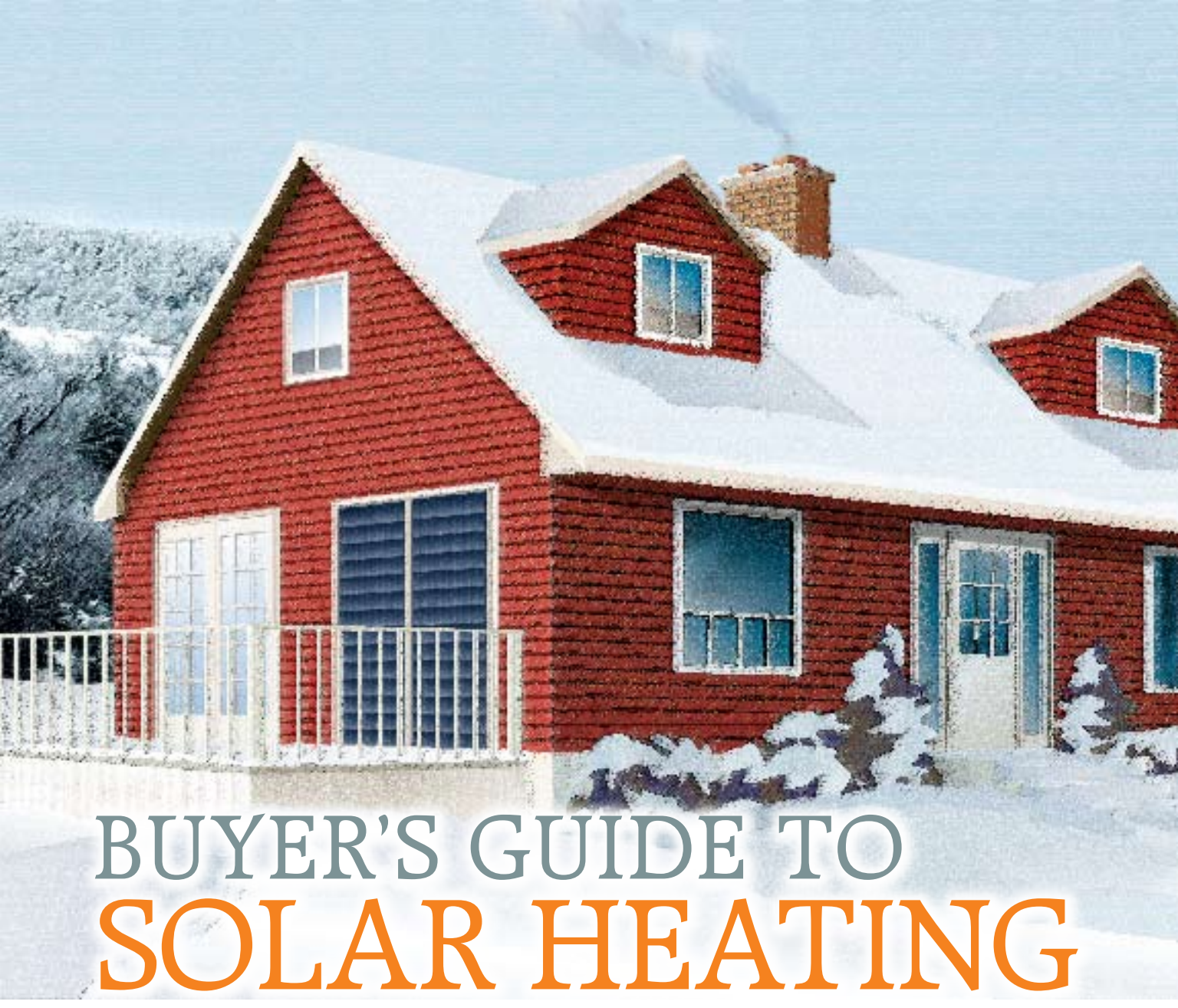

BUYER'S GUIDE TO SOLAR HEATING

Tap free heat from the sun with these solar hot-air collectors.

By Dan Chiras

Are you freezing in the winter to keep your fuel bill down? Or paying an arm and a leg to stay warm? Either way, it's probably time to consider installing a solar hot-air system. There are several options, and these systems are a hot commodity right now — in recent months several suppliers have reported increased consumer interest.

Solar hot-air systems capture sunlight energy and use it to heat incoming air. Heated air is then transferred into your home, often with a small electric fan. The solar energy costs what it always has cost — nothing. Solar hot-air systems can help alleviate homeowners' worries about rising fuel costs and provide years of inexpensive, maintenance-free comfort. They can heat homes, offices, workshops, garages and barns.

SOLAR SIMPLICITY

All solar hot-air systems rely on hot-air panels or collectors. Collectors are typically mounted on south-facing walls, roofs or even on the ground, if it's unshaded during the heating season.

