# Active solar energy collection

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Active solar heating systems use solar energy to heat a fluid -- either liquid or air -- and then transfer the solar heat directly to the interior space or to a storage system for later use. If the solar system cannot provide adequate space heating, an auxiliary or back-up system provides the additional heat. Liquid systems are more often used when storage is included, and are well suited forradiant heating systems, boilers with hot water radiators, and evenabsorption heat pumpsand coolers. Both liquid and air systems can supplement forced air systems.

Solar liquid collectors are most appropriate for central heating. They are the same as those used in solar domestic water heating systems. Flat-plate collectors are the most common, but evacuated tube and concentrating collectors are also available. In the collector, a heat transfer or "working" fluid such as water, antifreeze (usually non-toxic propylene glycol), or other type of liquid absorbs the solar heat. At the appropriate time, a controller operates a circulating pump to move the fluid through the collector.

The liquid flows rapidly, so its temperature only increases 10? to 20?F (5.6? to 11?C ) as it moves through the collector. Heating a smaller volume of liquid to a higher temperature increases heat loss from the collector and decreases the efficiency of the system. The liquid flows to either a storage tank or a heat exchanger for immediate use. Other system components include piping, pumps, valves, an expansion tank, a heat exchanger, a storage tank, and controls.

The flow rate depends on the heat transfer fluid. To learn more about types of liquid solar collectors, their sizing, maintenance, and other issues, seesolar water heating.

Liquid systems store solar heat in tanks of water or in the masonry mass of a radiant slab system. In tank type storage systems, heat from the working fluid transfers to a distribution fluid in a heat exchanger exterior to or within the tank.

Hot-water baseboards and radiators require water between 160? and 180?F (71? and 82?C) to effectively heat a room. Generally, flat-plate liquid collectors heat the transfer and distribution fluids to between 90? and 120?F (32? and 49?C). Therefore, using baseboards or radiators with a solar heating system requires that the surface area of the baseboard or radiators be larger, temperature of the solar-heated liquid be increased by the backup system, or a medium-temperature solar collector (such as an evacuated tube collector) be substituted for a flat-plate collector.

There are several options for incorporating a liquid system into a forced-air heating system. The basic design is to place a liquid-to-air heat exchanger, or heating coil, in the main room-air return duct before it reaches the furnace. Air returning from the living space is heated as it passes over the solar heated liquid in the heat exchanger. Additional heat is supplied as necessary by the furnace. The coil must be large enough to transfer

sufficient heat to the air at the lowest operating temperature of the collector.

Solar air heating systems use air as the working fluid for absorbing and transferring solar energy. Solar air collectors can directly heat individual rooms or can potentially pre-heat the air passing into a heat recovery ventilator or through the air coil of an air-source heat pump.

Air collectors produce heat earlier and later in the day than liquid systems, so they may produce more usable energy over a heating season than a liquid system of the same size. Also, unlike liquid systems, air systems do not freeze, and minor leaks in the collector or distribution ducts will not cause significant problems, although they will degrade performance. However, air is a less efficient heat transfer medium than liquid, so solar air collectors operate at lower efficiencies than solar liquid collectors.

Although some early systems passed solar-heated air through a bed of rocks as energy storage, this approach is not recommended because of the inefficiencies involved, the potential problems with condensation and mold in the rock bed, and the effects of that moisture and mold on indoor air quality.

Solar air collectors are often integrated into walls or roofs to hide their appearance. For instance, a tile roof could have air flow paths built into it to make use of the heat absorbed by the tiles.

Air collectors can be installed on a roof or an exterior (south-facing) wall for heating one or more rooms. Although factory-built collectors for on-site installation are available, do-it-yourselfers may choose to build and install their own air collector. A simple window air heater collector can be made for a few hundred dollars.

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