SOLARENERGY

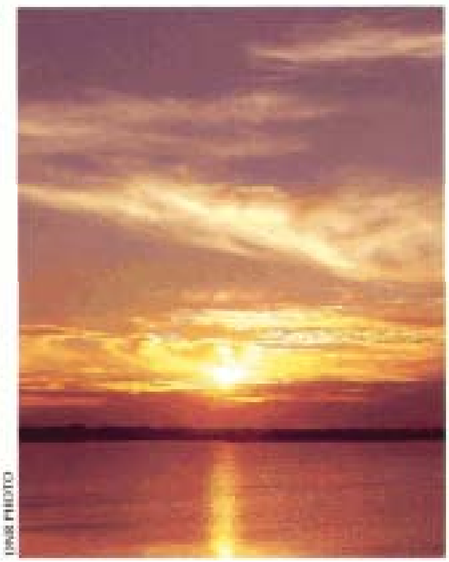
Here Yesterday Gone Today Back Tomorrow?

by Randy Martin

Solar energy was a popular subject 10 years ago when the federal government was pumping millions of dollars in research and demonstrations. Solar energy was a popular subject because it was about the only energy resource that the public could rally behind in response to oil and gas shortages and embargoes.

Most everyone who remembers the 1973 Arab oil embargo and the crisis in 1981 will agree that another shortage and price flare-up is eminent in the next 10 years. Today's low prices and abundant sources have dealt a near death blow to the fledgling solar industry which had its beginnings in the mid-1970s. The general public has lost a measure of motivation for such alternatives. Prudent business decisions based on short-term paybacks (three to five years) often prevent individuals and businesses from implementing alternative energy strategies which will, in time, be commonplace.

Modem day applications of solar energy in Iowa can be found in early agricultural buildings. Farmers in the early 1900s constructed many of their livestock buildings with the axis running east and west. The openings for livestock were on the south side. They were using the basic principles of passive solar energy. These early farmers relied on wood or corncobs to add heat to their buildings or keep their livestock waterers from freezing. Then came innovative devices designed to ease the farmer's workload. Propane furnaces and electric livestock water heaters came along. Propane and electricity were inexpensive so the farmer latched onto these energy sources. Farmers became less concerned about proper



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orientation of buildings — they could just put in a larger furnace.

The life of abundant and inexpensive energy continued until the Arab oil embargo of 1973 jolted us back to reality We began to realize that foreign dependence for energy was catastrophic and fossil fuels were not an infinite source of energy. Prices increased dramatically. We became more energy conscious. We added insulation to our homes and began to look for alternative energy sources.

Reacting to the Arab oil embargo, the federal government created the Federal Energy Administration in the same year. The name was later changed to the U.S. Energy Research and Development Administration (ERDA), and eventually the U.S. Department of Energy (DOE). The following year, the Iowa Legislature created the Iowa Energy Policy Council (EPC), which became the Energy Bureau of the Iowa Department of Natural Resources in 1986.

