As Energy Grows Scarcer, Science Again Looks to the Sun
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Goal of Research Is to Lower Solar-Heating Cost for Homes

By BAYARD WEBSTER

While the sunne shineth—make hay.

—John Heywood [1546]

The sunlight that most people take for granted makes it possible to grow all the plants on earth, make skyscrapers appear to be spires of gold, produce air currents that turn 100,000 windmills and make dewdrops sparkle like diamonds.

To the layman it is usually something to enjoy.

But to solar and energy scientists, aware of the growing worldwide shortage of power, sunlight is a form of electromagnetic radiation that, in the space of about eight minutes, reaches from a star across 93 million miles of space and descends on the earth with a tremendous energy that has yet to be tapped in any significant amount.

In the United States alone, it has been estimated that some 9,000 trillion kilowatt-hours of solar energy are received annually, the equivalent of power available from 1.15 trillion tons of coal. That is almost 2,000 times as much as current annual United States production.

Today, as the prices of conventional fuels go up and supplies go down, it is not hard to see why the promise of power from the sun has aroused the interest of governments and industries, home owners and utilities, and has sent scientists scurrying into labs and deserts and onto roofs to see how this energy source can be captured and used efficiently on a broad scale.

How soon the promise will become a reality for the average home-buyer is a matter of conjecture, but one major concern announced a few weeks ago that it expected to enter the solar-heating field for homes this month.

Homes Option Seen

Such a move, the first by any large industry, is regarded as a strong indication that within the next year or two a majority of new home buyers will have the option of installing a solar-heating unit. The unit would be relatively expensive initially and would provide no more than 50 to 85 per cent of the total heating requirements.

Although solar applications range from simple hot-water heaters and crop dryers to home heating and cooling and from electricity produced by solar cells to large power-plant installations, the center of attention today is how to achieve commercial production of cost-competitive solar-heating units for residences in the near future.

At a National Science Foundation solar-energy workshop held a few weeks ago in Arlington, Va., most of the 500 architects, engineers, home-builders, Government officials, planners and researchers who attended shared the belief that commercially designed components and systems for solar heating of new homes would be relatively commonplace in a few years.

They felt that it would be from three to five years before combined—and more sophisticated—heating and cooling systems would be available. And it will be much further into the future before such applications as solar cells for home electricity production and multi-megawatt solar plants for large-scale electrical output come into being.

But, for the new-home buyer, the most encouraging note sounded at the conference was an annoucement by PPG Industries in Pittsburgh that it was going to start production of solar-heat collectors for sale on the commercial market within the next few weeks. This is the first move by a major industrial concern to get into the solar-energy field.

This commercial activity has been triggered by a combination of problems that are compounded because the demand for energy in the United States is growing close to 5 per cent a year.

These problems include sharp rises in costs for oil, gas and electricity, depletion of oil and gas reserves in a few decades, despoilation of land by coal mining, increasing problems with nuclear power, a lack of additional hyroelectric power

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Average Solar Energy Received at Selected Cities

	Million kilowatt-hours per acre per year
El Paso, Texas	9.5
Fresno, California	7.8
La Jolla, California	7.0
Miami, Florida	7.0
Salt Lake City, Utah	6.7
Lincoln, Nebraska	6.3
Cleveland, Ohio	6.1
Washington, D.C.	5.8
Seattle, Washington	5.4
Boston, Massachusetts	5.2
New York City	4.9

Source: Daniel S. Halacy Jr.

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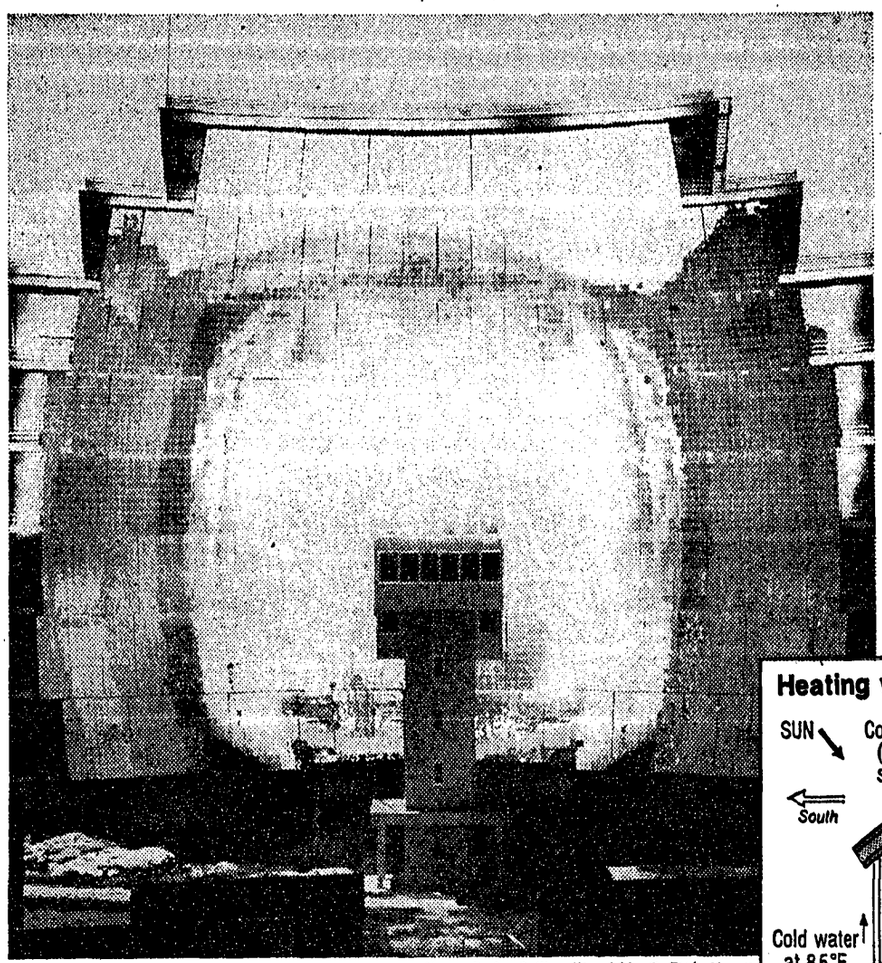

