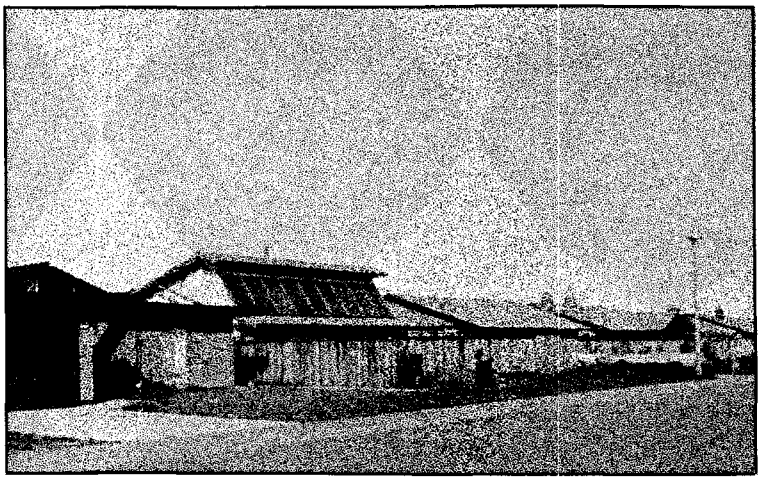
Solar Power Now

by Tom Zeman



Few people pay any special attention to the home of Chuck and Jan Ward in Davis, California. And at first glance, it's not apparent why anyone should. The Wards live in a ranch-style home in a recently developed suburban area of this college town, and their house looks a great deal like others on the block. But the nine window-like panels discretely designed into a dormer on the roof remind the careful observer that there is something very unusual and exciting happening in this particular house. Those panels represent an important new departure in this country's struggle over a national energy policy: the arrival of direct solar energy as a practical, economically feasible way of providing heat for the average American home.

The advantages of direct use of the sun's energy are obvious and decisive. At a time when the nation is on the brink of a trillion dollar commitment to massive development of fossil fuel and nuclear power, carrying with it the gravest environmental and social implications, solar power —combined with a serious energy conservation program— offers us an infinitely more attractive alternative. Solar energy is not only safe and environmentally clean; it is also inexhaustible and free. Not even Exxon, not even OPEC, will ever own the sun.

The solar power/conservation approach also offers the most practical remedy to the short-term energy crunch over the coming decade because it is technologically the simplest. In contrast, practical, *safe* nuclear energy is a long way off. A nuclear power plant takes a decade to build and license. Uranium supplies in this country are running short, prices for building and fueling nuclear power plants have doubled and tripled since 1970, and perfection of the first generation of nuclear reactors, let alone the as yet untried breeder reactors, is far away. One business magazine, *Forbes,* recently warned that America's increasing dependence on foreign uranium supplies could lead to the formation of a "uranium OPEC" which would do to the price of nuclear power what the oil producers have done to the price of oil. (Similarly, it takes about eight years to put an offshore oil well into production.)

By contrast, a serious solar power/conservation program could be applied immediately, and begin cutting into demand for other forms of energy by the end of the decade. While the nuclear reactor program remains bogged down in scandals over safety standards, solar technology has been extensively tested and proved. Solar water heating did a booming business in Florida, the southwest, and California during the first half of the century, and it died out only in the Fifties when natural gas was temporarily cheap and plentiful. In the last two decades, tens of thousands of solar heating units have been manufactured and installed in Israel, Japan, and elsewhere. In parts of Australia, solar water heating is now required by law.

Other, more sophisticated applications of solar power do indeed require considerable research and development before they can be put into practice. But that should not obscure the fact that present day solar technology, such as the Wards employ in their home, is ready to be implemented now.

But without a word of public debate, the solar/conservation strategy has been shunted aside by the energy policy-

makers in favor of an accelerated nuclear/fossil fuel program. The R & D budget recently proposed by the new Energy Research and Development Agency (successor to the AEC) tells part of the story. The vast majority of the budget—over two billion dollars worth—is devoted to nuclear energy, including weapons development (ominously the biggest single item in the national energy budget), uranium enrichment, and reactor development. Next comes funding for coal, then petroleum, then oil shale. Finally, with a mere 1.5 percent of the ERDA budget, comes solar research. The $57 million dollar solar program is just a fraction of the accelerated solar development budget proposed by the National Science Foundation, and is actually $10 million short of the "minimal" solar program described by the NSF.

