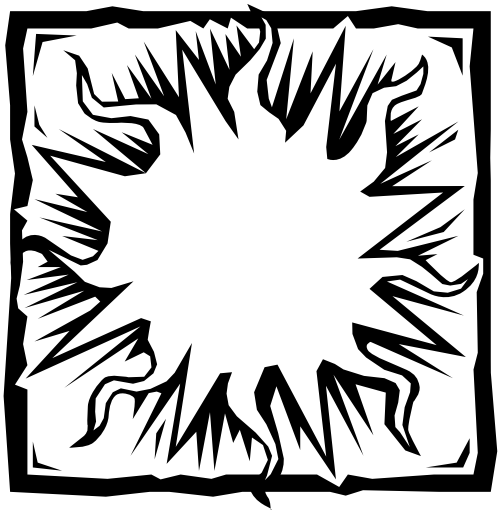
Facts about Solar Energy: Solar Heating

Introduction



Harnessing energy form the sun holds great promise for meeting future energy needs because the sun is a renewable and clean energy resource. Fossil fuels will eventually run out and the future of nuclear power is uncertain. For these reasons, other energy sources need to be developed. Solar energy is one of these sources.

Solar energy is produced by the sun, which is a gigantic nuclear fusion reactor running on hydrogen fuel. The sun converts five million tons of matter into energy every second. Solar energy comes to Earth in the form of visible light and infrared radiation. Scientists expect that the sun will continue to provide light and heat energy for the next five billion years.

Solar Energy Potential

The amount of solar energy that strikes Earth's surface per year is about 29,000 times greater than all the energy used in the United States. Put another way, in one hour more energy from the sun falls on the earth than is used by everyone in the world in an entire year. Solar energy used for heating is measured in Btu (British thermal units). The solar energy falling on Wisconsin each year is roughly equal to 844 quadrillion Btu of energy, which is nearly 550 times the amount of energy used in Wisconsin.

Although the amount of solar energy reaching Earth's surface is immense, it is spread out over a large area. To be used for heat, the energy from the sun must be collected and transferred to some other medium (such as air, water, or rock) to increase its temperature. Solar systems can be used for various applications requiring thermal energy, the most common uses being space heating, hot water heating, and swimming pool heating.

Solar Space Heating

Solar energy can used for space heating in buildings, employing either passive or active systems.
In a passive solar space heating system, the building itself is architecturally designed to capture solar energy and use it to heat the interior. Rooms called sunspaces or solariums, as well as greenhouses, can be built onto the south side of a home or building to collect solar energy. In some cases, structures such as trombe walls may be used to move air through the wall structure itself helping to distribute thermal energy to the interior space. The building is often designed so that the warmed air from these spaces can naturally circulate to other rooms. Large mass brick or stone walls and floors can be used to absorb the sunlight and store energy for heating at night. Because they do not require any type of mechanical system, passive solar buildings usually need little maintenance and can help lower cooling costs. Because they are integrated into the building design, it is usually difficult to retrofit an existing home to include a passive solar system. For new construction however, incorporation of passive solar heating can significantly reduce energy costs for the home owner.

In an active solar space heating system, a solar collector is used to heat a fluid (e.g., water or air) which is pumped or blown through tubes or ducts to deliver heat where it is needed. If air is the heat transfer fluid, then the warm air can be delivered directly the desired interior space. If a liquid is used as the heat transfer fluid, the energy can be transferred by a heat exchanger within the blower unit of a traditional forced air heating system. Alternatively, the heat transfer fluid can also be pumped through a radiator or a radiant floor heating system to warm the interior space. In Wisconsin, active systems frequently use a glycol antifreeze

