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ABSTRACT

This booklet provides an introduction to solar energy by discussing: (1) how a home is heated; (2) how solar energy can help in the heating process; (3) the characteristics of passive solar houses; (4) the characteristics of active solar houses; (5) how solar heat is stored; and (6) other uses of solar energy. Also provided are 10 questions to answer (based on the readings), five additional questions to answer (which require additional information), and information on how heat moves. (JN)

DOE/CE-0093/1

INFORMATION
U.S. DEPARTMENT OF ENERGY
CONSERVATION AND RENEWABLE ENERGY INQUIRY AND REFERRAL SERVICE

Solar Energy and You

Solar energy is heat and light that comes from the sun. Thousands of years ago some people used this energy to heat their homes. Today, solar energy is again helping to heat buildings.

Why is everyone interested in solar energy now? The reason is that the fuels we burn in our furnaces are very expensive, and the supply of these fuels is shrinking everyday. People are trying to find new ways to heat their homes, factories, offices, and schools without using so much expensive oil and gas.

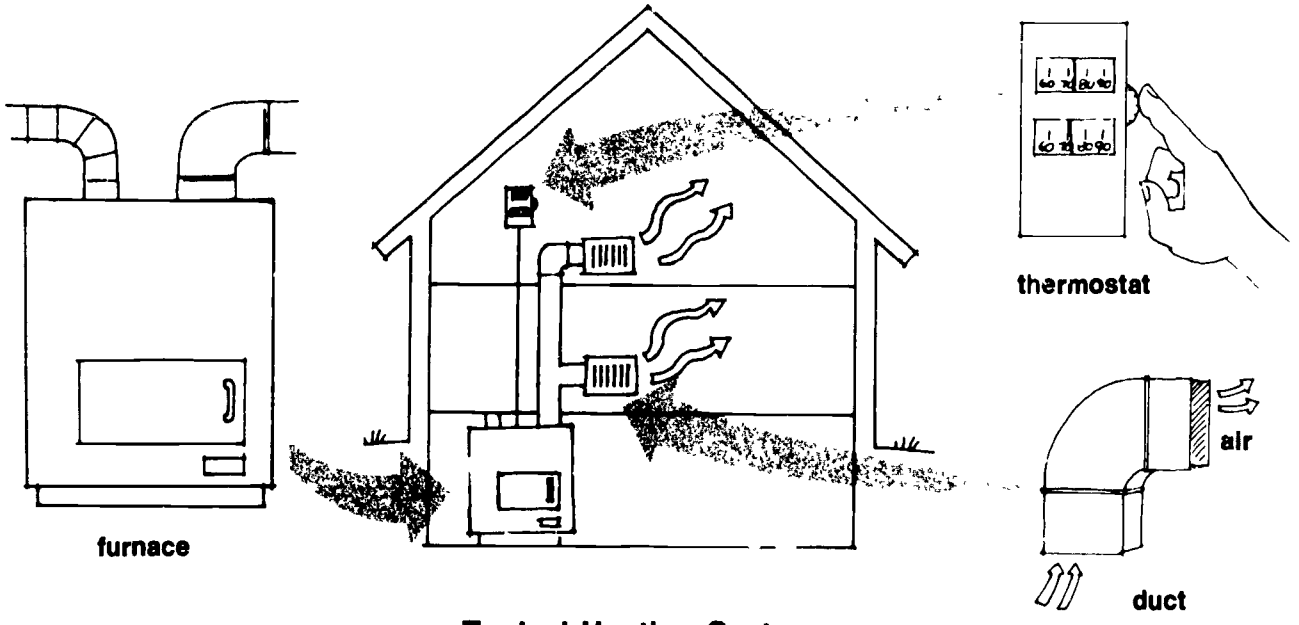
But before you learn how the sun can provide heat for buildings, there are a few facts about your home's heating system that you should know

How is Your Home Heated?