But the ERDA budget is no more than a reflection of the overall national budget for energy development—a budget which, according to Chase Manhattan Bank, will run well over a trillion dollars between 1970 and 1985. As the oil company advertisements never tire of telling us, the vast bulk of research and development of new energy sources will come not from public tax monies, but from private corporate profits over whose disposition only the boards of directors have any say. A sign of the extent to which national energy policy has become hostage to corporate balance sheets was the recent abandonment by the Ford Administration of its modest proposal to tax windfall oil profits after the oil companies threatened to curtail their new investments. When the trillion dollar investment decisions have already been left to the energy industry to make, it should be no surprise that federal R & D priorities simply follow suit. And the leading suit for the big decision-makers, such as Exxon, General Electric, Westinghouse, and the utilities, is certainly not the rapid development of a free, limitless supply of energy provided by the sun.

What all this amounts to is an abdication of any meaningful public control over national energy policy in general, and a deferral, for the "foreseeable future," as a GE spokesman put it, of serious development of available solar technology in particular. The lopsided numbers in the ERDA budget tell us that perhaps the most fateful decision of the last quarter of the century has been made for us, and we have not even been told, let alone consulted.

[TAKING WRONG TURNS]

Direct use of solar energy has a long history, stretching back to the second century before Christ when the Romans used solar reflectors to set enemy ships on fire. A solar powered steam engine was featured at the Paris world exposition almost a century ago. The National Petroleum Institute, hardly the chief proponent of the solar/conservation strategy, admits that, "Had it not been for an abundance of fossil fuels . . . we might today have a 'Solar Energy Economy' just as effective and efficient as our 'Fossil Fuel Economy.'" Well supplied by fossil fuels, Americans have tended to relegate direct use of solar energy to the realm of science fiction. But it is now apparent that fossil fuels are not unlimited, and that the fossil fuel economy is neither effective nor efficient; in fact, it is collapsing. What is less apparent to most people is that our present energy system sounds and works more like science fiction than any alternative we could possibly invent. We take for granted the incredibly circuitous process of discovering, extracting, refining, transporting, packaging and burning long-fossilized plant life in order to obtain geologically concentrated doses of the same solar energy that shines down upon us, every day and everywhere.

To be sure, this Rube Goldberg system of putting the sun's energy to work performed quite well for a century or so, but the awkwardness of the system has finally caught up with us. First, we've been using this stored up energy much faster than nature can manage to concentrate it for us: fossilization takes a long time, and nature's cupboard is beginning to look bare. Second, we can't even use efficiently all the fossilized sunlight we have been releasing so indiscriminately. The better part of that solar energy which has been accumulating under the earth over the lifetime of the planet is being returned to the environment in a geological instant, as *wasted* heat—resulting in serious thermal pollution (not to mention all the other more familiar pollution problems caused by burning fossil fuel). It has become obvious that the financial, environmental, and social costs of such a roundabout system of utilizing the sun's energy have become too much to bear.

Nuclear power plants were once heralded as the answer to the nation's future energy needs. But it turns out that the nuclear cure is worse than the fossil fuel disease. Uranium for the present generation of reactors is running in even shorter supply than fossil fuels. The "breeder reactor," which is supposed to produce more fuel than it consumes, is still on the drawing board and is likely to stay there for a long time. But what is worse, the reactor program has been beset by a series of scandals surrounding the safety of the plants (see RAMPARTS, August 1974). A great many of the plants now in operation have been shut down to investigate mysterious cracks in the pipes carrying coolant to the nuclear core. So far, the back-up core cooling system, which is supposed to prevent disaster in case the main system fails, has itself failed to operate properly in the only tests made. And even if that system could be made to work, it would still not put to rest legitimate fears of a core "meltdown" which could result in tens of thousands of deaths. Although there would be no mushroom cloud explosion, the release of deadly radioactive materials would be disastrous.

In addition, nuclear power plants release *more* waste heat to the environment than do fossil fuel plants, thus *accelerating* thermal pollution. And nuclear power plants leave another legacy, one far more dangerous than even the worst effects of fossil fuel plants—intensely radioactive waste products, often seething with their own heat, which will remain a severe threat for thousands of years. Our present technology has no idea how to neutralize these wastes: they can only be stored, and watched continually. Even proponents of nuclear power, such as Dr. Alvin Weinberg, formerly head of the AEC's Oak Ridge Laboratories and now with Project Independence, admit that *just guarding these wastes* against accident or sabotage will require a "commitment to a permanent social order" and the creation of a "nuclear priesthood" that must dedicate itself to thousands of years of uninterrupted service.