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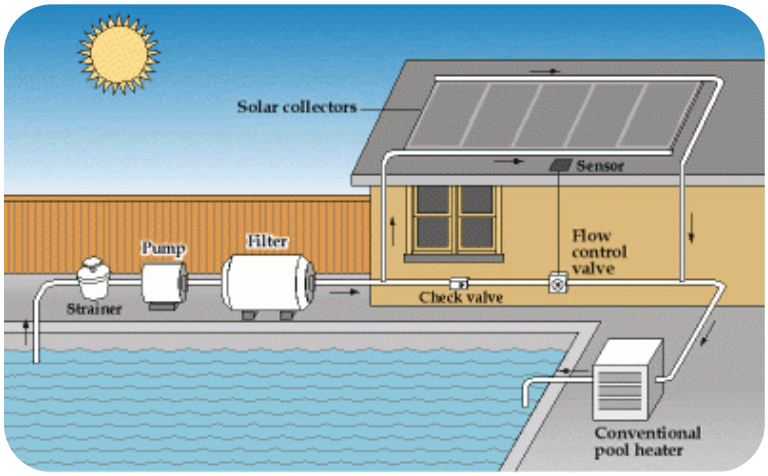
mixture as the heat transfer fluid to prevent freezing during winter months. To provide heat at night or when the sun is not shining, the energy collected by active solar systems can also be stored in a well-insulated bulk container that holds a large volume of hot water, or a large mass of hot solid such as brick or stone.

Solar Water Heating

Solar water heating systems operate in much the same way as active space heating systems. The solar energy is collected, and transferred to a fluid (either water or glycol). Instead of transferring this energy to the interior space of a building as in solar space heating, the energy is instead used to provide hot water. According to the Solar Energy Industries Association (SEIA), the return on investment for solar water heating can be as low as 3-6 years for a well-designed system, the lowest of any solar technology. Solar water heating systems can be used in homes throughout the United States. Solar water heaters are also especially well-suited for applications that require large volumes of hot water, such as laundromats and car washes, and facilities with heavily used shower rooms, such as athletic gymnasiums and college dormitories.

Solar Swimming Pool Heating

Swimming pools are a very good application for solar heating, because they require a substantial amount of energy to heat large volumes of water, but they do not need to achieve very high temperatures. Because the operating temperatures of solar pool systems are relatively low, the solar collector and active pumping heat transfer system can usually be constructed of lower cost materials (in many cases employing inexpensive plastics). Swimming pool heating systems are especially attractive for schools, hotels and resorts that operate large pools and waterparks. Solar pool heaters are also applicable for residential homeowners, and often are more affordable than heating a pool using other energy sources.



Source: Energy.gov. Solar Swimming Pool Heaters.

Other Solar Heating Applications

Other uses of solar heat include applications such as solar cookers, solar crop dryers, and solar wood kilns for drying lumber. All of these applications are based on the construction of an enclosed structure combined with some means to collect solar energy. The structure must be well insulated to reduce heat loss and a thermostatic control system used to monitor and regulate the temperature. In drying applications, an air-handling unit is typically also required to control the humidity of the system. The advantage of all these systems is that the solar energy is available for free, offsetting the purchase of traditional heat sources such as natural gas, propane, or electricity.

Effects

Solar heating offers several benefits. Solar heating systems have minimal, if any, fuel costs. Passive solar heating systems have very low operating and maintenance costs; costs for active systems are somewhat

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higher. Solar heating systems produce virtually no air emissions or waste while in use. They can be built quickly and in many sizes. They are also easily adapted to the needs of rural and developing communities and are well-suited for communities with limited access to other energy resources.

One limitation of solar heating is that the sun is not available at night and is less available on cloudy days. Solar heating systems either need to store the heat they collect or use backup heating systems when the sun is not available (e.g., woodstove, electric heating systems, small furnace).

Outlook

Because we can anticipate harvesting the sun's energy for the foreseeable future, the outlook for solar energy is optimistic. The environmental benefits of solar heating and its ability to meet the heating needs of most homes and buildings make it an attractive alternative to using nonrenewable fossil fuels. Reducing costs by mass-producing equipment, designing buildings that include passive solar systems, and improving energy efficiency may also help to encourage the growth of solar heating systems.

A significant number of homeowners and businesses in Wisconsin have demonstrated that both passive and active solar heating systems are an environmentally friendly way to meet their heating needs. One of the main factors that will influence the future growth of solar heating is the cost of other heating fuels and technologies including home heating oil, natural gas, propane, geothermal, and wood heat. As of 2017, hydraulic fracturing (fracking) has made natural gas quite affordable, so consumers with access to natural gas do not have as strong of a financial incentive to pursue solar heat. On the other hand, for those that wish to embrace renewable energy instead of fossil fuels, solar heating is an option to consider. It is usually advised to assess your building design and your local energy resources to determine what type of renewable heating system might provide the greatest economic benefit.

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