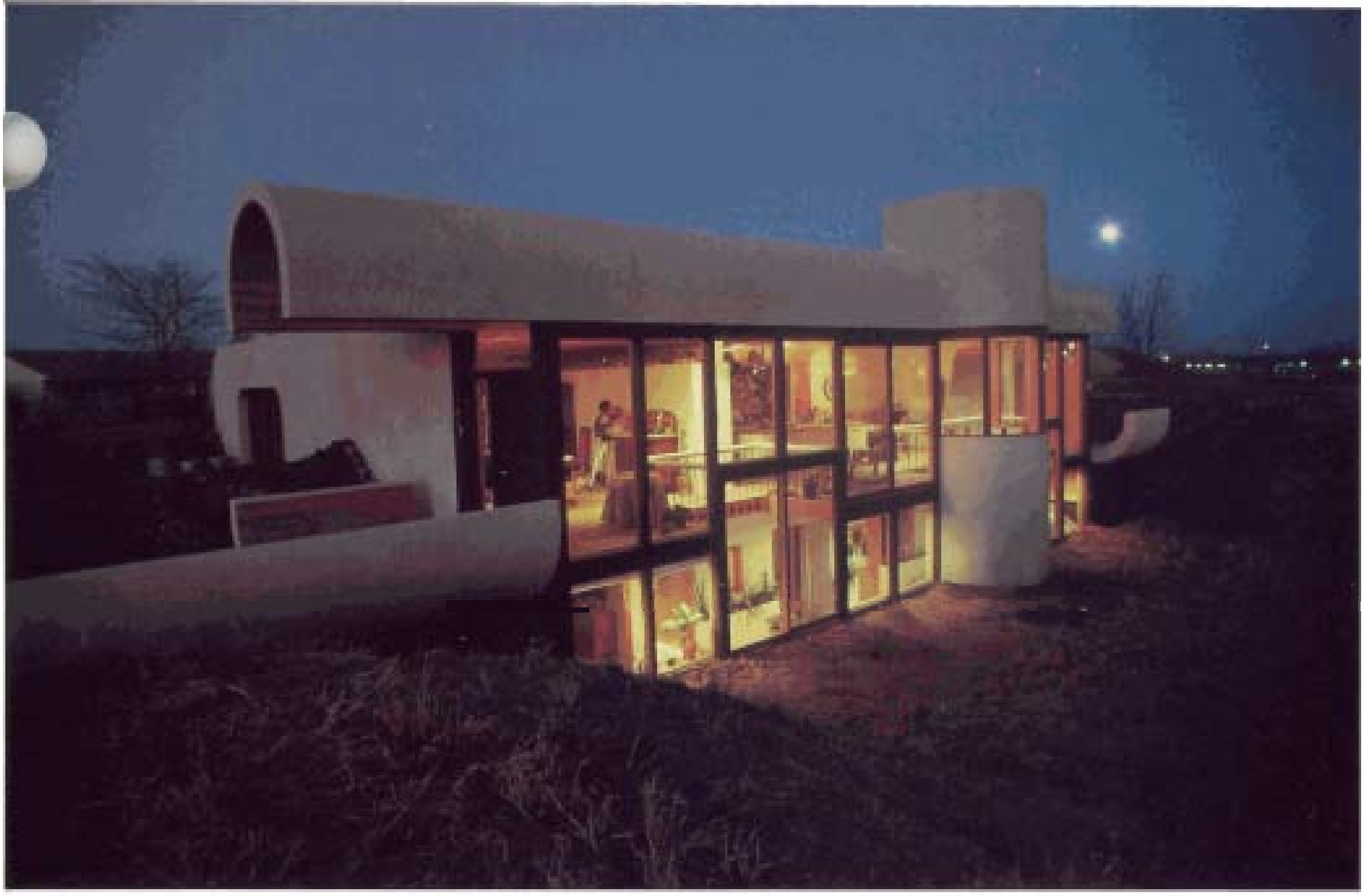
Iowa, along with the rest of the nation, began its early infatuation with solar energy with what is called "active solar technology." These systems rely on moving parts such as pumps, valves and fans, and are packaged systems that are attached to a building to heat *air* or water.

Scattergood School in West Branch, Iowa, was one of 32 early "active" solar demonstration projects around the nation funded by ERDA in 1976. The school received $85,000 to install a 2,500-square-foot active solar *air* collector system on their new school building. The system used 65 tons washed river rock for heat storage. The system is still in operation today

In 1977, the Longfellow School in Marion, Iowa, received more than $220,000 in federal dollars to install a 5,000-square-foot active solar liquid space and water heating system. The system was supposed to provide 74 percent of the school's heating requirements, but was poorly designed and experienced tremendous efficiency losses in the transferring of solar heat to storage. The system was dismantled in 1984 and the parts sold to enterprising individuals.

The Iowa Legislature appropriated $200,000 in 1977 for the installation of a high temperature concentrating collector system at the Capitol Complex. The 2,000-square-foot system was designed to deliver steam to the complex's heating and absorption chilling system. Plans were made to install an additional 2,000 square feet of collectors in 1979. The experimental system was never able to maintain its calibration to focus the sun's energ and was dismantled and sold in 19

Individual homeowners at this time were experimenting with do-it-



The Laurent Hodges' home in Ames, designed by Dave Block, is Iowa's first passive solar house.

yourself solar space heaters. They found plans in popular magazines and purchased materials to build the collectors themselves. These "room heaters" were quite primitive but often worked well enough to heat an average room while the sun was shining. Many however, were discovered to lose as much energy as they gained through reverse thermosiphoning when the sun went down.

A group of Iowans interested in the promotion of solar energy met in March 1978 at Des Moines Area Community College and started the Iowa Solar Energy Association. Membership grew to a high of 271 in 1981. The organization has since changed its name to the Iowa Association for Energy Efficiency to more accurately reflect its current direction. It currently has around 50 members.

