CDA "Decade 80 Solar House" Completed

America's most energy self-sufficient home has just been completed in Tucson, Arizona.

Called the "Decade 80 Solar House", this innovative prototype home uses solar energy for up to 75% of its cooling, 100% of its heating, and for powering selected small appliances and electrical systems. Although lighting and major appliances are powered by conventional electric sources, overall energy savings are still estimated at 90% in the winter, and 80% in the summer over ordinary homes. The "Decade 80 Solar House" is the first true home – as opposed to on-campus solar projects and other experimental structures – to receive so much of its energy needs from the sun.

Conceived and built by the Copper Development Association Inc., as an industry-wide market development effort to create new applications for copper, brass, and bronze, the 3,400 square foot home is described as the first solar home capable of fulfilling an American family's highest expectations of comfort, convenience, and even luxury. The solar home features such new products as a combination copper roof and solar energy panel system, a "thin-line" brass door and window system, a "Life Safety" copper sprinkler system, and solid copper and brass "wallpaper". The CDA solar house even has a CDA electric vehicle in the garage that is recharged nightly by means of an outlet similar to that for a home clothes dryer.

"The 'Decade 80 Solar House' was built to document that every element needed to build an almost totally energy self-sufficient home is on the market today at affordable prices. Further, such a home can be built by local contractors using the local building trades," explains Paul A. Anderson, CDA's building construction market development manager. "We also wanted to show that a solar home can be almost maintenance-free so far as the energy system is concerned, and we will underscore that fact by putting this home up for sale on the open market after we have had a chance to record performance data during its first year of operation."

Designed to prove out alternate power sources in the face of continuingly high energy costs, the Tucson home incorporates the first totally integrated solar collector-roof system that is commercially available to the building industry, one capable of installation with the normal skills of today's tradesmen.

Said to combine the virtues of copper roofing and copper plumbing, the new solar energy panel system consists of 2' x 8' copper sheets, 0.016-in. thick, laminated to plywood combined with unique, rectangular copper tubes to carry the energy system's transport and storage medium – water. The copper panels and copper tube are blackened to better absorb radiant heat, transferring this heat to water circulating throughout the house in copper tube. On cloudy days when less energy is available from the sun –although there always is some – a buried insulated storage tank provides stand-by energy in the form of 3,000 gallons of solar heated water.

The combination roofing and solar collector system is described as more economical than "new roofing plus and solar panels in existance". Although solar roof installation costs are significant –even in the case of this new economical system – the home owner should get back what he paid for that system in fuel savings within the first decade of use, reports Mr. Anderson. "In addition, of course, the owner has added measureably to the house's resale value through the use of quality copper products".

Mr. Anderson says the combination copper roof and energy panels is an affordable, versatile energy system that can be used either for existing structures or new buildings, but is particularly economical in new construction where it functions both as roof and energy system. The new system can be used to cover wither the entire house or a single room such as a new family room.

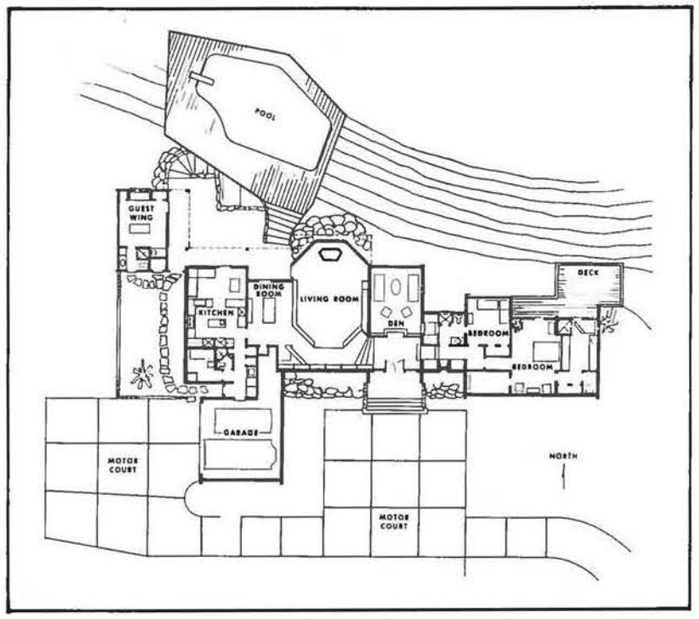
One of the most innovative aspects of the CDA house is that solar energy supplies so much of its cooling. The fact that the house is in warm Arizona presents more of a challenge rather than being an advantage in climate control, explains Mr. Anderson. "For although heating needs are less here, cooling demands are much higher–and its in cooling where solar breakthroughs are needed".

