric heating in most of the country today. With the cost of electricity likely to double within a decade, and domestic supplies of natural gas running low, solar energy systems could provide practical and economical options for heating and cooling of homes and schools. While the solar cells developed for spacecraft are quite expensive, mass production techniques that would result in considerably less expensive photovoltaic converters for use on earth are being examined by NASA and the NSF.

Weingart estimates that if a 1,500-square-foot roof on a house in the Southwest were covered with solar cells that were 10 percent efficient, about 100 kilowatt hours of electricity would be provided on a typical spring day. The present daily use of electricity in residences in southern California is about 20 kilowatt hours. This leaves 80 kilowatt hours available for other uses. Some of this surplus could be used to charge batteries for a small electric-powered commuter vehicle that could travel up to 80 miles per day. If solar cells of the same efficiency—but able to operate at about 200 degrees— were developed, the heat collected by the rooftop array could provide the majority of heating, cooling, and hot water supply for residences in the Southwest. In other parts of the country, solar-generated electric thermal power could, in principle, significantly reduce the load on conventional fuels and conventional central electric power production.

The use of solar energy for large-scale production of electrical and chemical energy appears to be farther in the future. Virtually no substantial research and development have been supported in this area until very recently, and the current effort is of a small-scale, exploratory nature.

Some of the potential benefits of producing large amounts of power from solar energy rather than depending on fossil or atomic fuels have important implications for the United States and the rest of the world:

1. Solar energy conversion is inherently a low-impact technology. In principle it avoids some of the major areas of environmental impact such as air and water pollution, permanent land destruction, thermal effluent at the source, long-term storage of radioactive wastes, and addition of heat to the thermal budget of the earth.
2. The fuel is abundant and free.
3. If the total amount of power required in the U.S. can be limited to perhaps four times what is currently produced, the destructive exploitation of the natural resources of other nations (particularly the underdeveloped countries, which will need these resources for their own well-being) can be prevented—with a concurrent lessening of the dangers of political conflicts.
4. Availability of large amounts of solar-energy-produced power might eventually have a profound impact on the economic, environmental, and political conditions of the rest of the world. Supplying cheap and abundant power to low-technology nations, particularly those with very limited supplies of fossil fuels and limited nuclear technologies, may also prevent a world where every nation—large and small—has the materials to build nuclear weapons.

An area of 3,000 square miles in the deserts of the Southwest could hold enough solar energy collectors and converters to supply the total electrical needs of the U.S. today—if the equipment was 20 percent efficient in converting and delivering energy. An area 200 miles on a side could theoretically supply all the energy needs of the U.S. If this sounds somewhat grandiose, it nevertheless represents only 1 to 8 percent of the present farmland. Low quality land would be used for such installations. The federal government owns about 100,000 square miles of barren desert land in the Southwest, much of it used for gunnery ranges and testing of underground nuclear weapons. Much of this land is suited for solar-power generators.

Careful studies will have to be made to determine the ultimate technical and economic feasibility of various systems of conversion of solar energy (to produce electricity and chemical energy and to heat and cool buildings) and the various resources required for the development and implementation of this kind of energy on a meaningful scale. The best we can do at this early stage is to determine the economic range of the various solar energy conversion systems. If those ranges appear to approach the estimated costs for energy and power over the next several decades, we would do well to take a very serious engineering and economic look into the feasibility of such systems.