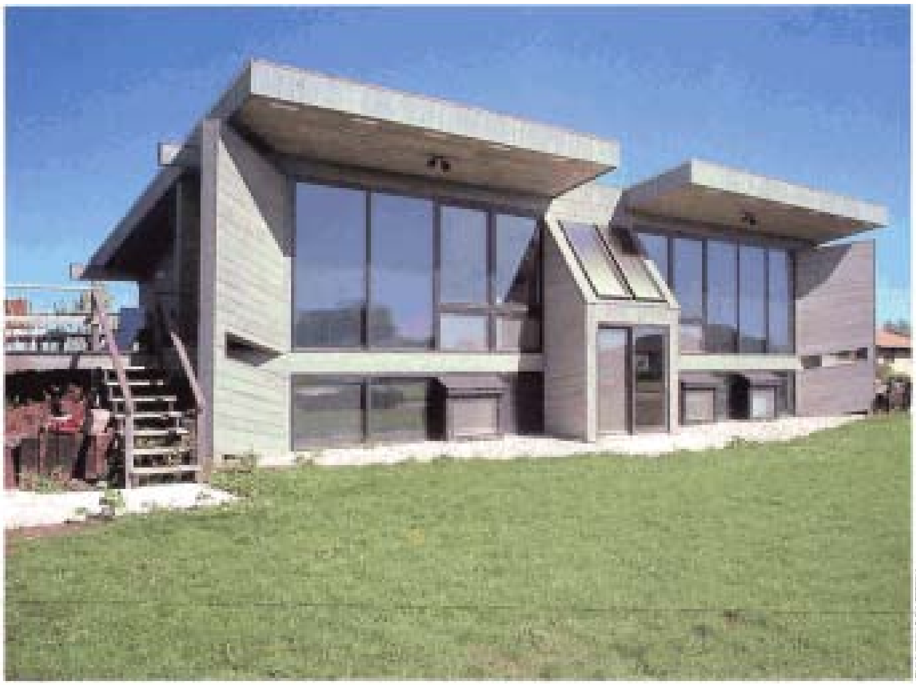
In March 1978 Iowa Governor Robert D. Ray signed a proclamation declaring Sun Day May 3,1978, an official day in the state. His proclamation called solar energy "the most abundant and least polluting energy source immediately adaptable to meet Iowa's energy needs." At the signing of the proclamation, the governor was given a "Solar Energy Today" t-shirt and treated with cookies baked in a solar oven.

In 1978 the federal government established solar tax credits. Homeowners purchasing solar energy equipment could receive a tax credit of 40 percent of the cost, up to $4,000 off their federal income tax. These credits gave a tremendous boost to the fledgling solar industry. The first companies were reputable businesses dedicated to the advancement of solar'energy. But, it wasn't long until solar companies began sprouting up everywhere. Unfortunately for this new industry, many entrepreneurs with little or no background in the fundamentals of solar energy began selling systems based on unfounded claims such as, "This 4x8 collector will cut your heating bill in half." It didn't seem to matter what the heating load of the house was.

Active solar systems were plagued with a myriad of problems. Early systems often had large, elaborate storage systems. Pumps and fans would break down, liquid systems would air lock, and plumbing would leak. These early systems were simply not designed to handle the severe temperature swings that caused excessive expansion and contraction.

The experiences and frustrations encountered in these early "active" years caused the solar advocate to take a step back and apply a more simplistic and reliable method for capturing the sun's energy. Thus the concepts of passive solar design became popular. It made sense to design new buildings to act as the solar "collector" and install additional mass, such as concrete, to absorb the solar heat collected during the day and release the heat to the space at night.

Iowa's first passive solar house was built in Ames in 1979. The house was designed by Dave Block, an architecture professor at Iowa State University, for the Laurent Hodges family. Hodges is a physics professor at Iowa State and an energy specialist with the Energy Extension Service. The whole south face of the home is



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Project Passive home (top) in Emmetsburg, was designed by Dave Block and included several types of passive solar systems. At Scattergood School (above) in West Branch, the air active solar system is still being used today.

glass, but a movable insulation system was designed to insulate the glass at night. The home has been thoroughly monitored and has lived up to its expectation of 80 percent of its heat supplied by the passive solar system.