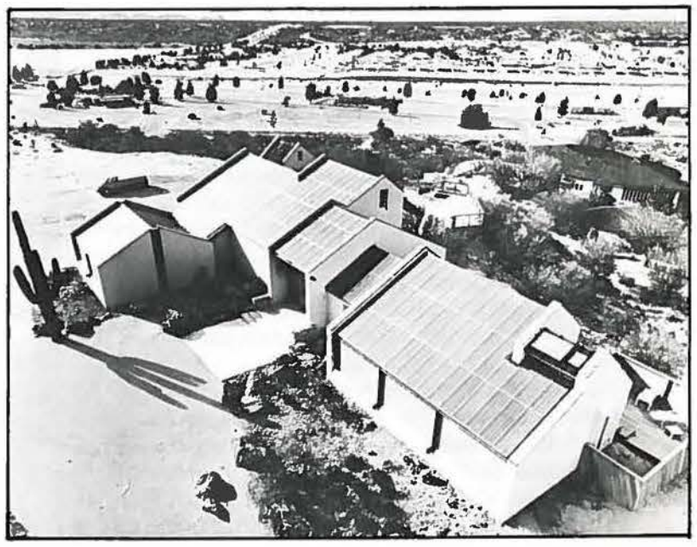
Air conditioning for the CDA solar house is provided by two standard Arkla Industries, Inc. lithium bromide-water absorption units modified for hot water "firing". While this type of absorption air-conditioning has been a technical reality for some years, it is only with recent increases in energy costs and solar technology development that it has become economically viable for residential installations.

"We're talking of 'first costs' only as being high. After that, it's an economical system with a long life because there are no moving parts," Mr. Anderson explains.

In addition to the solar collector panels, the house's energy system also incorporates silicon solar cells on the roof to convert the sun's energy to low voltage power for selected electrical systems and small appliances such as the home's TV and stereo sets, intercom, clocks, even the front door's electronic latching device. Solar cells also provide stand-by power for the home's overall security system in case of an electrical failure or outside interference.

As a showcase for both technological and home design innovations, the Tucson solar home epitomizes today's emerging look – that of "neutrals and naturals" including earth colors





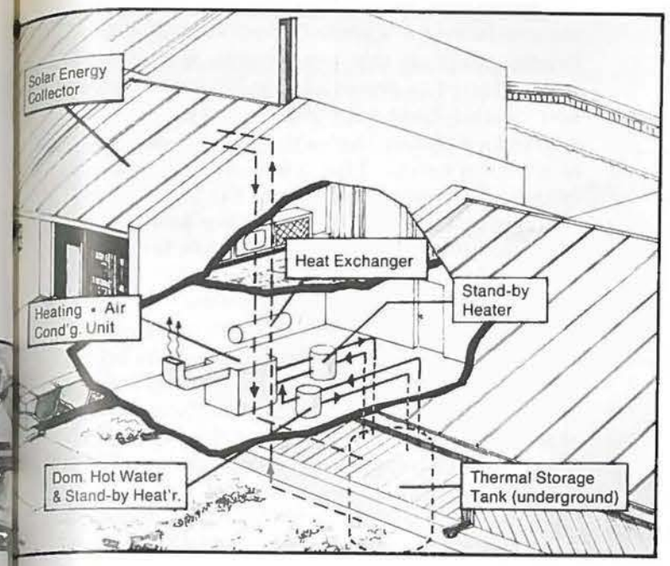
enhanced by the warmth and beauty of the copper metals.

The CDA solar home includes a number of prototype furniture pieces fabricated in the copper metals. Serving almost as a solar house motif, for example, is a series of cocktail cubes throughout the home in mirrored copper and brass, enriched with an abstract solar design. Another important decor element is a pole system in mirrored brass for curtains serving as the living room/dining room divider. Other decorative elements in the copper metals include parsons tables in copper and brass, mirrored brass pedestals, and a sculptured copper fireplace hood. Covering one of the walls in the dining room and the master bath is a flexible "wallpaper" consisting of thin gauge copper or brass laminated to a substrate

Architect of the "Decade 80 Solar House" is Arthur Kotch, A.I.A. Interior designer is Ving Smith, A.I.D., and Charlotte Smith. Mr. Smith also designed the prototype copper metals furniture for the solar home.