Some commercial systems are simple thermosiphon collectors that rely entirely on convection to distribute hot air, but most use fans or blowers controlled by relatively simple electronics. A temperature sensor mounted inside the collector monitors internal temperature. When it reaches 110 degrees, it sends a signal to a thermostat mounted

Solar hot-air collectors can warm your home's interior — and blend seamlessly into its exterior.

LEN CHURCHILL

inside the home, which turns on the fan if room temperature is below the desired level. When the temperature inside the collector drops to 90 degrees, or the room reaches its setting, the thermostat turns the fan off.

Solar hot-air systems actively produce heat only in the daytime, but some of that heat is absorbed by the building's thermal mass: drywall, tile, framing lumber, etc. At night, the heat stored in the thermal mass radiates into the rooms. The more thermal mass, the greater the nighttime benefit.

HOT AIR VS. HOT WATER

Solar hot-air systems are far simpler and easier to install than solar heating systems that circulate water as the heat-transfer medium. They're also less expensive, and don't use potentially troublesome chemicals or require complicated electronic controls. You can even build a solar hot-air system yourself (see "Build a Simple Solar Heater," Page 24).

Solar hot-air systems also produce heat earlier and later in the day than water-based systems. As a result, they may produce more usable energy over a heating season than water-based systems of the same size, according to the U.S. Department of Energy's online publication, *Consumer Guide to Energy Efficiency and Renewable Energy*. Moreover, air systems do not freeze. Minor leaks in the collector or distribution ducts, which cause significant problems in water-based systems, also are less troublesome in hot-air systems. (Water-based heating systems do have one major advantage: They can store heat for use at night in water tanks inside the home.)

TWO KINDS OF HEATERS

Solar hot-air systems have been around since the 1950s. Today's systems fall into two categories: open-loop and closed-loop. The difference lies in the source of air entering the system.

In open-loop systems, collectors draw in cold outdoor air, heat it and transfer the heated air into buildings. Collectors used in open-loop systems, known as transpired air collectors, incorporate a dark-colored, perforated metal facing, called the absorber plate. There's no glazing over the plate; the sides and back are insulated to reduce heat loss. Sunlight striking the absorber plate of a transpired collector heats it. Air is drawn through the plate by a blower and is piped to the interior of the building.

Closed-loop systems, the most popular option today, draw cool air from the house, heat it and return the heated air to the interior. These collectors include glass or other clear glazing over an absorber plate, typically made of dark-colored metal. Its surface is roughened to increase air turbulence so that air absorbs heat from it more effectively. The collector's back and sides are insulated.

Air from the home enters the bottom of the panel and moves up, either behind the absorber plate (back-pass collectors) or in front of it (front-pass collectors). Air moves in and out of the collector through ductwork running through the wall or roof — the shorter the better. Small registers are mounted inside on the air intake and outlet openings.

Of the two types of glazed closed-loop collectors, back-pass collectors are more common. Back-pass designs use single panes of glass; front-pass designs are double-glazed to reduce heat loss. That makes back-pass collectors somewhat less expensive to manufacture and about 50 pounds lighter than front-pass collectors and, therefore, a little easier to install.

Most systems are thermostatically controlled and include backdraft dampers on the outlets to prevent reverse convective airflow at night, which would suck heat out of a building.

HEAT OUTPUT

Closed-loop solar hot-air panels can substantially boost the temperature of air flowing through them. According to the U.S. Department of Energy, air entering a glazed collector at 70 degrees is typically warmed an additional 70 to 90 degrees. Open-loop transpired air collectors may provide considerably less heat than glazed collectors. Chuck Marken, president of AAA Solar and solar thermal editor of *Home Power* magazine, says transpired air collectors increase the temperature of the air flowing through them only about 20 degrees, which is probably of little value to residential structures. However, manufacturers report considerably larger temperature increases, achieved by restricting airflow through the collector.

Closed-loop residential solar hot-air systems can produce impressive results. Steve Andrews, a residential energy expert based in Denver, Colo., for example, installed a collector to heat the

bottom 500 square feet of his trilevel home, which was usually 5 to 6 degrees colder than the rest of his house. He found the collector made a big difference during sunny winter days and the following evenings. "Overall, the comfort improvement was dramatic," he says.

As part of my research for this article, I tested the SolarSheat 1500G, a closed-loop collector, and found it consistently raised the temperature of 68-degree indoor air that entered it by 40 degrees on sunny but cold winter days. (For more information about the SolarSheat and other commercially available panels, see "Seven Solar Heaters at a Glance," Page 36.)

Marken recommends one 4-by-8-foot collector per 500 to 1,000 square feet of heated space, depending on the location and energy efficiency of your home. A 2,000-square-foot home with unobstructed southern exposure might require two to four collectors. Separate collectors may be required for each room. For larger rooms, two or more collectors may be needed, with a more powerful fan to ensure adequate air flow. If collectors are shaded during part of the day, more will be needed.