The obvious alternative to the fossil fuel and nuclear nightmares is to cut across the long, complicated process of photosynthesis, fossilization, extraction, combustion, and all the intermediate steps, and simply utilize the sun's free and plentiful energy directly. About 5000 times as much energy shines down on this country every year than even the most extravagant predictions tell us we'll need in the year 2000. The problem is learning how to concentrate and store it for our own purposes. As the energy industries are quick to point out, large-scale, centralized production of solar-generated electricity is not yet feasible. But that is not really the point. We could use solar energy *now,* using decentralized solar collection equipment—in houses, apartment buildings, farms, offices, even factories—to cut deeply into the supplies of fossil fuel and electricity the energy industries must now provide.

The most promising way of doing this in the long run is the photovoltaic cell, which converts sunlight into electrical energy. The cells work—they are used on orbiting satellites to provide electrical energy. But at the moment they are about ten times too expensive for widespread terrestrial use. Bringing down the cost of solar cells, to meet the whole spectrum of energy needs, would constitute a major revolution in energy technology. It ought to be the nation's primary research and development commitment, ahead of new weapons systems, nuclear reactors, and the like. Instead, solar cell technology will receive about as much money all next year as the reactor program spends every *day.*

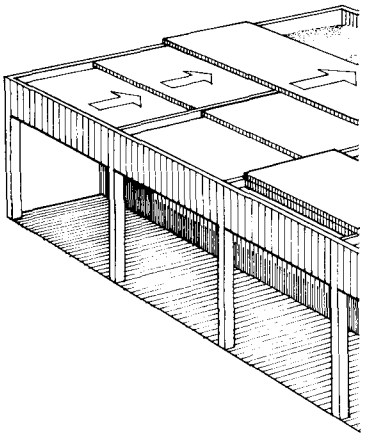
But there's no reason to wait for the solar cell in order to start using the sun to provide energy in the form we most instinctively turn to it for: warmth. Most homes and other buildings built in this country today are constructed as if to spite the weather outside. They require heating on even the sunniest winter day and cooling during most of the summer, due mainly to poor design. A number of modern office buildings lack even that miraculous energy-saving device, the window that opens. New York's World Trade Center, built with permanently closed windows, is heated with lights that cannot be turned off; in the summer its air conditioners must work *against* the lights.

Americans use more energy for room and water heating than they do to power their automobiles. With a serious commitment to the solar/conservation energy strategy, *most* of this demand could be permanently eliminated within a few years. The first step in such a program would be to reinsulate old homes and revamp building codes for new homes to cut the need for heating and cooling energy. According to a recent study published by the American Institute of Architects, a program of improving the design of new buildings and refitting old buildings with better insulation could cut energy consumption by 25 percent in older buildings and by 50 percent in newly-designed buildings. Improvements would include better insulation, storm windows and doors, and windows that make the best use of the sun's warmth in the winter while not making the building too hot in the summer.

These figures alone are impressive, but just building to use the sun rather than to fight it is not quite enough. By using simple solar heat collecting technology, combined with insulation, we can cut energy consumption in older buildings by 50 percent and in new buildings by 80 percent.

The main component of this technology is the solar collector, a glass-covered pan of water that sits on the roof of a house. The collector works on two very simple principles. Think how hot it can get standing behind a sunlit window on even the coldest winter's day from the radiant heat of the sun. Then think of how a swimming pool or a lake remains warm even after the sun has set if it has been sufficiently heated by the sun during the day. These two principles explain how the flat-plate solar collector works. It is a six-foot by four-foot flat pan or a system of pipes painted black (to absorb as much heat as possible) covered by a sheet of glass and some insulating material. Place it on your roof facing south on a sunny, or even a hazy day, and run some water (or other fluid) through it. In a very short time the fluid will become remarkably hot. Run the hot fluid into your hot water heater and/or your room heating system and provide a well-insulated tank to store the fluid

