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Common Sense Applications of Solar Energy in the Home

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COMMON SENSE APPLICATIONS OF SOLAR ENERGY IN THE HOME*

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ABSTRACT

Solar energy utilization combined with sound energy conservation can substantially reduce the operating costs of the average home. Passive solar systems which admit light in winter and exclude it in summer coupled with better insulation to slow the flow of heat are reappearing rapidly. Active solar systems which are more complex and costly are now being developed and tested. Examples of active and passive solar systems are included along with details on how to minimize heat flow at reasonable cost.

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COMMON SENSE APPLICATIONS OF SOLAR ENERGY IN THE HOME

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The use of solar energy in the home has become a lost art throughout much of the world.* The purpose of this paper is to show how the homeowner can revive this art, with the help of some scientific advances and good common sense. The reasons for re-evaluating solar tempering are obvious when one considers the rising cost of energy. In the past, as the cost of producing and delivering energy decreased, and material and labor costs increased, less emphasis was placed on home operating costs and contractors built to reduce the initial costs of homes. As a result of this wasteful philosophy, the cost of heating and cooling homes in many areas may soon exceed the mortgage payment. At the same time, clever adaptation of sound energy conservation and solar utilization can substantially reduce the energy operating costs of a wasteful residence.[1-6] This paper includes some practical approaches to better energy utilization and examples of homes that use both solar and fossil energy wisely.

Solar energy is still free; however, to be utilized it must be collected and stored which does cost money. One way to reduce the cost of solar energy is to integrate functions; for example, a window or skylight with a southern exposure can be used to admit both heat and light and provide the usual esthetic and ventilating functions. Heat loss in winter

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*Note however that passive solar heating continues to be practiced by native cultures in nearly all arid regions of the globe.

and gain in summer can be controlled by adding insulating drapes or venetian blinds to the basic window collector.

To become proficient in energy conservation and solar utilization, one must understand some basic principles of heat transfer into and out of homes. Whenever a temperature difference exists between the inside of a home and the outside, heat will flow from hot to cold. Insulation slows down this heat flow. Mixing of inside and outside air due to infiltration through walls, cracks, etc., causes increased heat flow, and in general should be minimized. However, some mixing is necessary to provide fresh air within the home. The same modifications to a home which make it warm and energy conserving in winter help make it cool in the summer. Heat is generated in many places within the home besides space heaters. Some of these heat sources are electric lights, water heaters, refrigerators, clothes washers and dryers, and people. In fact, nearly all of the electricity used in the home creates heat. If proper insulating provisions are taken this heat can be used in the winter months to drastically reduce the need for space heating. In summer this heat often must be removed by air flow or a cooling system.

The house shown in Figure 1 is divided into an energy efficient half and an energy inefficient half. One of the first rules of heat conservation is to limit heat conduction through the roof, walls and windows. This can be accomplished by adding insulation to existing homes or building with 2" x 6" studs on 24" centers and using greater insulation thickness in homes to be constructed. Double pane or storm windows (preferably wood frame, since aluminum is an excellent heat conductor) should be used. Another feature which has become almost extinct is the double entry door (or--even better--an enclosed porch or "mudroom") which prevents inside

and outside air mixing. Air leaks around windows and doors should also be minimized. The features described will make the best use of the heat or cold provided by purchased fossil fuels. Fringe benefits such as a less drafty, quieter and more uniform living environment may also be substantial.

The south-facing window or skylight collector is the most cost-effective collector on the market today. It can allow heat and light into the home. The venetian blind, shades, roof overhangs and shutters (interior or exterior), along with storm windows, are modifications which greatly enhance the usefulness of windows. Some of these modifications are shown in Figure 2. In winter the blinds control the amount and placement of light and heat within the room. Heat can be excluded while cool light is admitted in summer by using venetian blinds or placing windows under proper overhangs. For summer cooling, west-facing windows which admit the hot afternoon sun should be held to a minimum. Shades or shutters on windows slow down heat loss in winter and retard heat gain in summer. Improvements in solar and fossil fuel utilizations are possible in many existing homes.

Passive solar systems make what you have or build more efficient in utilizing the natural sunlight, while active systems capture the sun in special collectors and store it for your later use (see Figure 3). Each have advantages and drawbacks. The passive system requires some minor changes in our home life styles. Adjusting blinds, closing drapes and changing heat vents daily to exclude heat from unused areas of the house are all important to passive heating and cost little effort or time. The drawbacks of passive systems include lack of privacy, fading of decorator fabrics or furnishings due to the sun and lack of reliability.