CANSOLAIR

Above: Cansolair's SolarMax collectors incorporate 240 aluminum cans.
Below: Construction continues around two SolarSheat 1500G panels installed in the wall.

MAKING CENTS OF SOLAR HOT AIR

How much can a solar hot-air system save you? Bill Hurrle of Bay Area Home Performance, a company in Wisconsin that installs solar hot-air systems, says they're able to achieve a 25 percent to 35 percent annual reduction in heat bills, or about $200 to $270 per year, when retrofitting homes — not bad in his cold, cloudy climate.

Greater savings will be achievable in cold areas that receive more sunlight. As a rule, active solar heating systems are most cost-effective in cold climates with good solar resources, but they make sense in other locations as well. Many solar installers will help you determine the cost-effectiveness of a solar hot-air system, or you can run the numbers yourself.

One way is to calculate payback — or how long it will take to reclaim the cost of the system, plus installation, through annual fuel savings. Divide the cost of the system plus installation by the anticipated annual fuel savings. If a $2,100 system will save $300 per year in heating bills, simple payback is seven years. Manufacturers estimate paybacks of four to eight years, based on current energy prices.

To calculate payback accurately, consider rising fuel costs, interest paid on money borrowed to buy the system (or lost interest, if you withdraw money from savings to buy it), and maintenance costs. Fortunately, these systems have just two moving parts, a fan and a backdraft damper, and both should give many years of trouble-free service. The rest of the system should last 50 years or longer. Let's see: $300 saved per year, for 50 years, is $15,000!

When calculating payback, don't forget financial incentives from utilities and state and local governments. Federal incentives now are offered only for dual-use solar hot-air systems — that is, they also use hot air to heat water for domestic uses. To qualify for this credit, however, the panel must be certified by the Solar Rating and Certification Corporation. Currently, only one certified dual-use collector exists, the Northern Comfort, produced by Sunsiaray Manufacturing,

YOUR SOLAR HOME

although the SolarSheat products are currently being tested.

You also can use payback to calculate your return on investment (ROI) by dividing the payback into one. A system that pays for itself in five years has an impressive ROI of one-fifth, or 20 percent.

SHOPPER'S GUIDE

Before you buy a solar collector, make your home as energy-efficient as possible, because efficiency enables the system to meet a higher percentage of your heat requirements. Beef up insulation in ceilings and add insulation to walls, if they're uninsulated. Cover windows at night with insulating shades, and seal cracks in the building envelope with caulk and weatherstripping. Install foam gaskets in electrical outlets and light switches. Seal ducts in forced air systems.

Be sure to investigate local building codes and zoning ordinances before purchasing a solar hot-air system. You may need a building permit. Check out neighborhood or subdivision covenants as well. They may prohibit solar systems, although many homeowners have successfully challenged their neighborhood associations.

You can buy solar hot-air collectors online or through a growing list of solar suppliers, companies that also often install other solar systems such as hot water or electric systems. When shopping, watch out for too-good-to-be-true claims.

"Marketing departments can make anything look good," Hurrle says. "One panel won't heat a home, despite what some salespeople may tell you."

I personally prefer closed-loop systems — collectors with glazed panels. I think they look nicer than transpired collectors, and they produce lots more heat. Moreover, open-loop transpired collectors are designed primarily for commercial and industrial buildings and are generally not a good choice for home heating.

As energy expert Andrews notes, "Transpired air collectors appear to be very suitable for a range of commercial applications, but seem to present more challenges than opportunities in residential applications, either in existing or new-home applications." One problem in residences is that transpired collectors can pump in too much fresh air, resulting in more air changes than necessary. Some fresh air is desirable, but the loss of heat through cracks in the building envelope caused by massive fresh air influx could waste a substantial portion of the heat produced by the collector.

Although transpired collectors usually are not suitable for homes in colder climates, they are designed to work well in barns, garages, workshops and commercial buildings that need large amounts of fresh air. John Hollick, president of Conserval Engineering, says one of the best applications for their SolarWall transpired collectors is school buildings, where building codes require a steady supply of fresh air.

INSTALLATION

Installing solar hot-air panels is not a job for a beginner. Solar energy expert Marken says a seasoned crew of two can install a solar hot-air system in a few hours, but it's more realistic to set aside a full day. "If this is your first time, plan on a weekend, even with help," he says. Because collectors are fairly heavy and measure around 4 by 7 feet, you'll need a brawny assistant or two.