Houses are warm in the winter, but where does the heat come from? Most of the heat comes from burning **fuel**. The logs on a campfire or in your fireplace are a type of fuel, and the fire itself is a **heat source**. The heat source keeps your home warm.

What is the heat source in your home? Most house and apartment buildings have a type of large stove called a furnace in the basement. The furnace burns fuel and is the heat source for the whole building. Some furnaces burn wood or coal for fuel, but most of them burn oil or natural gas to produce heat. Some houses don't have furnaces. Their heat is produced from electricity.

A campfire or fireplace can heat only the space that is right around it. However, the heat from the furnace



Typical Heating System

We see that to heat a building, we need a heat source, a heat distribution system, and a heat control system.

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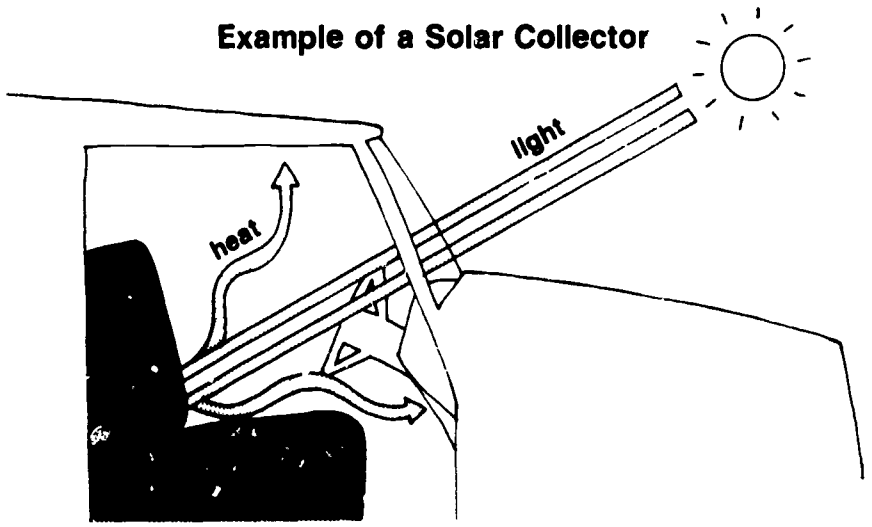
Example of a Solar Collector



must heat all the rooms in a house. How does this work? The heat produced by the furnace is used to warm either water or air. Then pumps move the hot water or air to the rest of the house in water pipes or special large tubes for air called air ducts. This movement of the hot water or air to warm other rooms is called **heat distribution.**

In addition to a heat source and a heat distribution system you need a way to **control** the amount of heat in your house. Then the rooms won't be too hot or too cold. How can you communicate with a furnace when you need more heat? Maybe you have noticed a small box with a dial inside that is mounted on the wall at home or at school. This box is called a thermostat. It measures the room temperature and signals the furnace to send more or less heat.

How Can Solar Energy Help?

The sun is a giant heat source. If you can collect enough solar heat, you can use it instead of the heat from a furnace. One way to collect heat is to trap solar energy with **solar collectors**. An example of how a solar collector works is a car that has dark seat covers and has all its windows closed tightly. When sunlight passes through the glass windows of the car, it is **absorbed** (taken in) by the dark seat covers and walls and floor. Light that is absorbed changes into heat. If the seat covers are a pale color, such as white or yellow, they would not absorb as much sunlight. So pale colored seats do not become as hot as dark seats.

Now here is an interesting fact about glass: it lets light in, but it does not let all the heat out. Even if it is cold outside, the inside of the car will be warm from the trapped heat. So a solar collector does three things: 1) it allows sunlight inside through glass (or plastic); 2) it absorbs the sunlight and changes it into heat; and 3) it traps most of the heat inside.

Solar collectors become so hot that they can be used as heat sources for a building. There are two kinds of buildings that use solar collectors as heat sources: passive solar buildings and active solar buildings. These two kinds of solar heated buildings will be explained in the rest of the fact sheet.

