

# ENERGY FACTS

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## Heating Your Home With Solar Energy<sup>1</sup>

- Q. Will solar heating really work in Michigan?
- A. Yes, but we can't expect solar energy to supply all of our heating needs because of our cold climate and often overcast skies. However, one can reasonably expect a solar system to supply 30 to 75% of a home's heating requirement. Although the present use of solar energy is limited, it can provide a significant amount of a home's heat requirement. Remember, fossil fuels are limited.
- Q. Why do so few people have solar systems today?
- A. The primary reason is economics. Until recently, it was not economical for a home owner to install a solar unit. However, solar energy is now becoming increasingly competitive with electricity and oil.
- Q. How do solar energy systems work?
- A. Solar radiation is absorbed by a collector, placed in storage, with or without a transfer medium, and distributed to the point of use—your living space. Each operation is maintained and monitored by automatic or manual controls. In Michigan, a regular, conventional heating system is needed in conjunction with the solar system.
- Q. What kinds of solar heating systems are there?
- A. There are two basic types: active and passive (see Figures 1 and 2). Active systems are divided into liquid and air systems. They use pumps and pipes (or fans and ducts) to carry heat

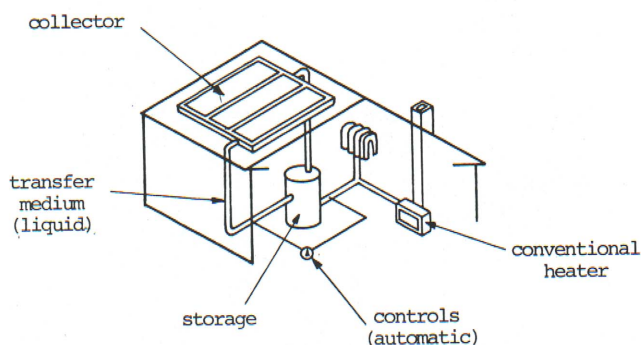


Figure 1. — An active system.

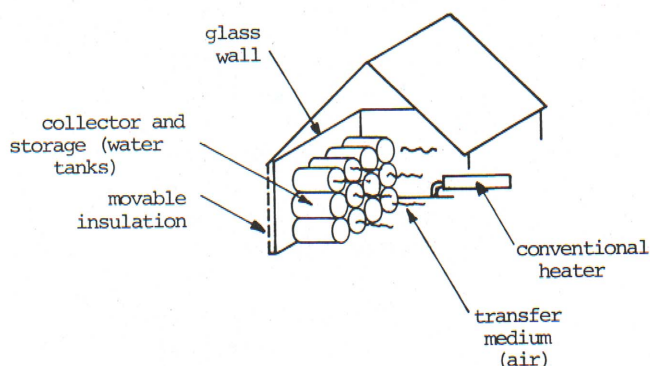
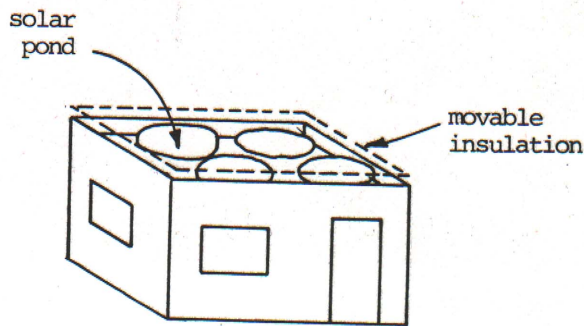


Figure 2. — A passive system.

from the collector to storage and from storage to the living space of the house. A passive system uses natural forces, such as gravity and convection, to accomplish the same objective.

Some passive systems use the wall of the house or a separate stationary wall as both the collector and storage medium. In the passive house, movable wall panels, or flaps, are often used to direct the heat throughout the living space. Another approach is to collect and store heat in water bags on the roof (see Figure 3).