Participating sponsors in the "Decade 80 Solar House" worked with the architect and interior designer in selecting the specific systems and products to go into the solar home. Sponsors and their product involvement include:

- Amana Refrigeration, Inc., microwave oven, refrigerator, freezer;
- American Standard Plumbing & Heating, fixtures, faucets and fittings;
- Arkla Industries, Inc., overall climate control system;
- Burlington Industries, Inc., furniture, lighting, carpets, draperies, bed linens and towels;
- California Redwood Assoc., interior paneling, fencing, decking and siding;
- Cascade Industries, Inc., swimming pool;
- ITT Bell & Gossett, Fluid Handling Div., centrifugal pumps and heat exchangers.
- Jenn-Air Corporation, cooking range, oven and grill;
- The Maytag Company, washer, dryer, food-waste disposer, and dishwasher;
- Owens-Corning Fiberglass Corp, fiberglas for draperies, wallcovering & bedspreads.
- Owens Corning Fiberglass Corp, fiberglas insulation and fiberglas duct system;
- PPG Industries, glass for solar panels, windows and doors;
- Schlage Lock Co., electronic locking device and locksets;
- 3M Co. (Scotchguard Products), protectors for the upholstery, draperies and wallcoverings;



- Tile Council of America, exterior and interior tiles.
- U.S. Plywood, exterior cladding and panels, interior paneling.

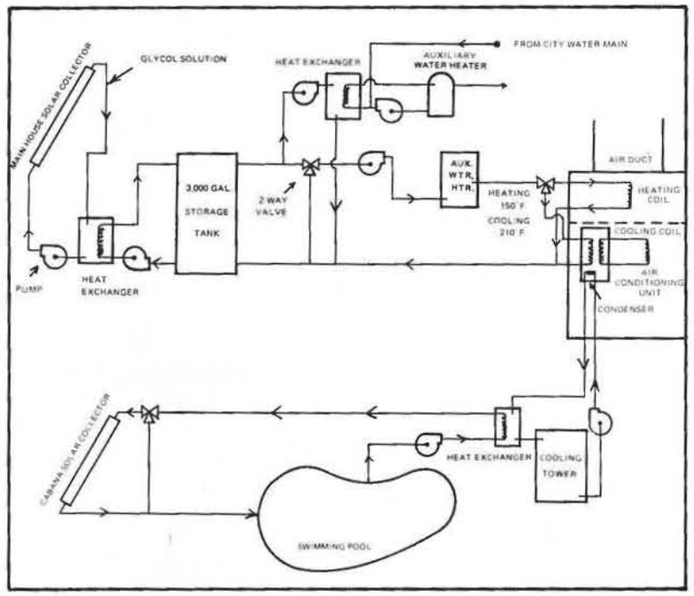
Among the new products and systems to be seen in the house that are of particular importance from a product innovation standpoint are the towering floor-to-ceiling brass doors and windows at the pool-side of the house that provide thin-line framing of doors and windows in heights not previously feasible, in addition to superior energy-saving insulating qualities. The living room door leading to the deck entertainment area, for example, is almost 11 feet tall, with bay windows on either side measuring approximately 8' x 9'.

Door and window frames are of a unique sandwich construction. One the exterior side of doors and windows, frames consist of unusually thin but strong sections fabricated in brass for maintenance-free long life and beauty. On the interior side of doors and windows, frames are of a permanently coated material that can be painted to match interior coloring styling. Exterior and interior frames are held together with a special thermal-break material with an insulating, fire-retardant urethane foam core that prevents heat loss and guards against condensation on the interior surface frame.

In addition to providing a more aesthetically pleasing "thin profile" combined with massive glass areas and superior insulation, the new door and windows are said to be competitive in cost with other top-of-the-line metal or permanently coated wood framed doors and windows. The thin-line door and the fixed window system is a prototype development of CDA, and could be on the market as early as Spring of next year.

From both a performance and architectural viewpoint, the key element in the house is its solar energy collecting copper roof. This dramatically sloping copper roof spans a sprawling, compound-like structure wedded to its desert environment through its natural earth tones, highly textured exterior walls, and low slung massive horizontal lines. Dramatizing the entry way are high-sheen copper-clad double doors and side panels in a raised repeat sun pattern.

According to the interior designers, they expanded on the architect's multi-unit, multi-level idea by creating a series of highly contrasting environments, each one not only furnished to evoke a unique mood but also lighted quite differently.



That the CDA solar house is to be a permanent home for a family is important, CDA believes, to prove that today's solar technology can be engineered to provide a new kind of carefree comfortable living environment that can be enjoyed even more than a home in the days of plentiful energy. That is why the CDA solar house, just as with the previous CDA showcase house in Houston, will become "the permanent home environment of a real American family," explains Mr. Anderson.

The year-round operating efficiencies of the CDA solar house are not dependent on its being located in Tucson or other such high sun-yield location, points out Mr. Anderson. "Solar energy storage technology is at a sufficiently advanced stage to make solar assisted homes practical as far north as Canada", he says.

Described as long-lasting, maintenance-free, easy to install and reasonable in long-term cost, the house's new solar energy collector system can heat water more than 100°F above surrounding air temperature. It is an extension of a successful laminated panel construction now on the market and introduced in the CDA house in Houston.