A back-up system is required if one does not drastically redefine his comfort limits. Passive systems are easy to operate and nearly universally adaptable as energy savers.

Active systems require a collector and storage unit as well as heat exchangers and circulators. The reliability is somewhat greater than passive systems because of the larger heat storage capacity. Disadvantages are that costs are high and components are complex and require maintenance. The advantages are more automatic operation and more home design and sighting freedom. For example, large south facing windows might not be desirable because of a poor view or blocking by other structures, but solar collectors could still be located on the roof or elsewhere.

To an energy consumer there are several strategies available. They range from minor changes in attitude and home improvements, resulting in energy and dollar conservation, to pioneering solar energy development. The minimum effort consumer strategy includes development of energy conserving habits and some home improvements. Electricity can be conserved by realizing that electric appliance operating time costs money. Thus good habits, such as turning off lights and radios etc. when not needed, cutting down on refrigerator open door time, will save energy and money. Sunshine and fresh air are ecologically sound clothes dryers. Thermal energy can be saved with similar good habits: using less hot water for bathing and clothes washing, and minimizing times that doors are open between heated (or cooled) rooms and the outside. Home improvements like better weather stripping and calking on doors and windows, storm windows, and increased insulation in attics and walls can save their installation costs in only a few years.

An intermediate strategy for solar utilization involves building a home which is energy conserving and adaptable to solar energy systems. The south side of Wayne and Lora Dow's house located in Sandia Park, NM is shown in Figure 4. It includes a large steeply pitched south-facing roof for the future deployment of solar collectors. The high current cost and expected developments in the manufacture of solar collectors made a deferred decision reasonable. In anticipation of a solar energy system, a storage tank vault and plumbing chases have been included to allow easy conversion. The zone heating system has also been designed to allow easy adaptation. The Dows have elected to use southern exposure for windows and skylights which heat and light a greenhouse, living room and family room-kitchen area. By providing for expansion into solar energy systems as fossil fuel prices increase, they have provided for their future needs.

Pioneering in solar energy is what Frank and Med Zanner, also of Sandia Park, NM, have done with their new home. A southwest view of the Zanner house is shown in Figure 5. In this house the entire south-facing roof (1000 ft^2) is a giant solar collector consisting of water-cooled roll bonded black aluminum plates to absorb the sun's energy. These plates are covered with a double-paned window of UV resistant fiberglass sheets similar to that used for patio covers. The heat collected by this home-made collector is pumped to a 2000 gallon storage tank. A water-heating coil built into the fireplace grate also provides hot water to this storage tank. The solar system provides both heat and domestic hot water. A propane gas hot air heating system provides back-up for the solar system. Good insulation, double pane windows and good solar control on windows, as well as a cool mountain climate, make cooling unnecessary. The garage

is heated by a separate solar system using hot air collectors and a rock filled storage chamber under the floor. The heat leaking from the rocks through the floor heats the garage. The Zanner active system required a great deal of engineering, plumbing and electronic control to obtain a desirable solar heated environment. Even though Zanner performed most of the assembly and installation himself, the component costs were in excess of $6,000.

The homeowner may select whatever consumer strategy is within his means and capability. As energy cost rises, most Americans will respond to the need for more efficient and wise use of available fossil fuels. Many will choose to reduce their dependence on these fuels by using the sun to heat their domestic hot water and to heat and light their homes. This rediscovery of individual conservation and solar utilization is both necessary and healthy.

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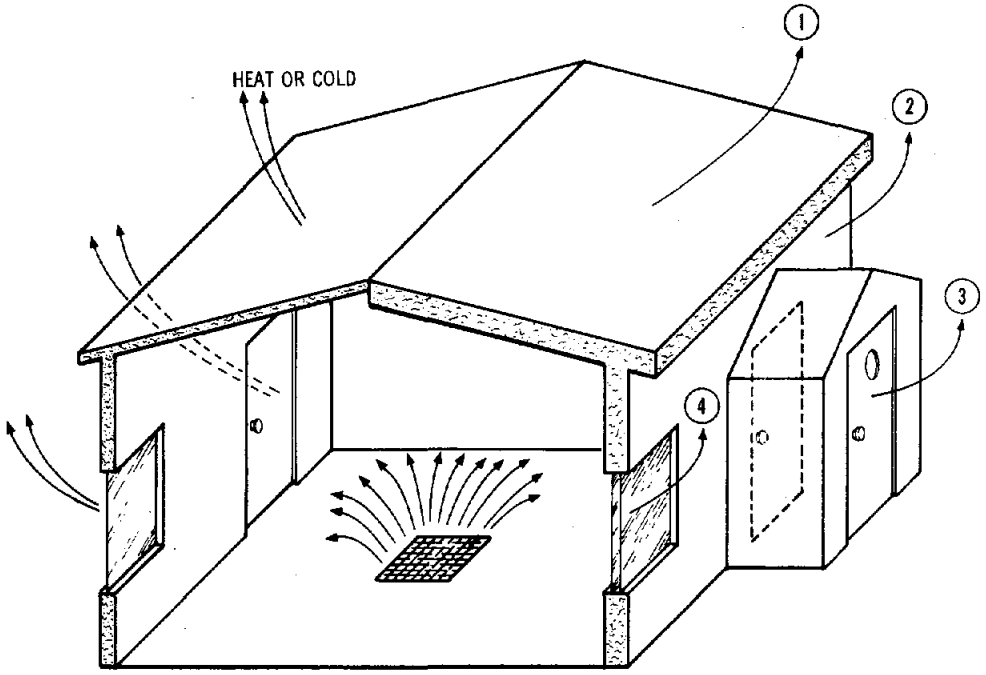