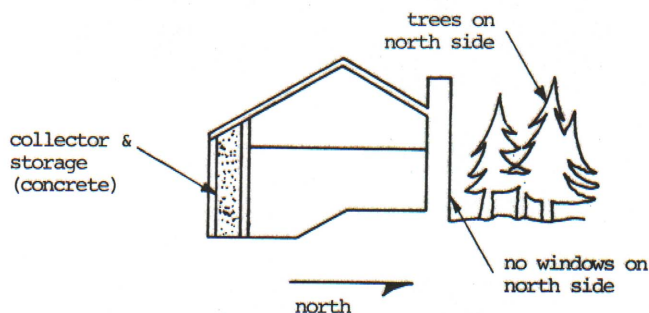
<sup>1</sup>From "Solar Energy and Your Home," U.S. Department of Housing and Urban Development, April 1977; and "Buying Solar" FEA/G-76/154. Adapted by Claudia Myers, Bill Stout and Jim Boyd, Agricultural Engineering Department, October 1, 1977



water bags can be flooded in hot weather

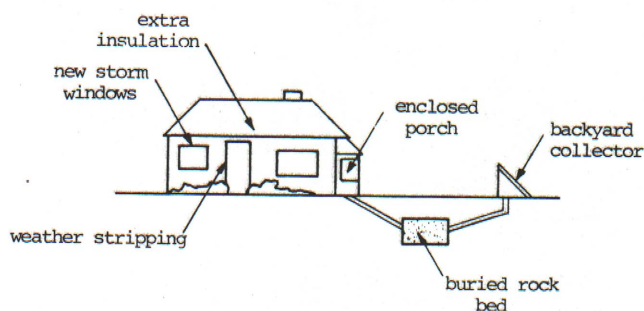
**Figure 3. — Collecting and storing heat in bags on roof.**

- Q. *Is a solar system suitable for my house?*
- A. Solar energy is not suitable for everyone's house. You need to know whether your house or lot can handle a large enough collector and storage system. The collector must face a southern direction and receive sufficient unobstructed sunlight, otherwise the collector won't work (see Figure 4).



**Figure 4. — Properly sited and aligned house.**

An important consideration is heat loss. Unless a home is well insulated, insulation will have to be added to the ceiling, walls and basement, and weatherstripping, storm windows and doors should also be installed (see Figure 5). A solar system is purchased to save money on heating bills. If you're losing heat because of poor insulation, it is more economical to save heat through better insulation than by adding heat through a solar system.



**Figure 5. — A solar system with a properly insulated and weatherstripped home.**

- Q. *How is the heat distributed throughout my house?*
- A. Heat from the collector or storage medium can be distributed to the rooms of your house through a forced warm air duct system, or it can be circulated by hot water in radiators or baseboard units. Water is preheated by the solar collector and brought up to the required temperature by the conventional, back-up system. Thus, your present heating system can often be adapted to distribute solar heat.

- Q. *How do I heat my house at night?*
- A. All day the heat generated in the collectors has been transferred to storage. A second set of pipes (for liquid) or ducts (for air) circulates heat from storage to the rooms of your home.

- Q. *What happens if there are a few cloudy or cold days in a row?*

- A. After the stored heat is exhausted, the auxiliary heater takes over. The storage systems should supply enough heat to last a few days. A system to provide warmth much longer than that would be too large and expensive.

- Q. *Can I use a solar energy system just to provide hot water for domestic use?*

- A. Yes. Domestic hot water systems are small and easy to install. They can be connected to your present hot water system, and many commercial systems are available. Such systems are regularly featured in do-it-yourself magazines.

- Q. *Can I heat my swimming pool with solar energy?*

- A. Yes. Some solar heaters for swimming pools operate on the same basic principle as a hot water system, except that the storage area is not the hot water tank but the swimming pool.

- Q. *What size of solar collector do I need?*

- A. For hot water systems, usually 1 ft.<sup>2</sup> of collector area is needed for each gallon of water required per day. This will furnish 40 to 75% of the energy needed to heat the water. For swimming pools, the rough estimate is 1 ft.<sup>2</sup> of collector for every 2 ft.<sup>2</sup> in the pool. For space heating, a rough estimate is 1 ft.<sup>2</sup> of collector for every 2 ft.<sup>2</sup> of floor space in the house to supply 50 to 75% of the heating requirements.