Copper tubing in the new energy panels is made rectangular for both functional and aesthetic reasons. Functionally, a rectangular tube collects more heat energy by providing greater direct contact with the copper collector panels, and aesthetically a rectangular tube has a superior architectural look.

Solar panels on the roof of the connecting guest wing are used not only to heat the swimming pool in the winter, but also to cool the water in the summer. During summer nights, pool water circulates through the roof/collector system and is colled by the desert air for swimming comfort during the hot days. The guest roof slopes at approximately a 40° angle to favor swimming pool heating during Tucson's spring and fall. The house roof slopes at approximately a 27° angle to favor summer cooling conditions when a relatively large amount of energy is required to keep the house air conditioned.

"Just as copper is the best roofing and plumbing material in the world, so copper makes the best solar collector," explains Mr. Anderson. "Copper conducts heat up to eight times better than any other material feasible for solar panels, and has higher resistance to corrosion."

Regarding installation, copper has the easiest joinability, a high adaptability to plumbing codes, and is most familiar to the building trades.

"When these advantages are combined with the fact that there are no complicated joining procedures with the new solar panels, the net result is a faster, more economical installation," Mr. Anderson summarizes.

In addition to the superior technical properties of copper making it the quality choice for solar panels, there also is the fact of copper's excellent and constant availability, continues Mr. Anderson.

Over the past 10 years, the U.S. has averaged over 91% in copper and copper alloy self-sufficiency. Increasing yearly, the high point in self-sufficiency—95.1% —was reached last year. This 95% copper self-sufficiency is in comparison with 15% self-sufficiency for aluminum, U.S. government data show. There also is a growing "above-ground" mine of copper. Because copper is the most recyclable of the engineering metals, half of the U.S. copper supply last year came from recycled scrap resources.

Fire protection for the CDA solar house is provided by an all-copper sprinkler system described as the first fire safety system to put the priority on saving life. Most sprinkler systems are thought to be "property-oriented" in that they are timed for industrial fires and required water supplies far in excess of what is needed to put out a residential fire. Such water demands put most sprinkler systems out of the economic reach of most structures. Called the "Life Safety System," this particular system protects the Transamerica headquarters building in San Francisco, the West's tallest tower. Use of the new copper sprinkler system in the elegant solar home is noteworthy, believes Mr. Anderson, because it documents that sprinkler systems can be both highly protective and aesthetically acceptable.

In the Tucson solar house, special PPG glass performs two opposite functions: in the solar panels, it attracts and traps solar energy; in the windows, it reflects back and excludes solar heat. In the solar panels, two panels of clear tempered glass separated by an insulating air space transmit a high level of solar energy to the black-coated copper absorber plate and insulate against heat loss. Further, short-wave length radiation passing through the glass is converted to a longer wave length, which the glass then traps for greater efficiency—the same principle as in greenhouses.

Windows on the pool-side of the house are glazed with special solar bronze tinted, double-glass insulation units that reduce heat gain by 40% for lower air-conditioning loads and improve indoor visual comfort. In insulating quality, the glazing is said to be comparable to nine inches of face brick, five inches of common brick, or 5.2 inches of high density concrete. On the sunside of the house is glazing that is highly reflective, almost mirror-like, tinted more in the copper tones, and of even higher insulating quality.

Regarding the actual climate control system, two Arkla lithium bromide-water absorption units together have a total cooling capacity of 71,000 Btu/hr or six tons. The same units also provide 120,000 Btu/hr—60,000 Btu/hr each—of heating during the winter, and include two 1200 cfm fans for circulating the air. The heat from the water circulating through the solar panels is transferred to a second closed water system with a 3,000 gal. insulated storage tank underneath the house.

A standard commercial, auxiliary water heater capable of providing up to 170,000 Btu/hr of thermal output is available on a standby basis. The house's solar system also incorporates a heat exchanger and an auxiliary standby heater to provide hot water for household use.

An important aspect of the "Decade 80 Solar House" is the plan that it be fully instrumented for computerized analysis to produce hard data on solar technology in a normal home environment. This information is to be made available to professionals, and would be updated regularly over a long period of time.

Site of the CDA solar house is near the Tucson National Golf Club, home of the famous Tucson National Open.

While installation costs will vary depending on the type of construction, the installed cost of the combination solar energy collection and roofing system being used on the CDA solar house is estimated at about $12 a square foot. Details on the collector are available through Revere Copper and Brass Incorporated.

The silicon solar cells running the house's television sets, stereo system, security system, clocks and other low-voltage units are from Solar Power Corporation, Braintree, Mass. Television sets and stereo system are from RCA Corporation, New York, N.Y. The flexible copper and brass Norwalk, Conn., and is available through architects, interior designers and the interior design departments of leading department stores.