Figure 1. Heat or cold flow paths out of a home's interior. The energy conserving half slows energy flow more than the wasteful half. The arrows also represent dollar flow: 1) through roof, 2) through walls, 3) through entrances, and 4) through windows.

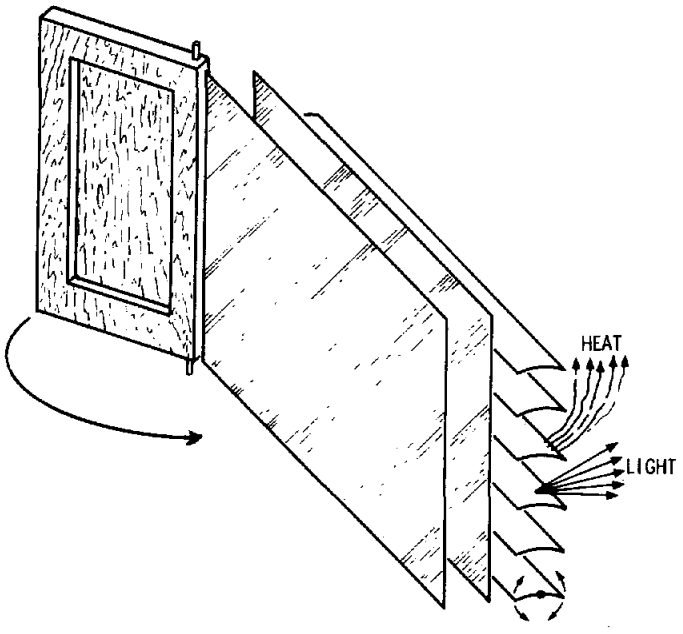

Figure 2. The window solar collector.

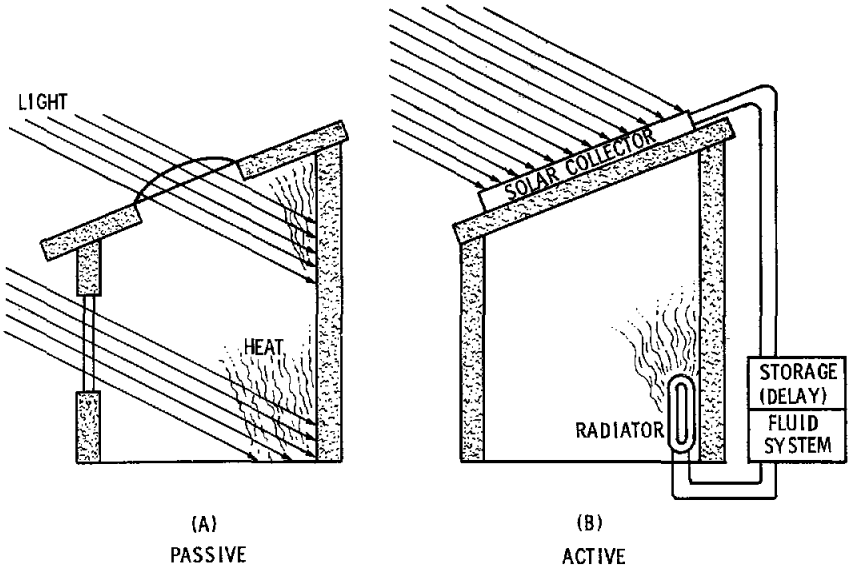

Figure 3. Active and passive home heating concepts.