Remember, these estimates are generalized due to the many variables to be considered.

- Q. *How is heat stored in a solar energy system and what size storage space is needed?*

- A. In space heating systems that use a liquid heat

transfer medium, the storage system is usually a large tank of water. Water storage holds heat well and is economical, but the tank must be protected against corrosion and heat loss. It is the most practical method for storage of liquid systems; about 1 to 2 gal of storage are required for every square foot of collector.

When air is the heat transfer medium, the storage system can be a bin of large gravel. Rocks or pebbles are economical and retain heat well. No corrosion proof tank is needed, but more space is required for the same amount of storage that water would provide. It is the most practical method of storage for air systems. As hot air flows through the space between the 1- to 2-in. gravel, it heats the bin. There should be about .5 ft<sup>3</sup> of rock for every square foot of collector.

A third method of storing solar energy, change of state storage, uses materials or substances (fusible salts) that change composition from solid to liquid when heated. But the salts can only go through so many heating and cooling cycles before they lose their capabilities to store heat. They have not been used on a commercial basis successfully yet. Some interesting experiments are being conducted which may prolong the number of cycles. About 1 ft<sup>3</sup> of storage space with salts is needed for every 9 ft<sup>2</sup> of collector.

Suppose the objective of the storage system is to hold 200,000 BTUs at over 100°F. Water systems would need 53 ft<sup>3</sup> at 3,300 lb, rocks would need 175<sup>3</sup> at 17,500 lb and fusible salts would require 19 ft<sup>3</sup> at 1,740 lb.

erator, which takes heat out of the box and puts it into a room. A heat pump consists of an evaporator, a compressor and a condenser (see Figure 6). A special liquid is pumped to the evaporator where it absorbs surrounding heat and changes into a gas. The gas is then pumped to the compressor which uses electricity to compress the gas and raise its internal energy to a temperature level useful for space heating. Next, it flows to the condenser where it changes back into a liquid and gives off its heat. The liquid is pumped to the evaporator and the cycle begins again. The quantity of heat extracted from such a system can be several times larger than the energy required by the compressor.

In a solar-assisted heat pump for home heating, the evaporator is placed outside the house and the compressor and condenser inside. A solar collector is used to supply heat to the evaporator. This assists in reducing the amount of heat that must be supplied by the compressor. However, these systems are not economical at the present time.

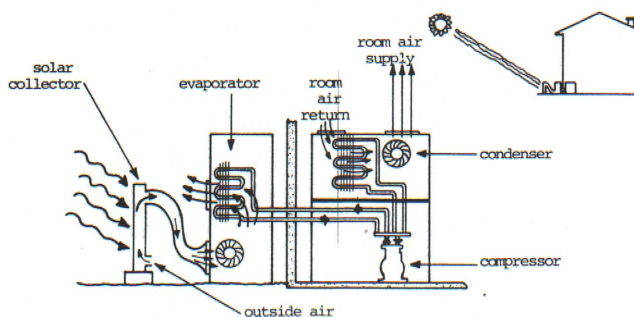


Figure 6. — Heat pump system and its proper placement in a home.

Q. Can I put in a domestic hot water system and add space heating later?

A. Sometimes, particularly in new construction where the basic house can be so designed, but plan ahead. Where will the storage tank be placed? A combined domestic hot water and space heating system needs much more collector area than a domestic hot water system alone. Determine how much of your energy dollar goes for space heating and how much for domestic hot water. Before you make these decisions, thoroughly analyze your own hot water and space heating costs and compare performance of available conventional systems.

Q. What is a solar heat pump?

A. Actually, it's a heat pump assisted by solar energy. A heat pump is similar to a refrig-

Q. Can a solar-assisted heat pump cool my house in the summer?

A. Yes. When the system is acting as an air conditioner, the fluid flow through the cycle is reversed, and heat is removed from the building and rejected to the environment. Unfortunately, the solar collectors are of no use to the heat pump in the summer.