What are Passive Solar Houses?

In some cases, a whole house itself is a solar collector (just like the car). These houses are called **passive** solar homes because they don't use any special **mechanical equipment** such as pipes, ducts, fans, or pumps. Since the sun shines from the south in North America, passive solar houses are built so that most of the windows face south. They have very few or no windows on the north side.

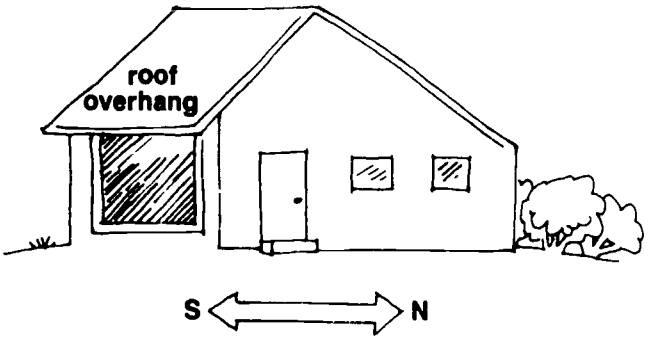
Some passive homes have greenhouses attached to them to let in light and trap the heat. The greenhouse is also used to grow plants because its many windows provide a lot of sunshine for the plants. Passive houses use walls and floors to absorb solar energy and turn it into heat. Passive homes do not use a mechanical heat distribution system. Instead, a passive home works because hot air is lighter than cold air. Because it is lighter, the hot air will naturally rise to the top of a room, leaving the cold, heavy air near the floor. In a passive home, air that is heated downstairs will naturally flow upstairs. Cold air will flow downstairs and will be heated up again.

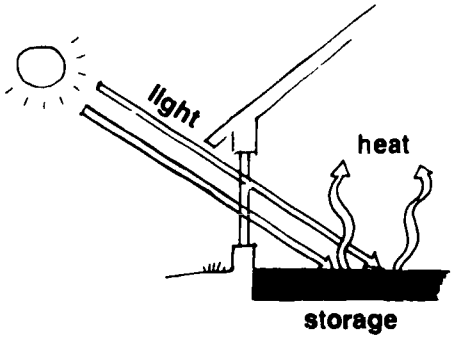
To control the amount of heat in a passive solar house, people close doors and windows to keep heated air in and open doors and windows to let heated air out. At night, special heavy curtains or shades are pulled over the windows to keep the daytime heat inside the house. In the summertime, awnings or roof overhangs help to cool the house by shading the windows from the high summer sun.

Some people can't design their houses to use solar energy this way. They too can use the sun for heat by choosing an **active** solar system.

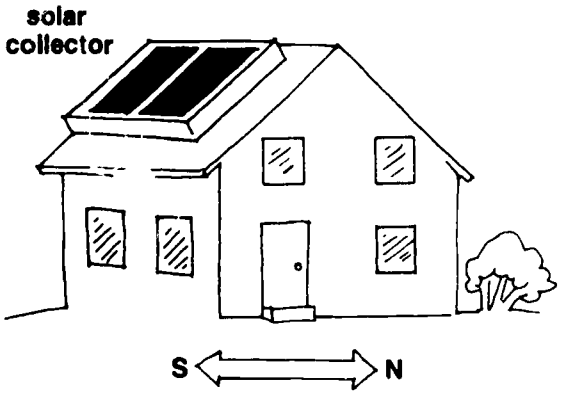
What are Active Solar Houses?

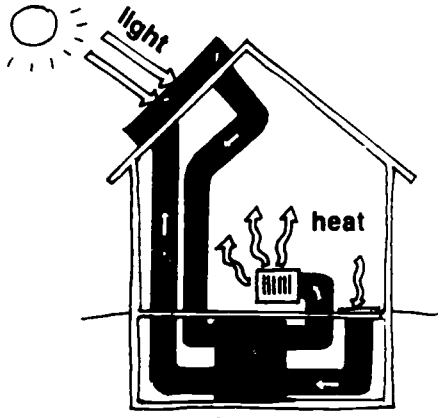
Some buildings do use special mechanical equipment to collect and distribute solar heat. These buildings have **active** solar heating systems. Active systems use collectors which look like boxes covered with glass. Dark colored metal plates inside the boxes absorb sunlight and change it into heat.