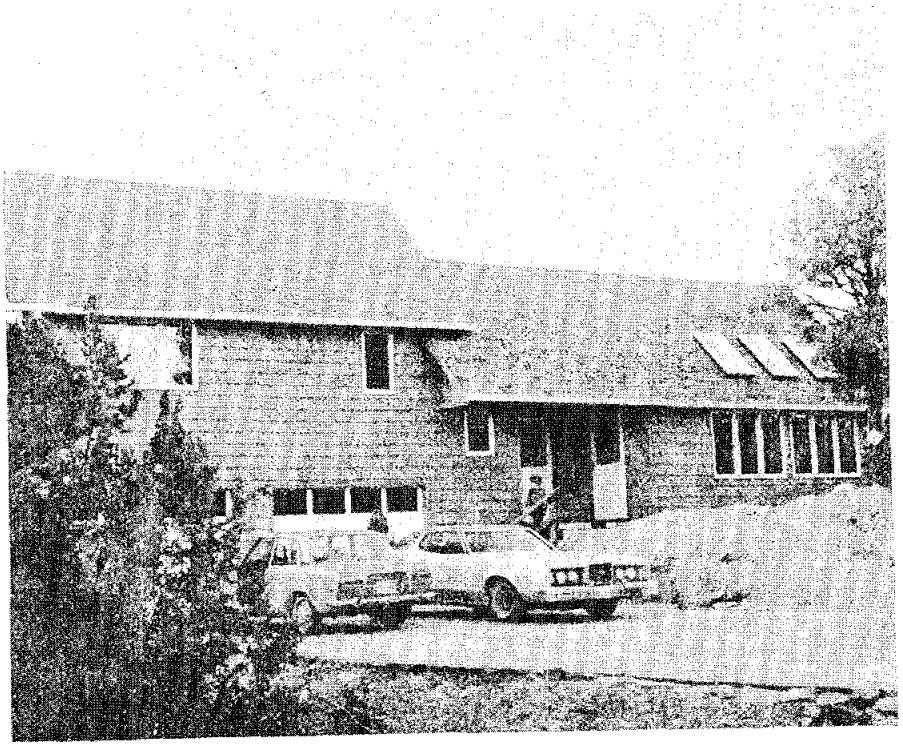

Figure 4. The solar adaptable home of Lora and Wayne Dow, Albuquerque, New Mexico, viewed from the south side.

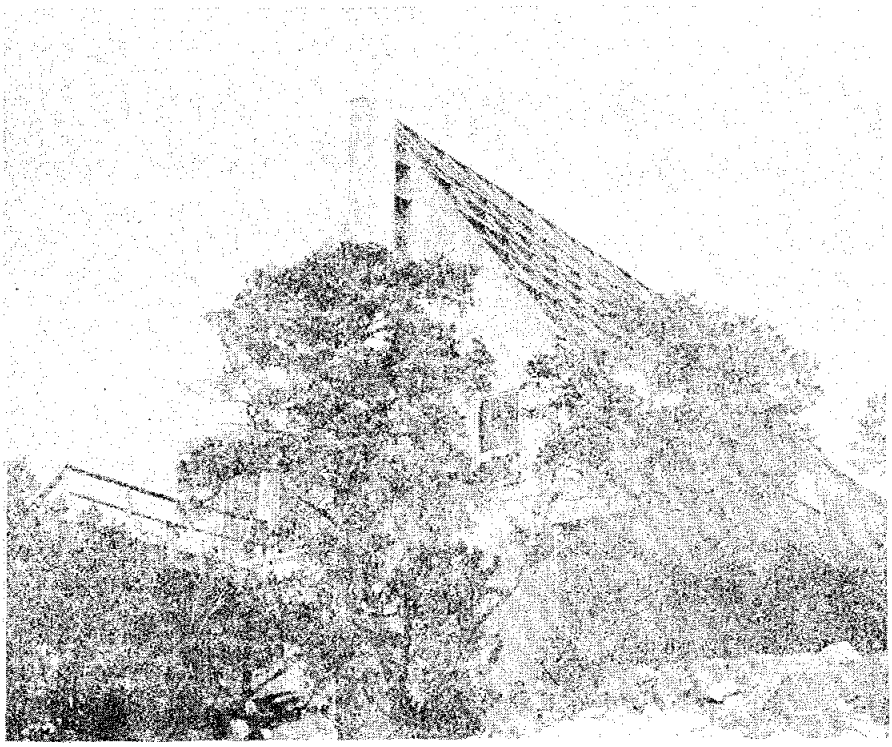

Figure 5. The heated home of Frank and Med Zanner in Albuquerque, New Mexico, viewed from the southwest.

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