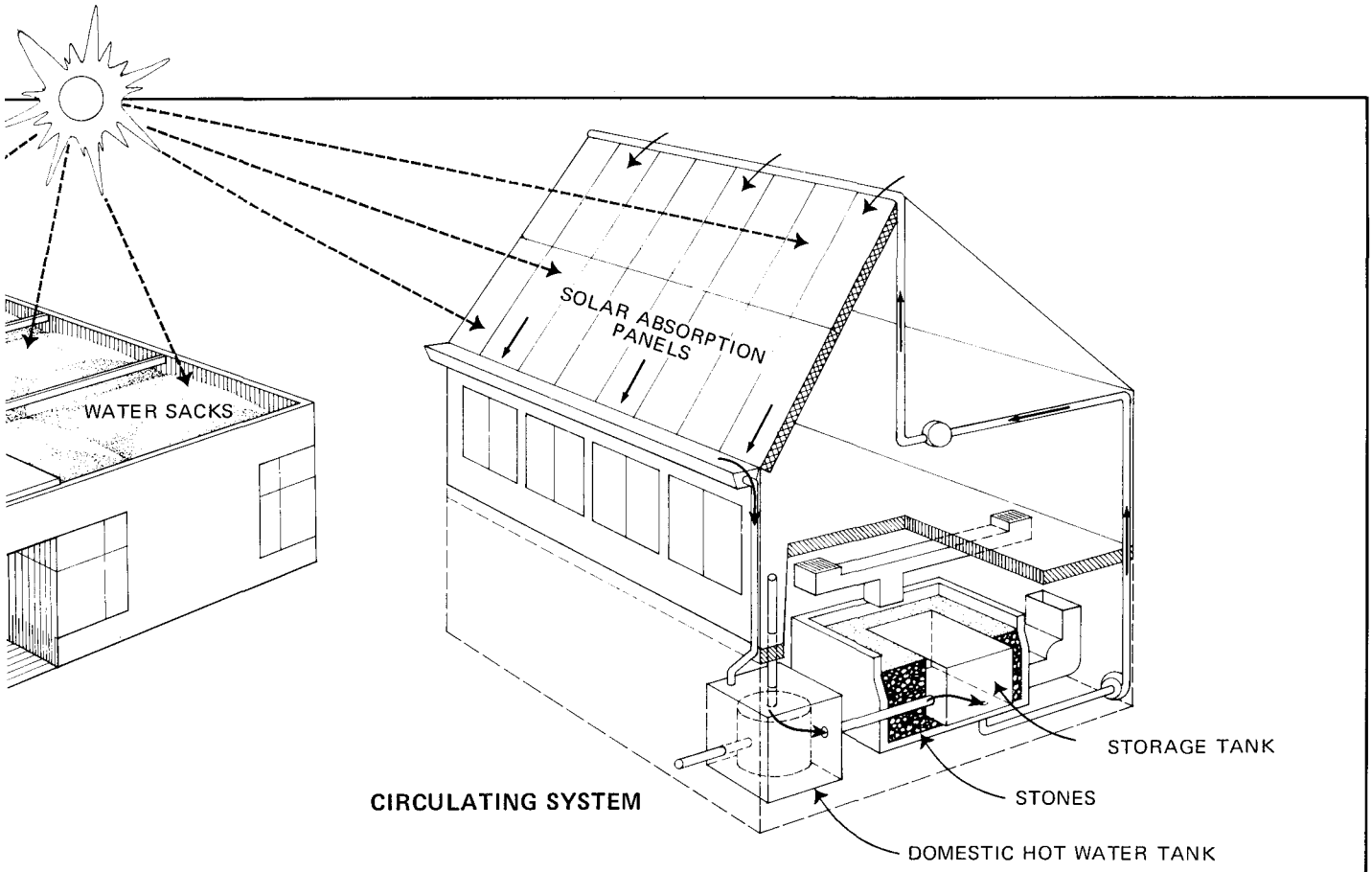
How It Works



PASSIVE SYSTEM

The diagram on the right shows the workings of a simple space- an water-heating system such as that used by Harry Thomason 15 yea ago in his home near Washington, D.C. Although more complex an efficient systems have been devised since then, the principles a basic: water is pumped from the storage tank under the hous which is surrounded by stones, up to the peak of the roof; it the flows down through the solar absorption panels where it absort heat (the temperatures sometimes approach the boiling point); th water finally runs off into a trough, passes through a pipe, an collects in the hot water tank which provides hot water for bat and other domestic uses; excess water travels from this tank into th stone-surrounded tank.

The house is heated by blowing air over the hot stones an through ducts. The water circulates continually as long as the sun shining; during cloudy periods of up to four or five days the wat will stay hot in the insulated tank. Of course flat-plate collector such as the ones used here, will absorb heat even on cloudy day but at a reduced rate. Even on overcast days, infra-red (heat) ray may be intense—as those who have been sunburned at the beach o cloudy days may attest. This type of system could be installed fairl easily in almost any house.



CIRCULATING SYSTEM

On the other hand, the "passive" systems (passive because they do not require the movement of water) call for specially designed homes strong enough to support a heavy black vinyl bag of water on the roof, and well insulated enough to fully take advantage of the type of heating the system offers. Harold Hay's house near Los Angeles (see left-hand diagram) uses a large bag of water which may be covered or exposed to the air by a sliding, insulated roof-top. For heating during the winter, the sack of water is exposed to the sun during the day; heat accumulated in the water is radiated into the house; at night the sliding roof-top is shut and the sack continues to radiate heat through the night.