People were also experimenting with earth-sheltered (underground) homes during this time. These homes appeared to work well when oriented toward the south, but the applications were limited as people felt uncomfortable with windows on only one side of the house and zoning regulations limited their construction in suburban neighborhoods.

In 1979 the Iowa Solar Office commissioned the design of Iowa Project Passive, a passive design for a home to be built by Iowa's building trade curriculums at area community colleges. The home was designed by Dave Block and included several types of passive solar systems: a direct gain system that allowed sunlight to enter directly into the home, a sunspace, or separate room designed to collect solar heat, and a thermal storage wall or trombe wal which had glass in front of a 12-inc concrete wall. The thermal storage wall would absorb the solar energy during the day and release it into the house at night. Four of the homes were built by area community college building trade programs. The design has performed very well and served to dramatically demonstrate the concepts of passive solar energy. However, the modem design received a cool reception in the Iowa home market.

Iowa's first "envelope home" was built near Conrad in 1979. The home was designed by Lee Porter Butler of California. The envelope concept uses a sun space along the entire south facade of the house. It has a double back wall which allows solar heated air to circulate (thermosiphon) from the sun space through the attic of the home, down between the back walls, through a crawl space under the house, and back to the sun space. It is essentially a house within a house. The system appears to work well in Iowa, but there has been co troversy over how it works. Some recent studies have shown that sh ting off the air circulation has actually increased the performance. The extra cost of building two shells is its major drawback.

During this time, it was becoming evident that passive solar worked best when combined with energy conservation. Kirkwood Community College in Cedar Rapids received a grant from Mid-America Solar Energy Complex to design and build a passive solar home in the college vocational-technical construction program. Its appearance was quite conventional but used double 2x4 construction in combination with moderate south glass. The "superinsulated" home was born in Iowa.

During the early 1980s the superinsulated concept began taking over. The days of the exotic passive solar home with 500 square feet or more of south windows were passing. People wanted more conventional-looking homes. Superinsulated homes could be built in any style and could incorporate moderate amounts of soutl glass without having to install larg amounts of mass. Homes with 12- and up to 16-inch walls were being

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The Ralph Goebel home in Ames (left), designed by Don Swanson, is an example of an "envelope" home. Bob Pecka's home (below) in Fort Dodge is an example of a liquid active solar system.

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built. Some of the builders were guaranteeing annual heating costs of less than $100, and in one case, $50 per year. The homes have performed as expected.

These passive solar, earth-sheltered, envelope and superinsulated homes were being built by a small percentage of Iowa builders on the leading edge of technology. The conventional builder in Iowa during this time was still building homes like they always had, with 2x4 construction, R-30 in the attics and no basement insulation. Many are still being built that way today

Due to stable and relatively low energy prices, today's energy efficient builder has backed off some from the "superinsulated" concepts of the mid-1980s. Today the norm in the energy efficient community is to built tight, well-insulated homes with moderate south glass. Instead of the $50-$100 per year costs, we're seeing $150-$200. Instead of double 2x4 construction, we're seeing 2x6 construction. If more passive solar is desired than just concentrating the windows on the south, a sun space is used.

We have run the gamut. We have experimented with the exotic, the glamorous and returned to the simple. Energy efficient construction based on simple conservation techniques is proving to be the most cost effective, practical and marketable.

In 1985 the federal residential solar tax credit ended. The few active solar companies remaining, soon closed their doors or changed their market direction. Today there are only a few companies in Iowa still involved in active solar energy. Most of their business involves servicing systems.

Solar energy has had its problems in Iowa, as in the nation. Many of the large active solar systems have been scrapped, but the experiences learned will allow the solar advocates and technologists to approach the next energy crisis with more pragmatism.

Passive solar systems have faired better. There have been a few problems with oversizing south glass without designing in enough mass so the house overheats during the day and cools off fast at night. But, overall, passive solar is much simpler than active solar and has few mechanical problems. We have proved that with proper design, passive solar works very well in Iowa.

What about the future? Passive solar will continue to be used regularly. With higher energy prices, active solar energy systems may again re-emerge. The real future of solar energy probably lies with photovoltaics or solar cells which generate electricity directly from sunlight. Their cost is still too high for general use, but increases in production efficiencies will soon make them applicable for a growing number of electrical devices and applications.

All our experiments in the past, successes and failures, have shown us that solar energy is still a very viable energy resource for Iowa. Stable prices for conventional energy currently cloud the future for solar energy. But many of us know and realize that future price shocks will clear our vision.

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