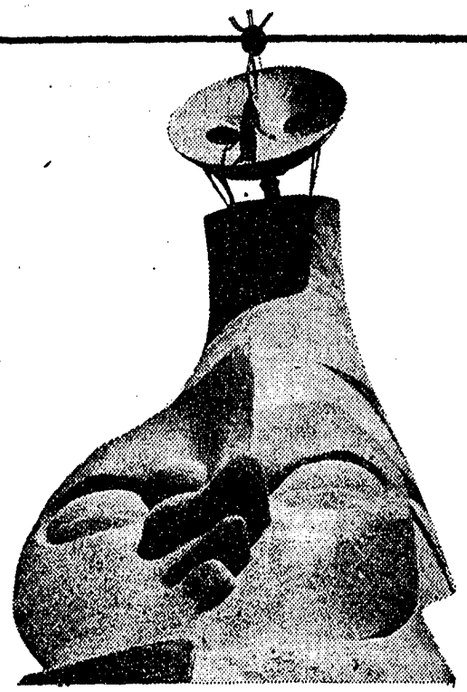

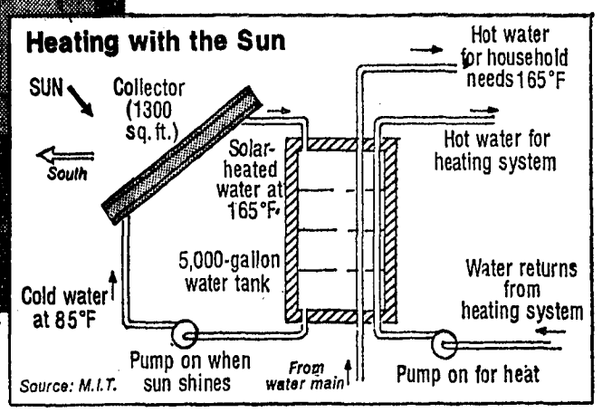

Above, Rapho Guillumette; right, © Paul Almasy

Energy from the sun is captured in a series of mirrors at a station in the French Pyrenees, above. At right is a statue surmounted by a representation of a solar mirror. The statue is in Osaka, Japan. Diagram shows domestic system for using solar heat.

Energy Shortage Spurs Solar Study

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plant sites, and the realization that geothermal power can provide only a small fraction of future needs.

As a result, alternative power sources are now being intensively investigated, with solar energy leading a list that includes production of hydrogen, methane and methanol, ocean-thermal and tidal-energy conversion and wind conversion.

In the United States there are already some two dozen solar homes, mostly experimental installations constructed by engineers with funding and technological aid from universities, private business and the Federal Government. Ten to 20 other solar-heated homes are known to exist in other parts of the world.

Collector Boxes Used

In one of its simplest forms, the home solar-heater comprises a collector box, or boxes, usually on the rooftop facing south, containing black-coated waterpipes over a black surface. The box is covered with one or several layers of glass. The glass permits sunlight to enter but keeps radiant heat emitted by the pipes and black surface from escaping into the atmosphere.

The water in the pipes is heated by the sun and is circulated through the house by a small pump using an auxiliary power source. The water may be stored in a heavily insulated tank where it can retain its heat for one to five days. It would thus furnish heat at night or when the sun is clouded over.

Some plans call for circulating air round the hot water tank and heating the house with warm air driven by a fan that uses auxiliary power. Still others circulate air directly over the black collector plates and distribute it round the house.

The cost of any of these units, which provide from 50 to 85 per cent of a home's heating needs, would range from $2,000 to $5,000 depending on the size of the home and other factors. Installation of units in older houses would be even more expensive. This initial outlay compares with a cost of $1,000 to $2,000 for a conventional furnace heating system.