Q. What does a solar system cost?

A. A solar domestic hot water system that supplies a third to a half of the hot water needs will cost about \$1,500 installed.

A typical solar space heating system including storage, collectors, controls and installation will run in the \$5,000 to \$10,000+ bracket.

A heat pump alone costs between \$4,000 and

\$6,000. And, a solar heat pump system will cost \$10,000 to \$20,000+. To find actual costs, contact manufacturers and distributors. They'll quote prices and help determine your specific requirements.

Q. *Will I be able to get a mortgage or a home improvement loan to install a solar energy domestic water or space heating system?*

A. Interest in solar energy systems is growing so fast that many progressive, forward-looking lending institutions are becoming receptive to this concept. However, you may have to shop around. Bankers are aware that a house with a well-designed solar energy system is likely to grow in value as fossil fuel costs rise. Some banks offer lower interest loans to people building energy conserving homes.

Q. *What kind of tax advantages can I get for a solar energy system?*

A. H. B. 4138 (1976) (Property tax): Provides that tangible personal property used for solar, wind or water energy conversion devices shall be exempt from excise tax on storage, use or consumption of personal property.

H. B. 4139 (1976) (Property tax): Provides that solar, wind or water energy conversion systems shall not be considered in assessing value of real property equipped with solar system.

Application for exemptions should be made to the State Tax Commission, Department of the Treasury.

Q. *Will a solar energy system raise the resale value of my home?*

A. Quite likely. A properly designed system with a proven track record for saving fuel dollars might be a valuable feature of your home 5 or 10 years from now. By then, solar homes may be selling at a premium.

Q. *Should I pay now or later when improvements in solar technology are sure to occur?*

A. There is no doubt that future solar systems will have improvements over present models, and there will not be as much risk for the buyer as there is today. However, costs for tomorrow's solar systems may go higher, and money now spent on conventional fuels will be saved if solar systems are used today.

Q. *How can I get my money's worth and protect my investment?*

A. Ask for proof that the product will perform as

advertised. The proof could come from an independent laboratory or a university. You should have the report itself, not what the manufacturer claims the report states.

Examine the warranty carefully. By law, the manufacturer must state whether the warranty is full or limited. If it is limited, know the limitations. How long does the warranty last? Are parts, service and labor covered?

Find out who will service the solar system if something goes wrong. Don't settle for a response that any plumber or handyman will do.

Don't forget your local consumer office or your Better Business Bureau. Both may be able to help you determine whether a seller is reputable or not. Check, too, to see whether or not there is a local solar organization around to ask for advice.

If the seller makes verbal claims not reflected in the literature, ask that those claims be written down and signed.

Q. *Where can I find a contractor in my area to install a solar energy system or find a solar home builder?*

A. A local home builder association is the best source. Listings of interested builders and contractors are also available from the National Solar Heating and Cooling Information Center, P.O. Box 1607, Rockville, MD 20850. This center was established by ERDA and HUD to answer questions about solar energy homebuilding. Phone them toll-free at (800) 523-2929.

#### Reading List

Daniels, F. (1964). *Direct Use of the Sun's Energy*. Ballantine Books, Inc., Westminster, MD. 271 pp.

Foster, W. M. (1976). *Homeowner's Guide to Solar Heating and Cooling*. TAB Books, Blue Ridge Summit, PA 17214. 196 pp.

Kreider, J. F., and F. Kreith (1975). *Solar Heating and Cooling: Engineering, Practical Design, and Economics*. Scripta Book Co., McGraw-Hill Book Co. 342 pp.

Lucas, T. (1971). *How To Build a Solar Heater*. Ward Ritchie Press, Pasadena, CA. 236 pp.

Michal, C. J., et al. (1975). *Solar Energy Home Design in Four Climates*. Total Environmental Action, Church Hill, Harrisville, NH 03450, 198 pp.