For cooling in the summer the process is reversed: the sliding roof is kept shut during the day and opened during the night. The mass of water, having absorbed daytime heat from the house, will radiate it into the night sky. Because it is radiating heat, not simply conducting it, the temperature of the water in the sack will be *lower* than the surrounding air. The water bag can be cooled even further by evaporation if ordinary tap water is run over its surface.

A system such as this can be very efficient and comfortable if the house in which it is used is well insulated. With additional research, it could probably be used in climates colder than that of the Southwest.

Drawings by Roland Hower

for use at night and on cloudy days. There are many permutations and variations on this scheme but that, essentially, is all there is to it (see above).

In many areas you will need a conventional back-up system to provide heat during long periods of bad weather (more than 2 or 3 sunless days in a row). But in most parts of the country, an array of solar collecting units will meet *most* of a family's energy needs–including hot water, room heating, and air conditioning (which constitute about 75 percent of a household's energy needs). Here is how such a system could work:

• **Water Heating**: This is the simplest use of the solar collector. You run the water directly through the collector and then divert it into an insulated storage tank (though you will want a storage tank larger than your present hot water heater). Or you may prefer a "closed system," in which the collector fluid runs out of the collector, passes through a heat coil in a water-heating tank (which heats the water in the tank by convection) and then goes back up into the collector. According to Dr. Donald Aiken of California State University at San Jose, a solar water heater can be added to a home for about $500–a one-time expense.

• **Room Heating**: The principle is the same as the solar water heater. The collector could be used to provide hot water for steam heating. Or air could be blown over the coils heated by the collector as in a standard hot air furnace. In the Ward house in Davis, a third system is used: water from the collector is run under the cement floor of the house and heat radiates through the floor.

There are other solar heating systems. Dr. George Lof of Denver, Colorado, has been living in a solar-heated house for 15 years, in which air is heated directly by passing it through the collectors. Another variation is the "passive" solar heating and cooling system used by Harold Hay in his house in Atascadero, California, and by Jonathan Hammond in his own home in Davis, and a home he is presently building in Winters, California. A passive system uses a mass of water, placed either along the south wall of the house or

(Continued on page 55)

Breaking the Mideast Deadlock

I. The Plan

"Israel assumes that retaining the territorial status quo is its optimal strategy, that only the necessary minimum should be surrendered at any given stage. But this is precisely the policy that led Israel to near disaster in the October war."

To solve the conflict in the Middle East means to bring about a state of affairs that no side will be interested in challenging by force.

A solution may be proposed as reflecting the actual balance of power between the conflicting parties. Alternatively, a plan may be offered as a good approximation of what is taken to be a "just" solution. A just solution is, e.g., one that seems reasonable and fair to an impartial observer who empathizes with the claims of both sides and who is interested in the well-being of both.

I take *opportunism* to be the acceptance of a solution solely because it reflects the actual power structure of the conflicting parties. This position also implies recognizing any change in the balance of power as a justification for changing the agreed-upon arrangements. *Realism,* I believe, consists in the imperative that a solution be *both* opportune and just. A future change in the balance of power in itself does not justify challenging a settlement already arranged; while the fact of the balance of power must be taken into account if a solution is to be at all attainable.

I consider the following an outline of a realistic solution to the Middle East conflict: Israeli withdrawal from the territories occupied in 1967; demilitarization of Sinai and the Golan Heights; recognition of Israel by the Arab states—and the Palestinians; Israeli recognition of a Palestinian state in the so-called West Bank and in the Gaza Strip; and finally, a municipally united Jerusalem, as capital to both states. This solution will be referred to as the Two State Solution.

[THE GENEVA VS. THE STEP-BY-STEP APPROACHES]

THE DOMINANT CONTROVERSY among Israelis today concerns which is preferable, a "step-by-step" solution or going to the conference table at Geneva to negotiate an entire solution at once. This might appear to be a debate about tactics; it is in truth a debate about the goals themselves.

It is clear to the Israelis that if there is any chance for an agreement with the Arabs, it will have to be more or less along the lines of the Two State Solution outlined above. It is not at all clear that this will satisfy the Arabs, but it cannot be doubted that they will not settle for less.

Thus, some might wish to go to Geneva in order to undermine once and for all the Two State Solution: this in fact is what the Israeli right wingers are after. Some might wish, on the other hand, to go to Geneva to *achieve* the Two State Solution: this is true of several elements in the

Palestinian

Jack Madvo/UNWRA

by Avishai Margalit