Passive Solar House





Active Solar House

Air or water flows through the collectors and is warmed by this heat. The warmed-up air or water is then distributed to the rest of the house just like in an ordinary furnace system. Thermostats are also used to control the delivery of heat in active solar heating systems. Active solar collectors are usually placed high up on roofs where they can collect the greatest amount of sunlight. They are put on the south side of the roof in a place where no trees or tall buildings will shade them.

Storing Solar Heat

When a furnace is used to heat a building, you don't need to store any heat as long as there is more fuel. Whenever heat is needed, you simply turn on the furnace. But when a solar heating system is used, what will happen at night or during cloudy weather when no sunlight can be collected? Solar energy systems must include some ways of storing the heat that was collected during sunny weather.

In active systems, either hot water is moved to large tanks of water, or hot air is moved to bins of rocks beneath the building. When it is needed, the hot water or air is taken back out of storage and sent to the living areas.

In a passive house, heat is absorbed by the thick walls and floors during the day. At night, when it becomes cold outside, warm walls and floors release their heat back into the room. If you have ever leaned up against a sunny brick wall or dark rock on a cold day, you were leaning on warm solar storage.

Houses with active or passive solar heating systems also have a furnace, wood burning stove, or some other heat source to provide heat in case there is a long period of cloudy weather. This is called a backup heating system.

Other Uses of Solar Energy

Solar energy can be used in many other ways besides heating buildings. Solar **photovoltaic cells** change sunlight directly into electricity; solar energy heats water for homes and businesses; and sunlight can even be used to cook food. As our supplies of precious gas and oil get smaller, we will find new uses for energy from the sun.

What Have You Learned?

From Your Readings

1. What is the definition of solar energy?

2. What are 4 kinds of fuels?

3. Explain each of these parts of a heating system:

   a. heat source.

   b. heat distribution.

   c. heat control.

4. Which car would be the best example of a solar collector? A car that has:

a. black seats and its windows open?

b. dark blue seats and its windows closed?

c. white seats and its windows closed?

5. Explain your answer to number 4.

6. Describe a house with a passive solar system.

7. Describe a house with an active solar system.

8. Which kind of house do you prefer? Why?

9. Why must solar energy systems have heat storage?

10. What can solar energy be used for besides heating buildings?

What Have You Learned?

From Your Research

1. What kind of heating system does your house have? (Hint: What is the heat source, heat distribution system, and heat control system in your home?)

2. How much do you think it costs to heat your house for one month in the winter? (Check with your parents.)

3. What climates would be the best for solar heating?

4. Would your home be able to use solar heat? (Hints: Is the south side unshaded? Is your home well insulated?)

5. Are there places in your neighborhood where you can buy solar collectors? (Check the telephone book.)

If you want to know more...

How Heat Moves

Heat always moves from a hot object to a colder one. When the two objects are touching each other, heat is transferred by **conduction.** When you lean against a cold wall, you warm the wall by conduction. When you lean against a dark, warm wall, the wall heats you.

When two objects are not touching each other, heat still travels from the warmer to the cooler one, but this type of heat transfer is called **radiation.** The sun heats the earth by radiation; your fireplace heats you by radiation.

When heat is carried from one body to another in a fluid such as air or water, and the transfer depends on the fact that hot fluids rise while cold fluids sink, this process is called **convection.** Air near the top of a room will be warmer than air near the floor because of convection. You can often feel cold air flowing into a warm room through the space underneath a door. In the summer, you open the top half of your windows to let out the warmer air near the ceiling.

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