Solar energy advocates are quick to point out, however, that over a 20-year life-cycle solar heating would be cheaper than the conventional units because there would be no fuel costs.

The PPG Industries collector boxes are expected to retail about $5.80 a square foot. Solar engineers' rule of thumb says that present-technology solar-collectors should equal about a third of a home's internal square footage.

By that rule, a 1,000-square foot home would need some 300 square feet of solar collectors. This would cost $1,800 alone, plus charges for shipping, storage tank, plumbing and installation.

Many proponents of solar energy say the Federal Government's lack of interest and its stinginess over the last few decades are responsible for the still-high initial cost of solar-energy technology. They often cite a General Accounting Office study that shows that from 1950 to 1970 Federal spending averaged $100,000 a year for solar-energy research.

Allocations since then have risen steadily to a current total of $50-million, although not in increments large enough to please solar-power enthusiasts.

Even so, the National Science Foundation is funding and testing a variety of solar-energy applications across the country.

Among these is the nation's largest solar project, now under construction in Denver. A $747,000 solar plant will be used to heat a 278,000-square-foot classroom center at Denver Community College. The total cost will be about $10-million, and the solar system designers claim that with the rising cost of conventional fuel, it will pay for itself in 10 years. Fuel costs for the plant, of course, are zero.

Also on the drawing board or already in work are such industrial and institutional projects as a new conservatory and administration building for the New York Botanical Garden in Millbrook, N. Y.; four public schools in Maryland, Minnesota, Massachusetts and Virginia, and a project at Arizona State University that will attempt to determine how best to deploy photovoltaic (solar) cells for optimum efficiency.

Most researchers believe that, eventually, electrical generation by solar cells will become cheap and efficient enough for general use. Now used mainly in outer-space vehicles or other applications where relatively little power is needed, the cells' main drawback is high cost. But new methods of mass producing the silicon cells—now manufactured individually—by a low-cost, continuous-ribbon technique are being developed.

On a more immediate level, Arthur D. Little, Inc., the industrial consultant firm in Cambridge, Mass., is conducting a study for some 80 commercial concerns to define the technical, economic and marketing prospects for solar climate-control technology.

An interim report of the study so far indicates that there is considerable market potential for solar energy devices, especially the smaller home heating devices that could be sold at relatively low cost.

According to Dr. Peter E. Glaser, vice president of Arthur D. Little, who is conducting the study, commercial development could be so rapid that in 20 years the saving in conventional fuel sources in the United States alone could equal two million barrels of oil a day—the amount expected to be flowing through the Alaska pipeline.

Output Is Small

At present a score of industrial concerns, mostly small, declare themselves to be in the solar home heating field, but their output is tiny.

Why, then, with the technology available, with the desire of hundreds, and probably thousands, of homeowners to build solar homes, and with the fast-rising costs of oil, gas and electricity, isn't solar heating already a major factor in the marketplace?

According to observers in the field there are many reasons. Among the main reasons is lack of availability and a scarcity of sales outlets for them.

But despite these obstacles, the prospects for the immediate future of solar heating are not unbright, as the following indicate:

¶The Government has already earmarked $200-million for solar-energy programs over the next five years and may provide more.

¶There are 16 bills before Congress designed to support solar energy. One of them, the Solar Heating and Cooling Demonstration Act, passed by both Houses, will provide $50-million to subsidize development and use of solar units in 2,000 homes, schools and factories.

¶Two states, Indiana and Arizona, offer reduced property-tax assessments for homeowners who buy and use solar heating and/or cooling equipment.

¶At least two bills have been prepared in Congress proposing individual income-tax reductions of up to $3,000 to help defray costs of installing solar units in homes.

A few decades ago, thousands of solar home and water heaters were in use in this and other countries. But, as gas and oil became readily available and cheaper to use, solar heaters became a costlier and less convenient alternative. Today the situation is slowly but inexorably reversing itself.

Government Aid Favored

Three recently made independent studies project different, but extremely optimistic, forecasts as to the future viability of solar heating and cooling.

Two of these studies—one by the National Aeronautics and Space Administration with the National Science Foundation, the other by TRW Systems—estimate that solar energy, if given strong support, could supply up to 35 per cent or more of the nation's heating and cooling needs by the year 2020, little more than four decades hence.

The third study, by Walter E. Morrow Jr. of the Massachusetts Institute of Technology puts the figure at 25 per cent by 2020.

Today, the advocates of solar energy feel that its practicality and benefits have been demonstrated and that its technology for simpler application is now available. What remains to be done, they say, is to make it available to the consumer, a job best done by private industry with the help of Federal and local governments.

Then it can be used, they add, first by hundreds, then by thousands and more, to provide a continuous, non-depleting energy source.

The original small band of solar partisans is now being joined by scores of representatives from the fields of science, government and industry who say that the sun—the engine that drives the earth—can now be harnessed to provide non-polluting energy.