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Solar Space Heating

Green Living Topics - Solar Space Heating

While using solar thermal energy to heat domestic water is fairly standard practice throughout the world, the U.S. is certainly not at the head of its class in this subject! The American public is starting to show considerable interest in solar because people are asking for ways to cut sizeable chunks from their heating bill, which for many is their largest utility bill. And for some, solar thermal energy can drastically decrease the dependence on fossil fuels for heating needs.

These systems are also economically viable because the investment will pay for itself in approximately 10 to 15 years. There were many solar air systems installed starting in the late '70s, but technology at that time did not allow for the capacity to store energy for later use. With solar thermal energy, we have the ability to store heat and use it even when the sun is not shining.

Solar Space versus Solar Water

A couple of differences between solar thermal systems that heat water for domestic use versus those applied to domestic and space heating are:

Collector pitch. In a space heating system the collector needs to be at a much steeper pitch to catch more of the winter sun. This also helps to prevent overheating in the summer when the load is much smaller.

System size. Space heating systems require a much greater area for collecting solar energy than water systems, because they need to produce much more heat. This means that more storage space is also necessary, and adequate storage is crucial in preventing overheating problems during the summer. The simple sizing rule of thumb is two square feet of collector for every ten square feet of a building's footprint. Working with a local solar professional is the best way to find out what size system would be appropriate for your space and your local climate, as climate can drastically affect the size and type of system.

Domestic solar thermal systems can sometimes provide for an impressive 75% of your water-heating load if the system is sized and installed correctly. The capacity will depend on where you live—a space heating solar thermal system usually tops out at 50%, unless you live somewhere with very sunny winters like Colorado, in

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which case you might inch closer to the 75% mark.

Types of Systems Compatible with Solar Thermal

Not all space heating systems can be supplemented with solar heat—baseboard radiators, cast iron radiators, steam heat, and electric heating systems are just not compatible because of either the need for higher water temperatures or the source of heat. For instance, baseboard radiators are heated by a high temperature boiler with a fluid of approximately 180 F. When the fluid returns to be reheated by the boiler, it has only dropped to 150 F. Solar will only heat a fluid up to 150 F, meaning that it would not be able to increase the temperature anywhere in that heating loop.

However, low temperature applications that can utilize mid-range temperatures created by solar are ideal. Radiant floors, forced-air furnaces, high mass systems, and fan convectors can all be easily supplemented with solar heat. These heat distribution methods can be integrated into an existing system or installed as independent heating units.

Radiant Floors

Every system is a bit different, but the basic principle is that the fluid running throughout a floor is heated by the sun, and if the sun doesn't get the fluid hot enough, the back-up water boiler will bring it up to the desired temperature. These systems are compatible with solar because they operate at a temperature of around 100 degrees, right in the middle of a solar thermal system's operating range. Radiant heating systems can operate at these low temperatures because the "radiator" is the whole floor, which is a very large radiator!

Many radiant floor applications place the fluid-transporting tubes within a concrete slab. This helps with efficiency because the slab works as a thermal mass, holding the heat for an extended period of time. Solar thermal systems bring the fluid temperature up to an average of 100 F, which is the ideal temperature of fluid for a radiant floor application. Some radiant systems can be retrofit underneath the floor joists and radiant tubing can also be placed in walls or ceilings.

High Mass Systems

High mass systems are a relatively new configuration for solar space heating that utilize hot solar fluid from the collectors and run it through tubes in a large bed of sand located directly underneath a building. The major limitation of most solar space heating systems is that during summer months when the solar resource is greatest, the demand for heat is the least. This is less of a problem for high mass systems because the large thermal mass of sand takes a long time to heat up, but takes a long time to release its heat as well.

The sand bed operates as a primary storage for the solar heat, which utilizes the properties of sand to its advantage. The system allows you seasonal storage, meaning that you can bank some of the heat generated in the latter months of the summer for use in the winter when you actually need it. This allows for significantly greater production from the solar collectors and allows solar to fulfill a higher annual percentage of your heating load. Since the system works on a seasonal schedule instead of just a daily schedule, it is often compared to a slow moving train. You have very little control over the daily temperature of a building and with this system, you'll need a backup to increase and decrease the temperature inside as the degrees fluctuate outside. These systems are rarely retrofit in existing home and are mainly installed for new construction.

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Forced-Air Furnace Integration

This is a great way to integrate solar into an existing heating system. It works very similar to an air conditioner—air is pushed by a fan past a water-to-air heat exchanger and is sent through the existing air vents of a home. The heat exchanger is a finned coil placed in the plenum or ductwork of the furnace. When the thermostat in the home calls for heat, it will

check to see if there is solar energy stored in a large solar-heated water storage tank. If so, the fan turns on and a pump circulates fluid from the tank through the heat exchanger. Once the solar energy is depleted, the furnace reverts back to normal operation and utilizes the gas burner. This system does have the parasitic load of the fan, but it is an efficient retrofit that can meet up to 50% of a building's space heating needs.

Independent Fan Convector Units

Another way to get around situations where the existing system is not compatible with solar thermal heat is to use individual fan convector units in the main rooms of a building. These units work in a similar way to the forced air system—solar fluid is pumped through a water-to-air heat exchanger while a fan pushes air past the heat coil, making hot air. This type of heating system is often seen in hotels because its integration is simple and convenient—these systems can mount inside of a wall or floor, or they appear as units attached to the wall or sitting on the floor. This is a simple way to bring some solar into a building without installing a whole new heating system.

Space heating with solar can have a huge financial impact for residential and commercial applications. Plus, you'll start paying reduced utility bills – saving more money every time rates rise. You will enjoy instantly increased home equity that often equals the cost of installation and within a few years, you'll recover the initial expense.

The first step in reducing your energy bills is to conserve energy and to use it more efficiently—it is more cost effective to conserve energy than to purchase it. After you have conserved as much as you can, the next recommended step is to get a solar water heater for your domestic and space heating needs. Enjoy free, clean energy from the sun!

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