The panel should face as close to due south as possible. The most common place to mount a solar hot-air collector is a roof, where shade is least likely. Unfortunately, roof mounts are usually more complicated and more costly than wall mounts. In homes with attics, installation requires flexible insulated ducts to transport air to and from the collec-

Seven Solar Heaters at a Glance

Company	Model	Type	Estimated Peak Output (Btu/hr)	Airflow (cfm/min)	Cost
AAA Solar Supply Inc.; 2021 Zearing NW, Albuquerque, NM 87104; (800) 245-0311; *www.aaasolar.com*	Sun Aire (2 sizes)	closed	5,000 to 6,000	362 to 488	$864 to $1,273
Cansolair Inc.; Box 100, Colliers R.H., NL, Canada A0A 1Y0; (709) 229-4387; *www.cansolair.com*	RA 240 SolarMax	closed	9,500	90	$1,649
ClearDome Solar Thermal; 3368 Governor Dr., 153-F, San Diego, CA 92122; (888) 227-7547 ext. 3427; *www.cleardomesolar.com*	Low Profile UB Solar	closed or open	2,048	100	int., $395 ext., $449
DeSoto Solar; 1410 20th St. #20, West Des Moines, IA 50265; *www.iedu.com/DeSoto*	on-wall (4 sizes)	closed	variable	variable	$240 to $1,280
	in-wall (3 sizes)	closed	variable	variable	$200 to $840
Sunsiaray; 4414 N. Washburn Rd., Davison, MI 48423; (810) 653-3502; *www.sunsiaray.com*	Northern Comfort	closed	3,000 winter; 4,000 summer	237	$1,150 to $1,400
Your Solar Home, Inc.; 299 Applewood Crescent, Unit 4, Vaughan, ON Canada L4K 4E7; (866) 556-5504; *www.yoursolarhome.com*	SolarSheat 1500G, GS	closed	5,118	90	$1,655 (G); $979 (GS)
Conserval Engineering Inc.; 4242 Ridge Lea Rd. Unit 28, Buffalo, NY 14226; (716) 835-4903; *www.solarwall.com*	SolarWall (3 sizes)	open	7,800 to 15,600	70 to 135	$1,959 to $2,788

tor. Outdoor runs of duct are protected from the elements by galvanized pipe. Much shorter duct runs suffice in homes with closed ceiling cavities and for wall mounts. Like roof mounts, ground-mounted systems require considerable ductwork, and both require much heftier fans to ensure adequate air flow.

To install a glazed collector, you'll need to cut two 5- to 7-inch holes in the wall or roof and ceiling. Transpired air collectors require only one hole, albeit a rather large one (up to 9 inches in diameter). When cutting holes in a wall or roof, be certain not to damage water pipes or electrical wires.

Comments
Wiring hookup required; ships assembled
Wiring hookup required; uses 240 aluminum cans in collector; washable air filter; ships assembled
Interior model intended for use inside a large window; plugs into standard outlet; units connect in series; ships assembled
On-wall model meant for agricultural structures, warehouses, shops, etc.; in-wall installs much like manufactured windows. No wiring required (thermosiphon, uses no fan); both types available in economy or high-efficiency models; ships assembled
The only SRCC-certified solar hot-air panel; also heats water; dual use qualifies it for federal credit; wiring hookup required; assembly by professional installer
No wiring required (uses integral PV panel); ships assembled; 1500GS is an auxiliary panel
Wiring hookup required; several colors available; 100 percent recycled materials; ships unassembled

You'll also need to hook up the thermostat, temperature sensor and fan. Wiring diagrams can be difficult to understand for the electrically illiterate. To make life easier, two manufacturers have provided rather ingenious alternatives to wiring. Your Solar Home sells my favorite solar hot-air collector, the SolarSheat 1500 series, which comes with its own supply of electricity: a small solar electric module that powers the unit's fan. To install, simply mount the panel on the wall or roof and then attach two wires from the panel to the thermostat inside the house. It's affordable, a snap to wire and very attractive.

Cansolair provides another simplified wiring solution. Its Solar Max is a glazed collector made from 240 empty aluminum cans, painted black and arranged in 15 vertical columns. Air flows through the solar-heated cans, pulled by an indoor fan in an attractive console that plugs into a 120-volt wall outlet. The fan unit also has a washable filter that helps keep indoor air clean. *(To read about a DIY solar heater that utilized aluminum cans, see "A Solar-Heated Church" in our Archive at* www.MotherEarthNews.com. *—MOTHER)*

Solar hot-air collectors are often attached to existing walls or roofs, but DeSoto Solar sells collectors designed to be integrated into walls, reducing their profile. Such installations work especially well in new construction or when building an addition to a house, so the panel can be installed into the wall as the structure is framed.

SOLAR COMFORT

If a solar hot-air system makes sense for your home or your business, you'll be rewarded many times over. Once you've paid off your investment, you'll get free heat for the life of the system. And perhaps best of all, you'll be doing something positive to create a cleaner, healthier future.

Solar Sources

The Homeowner's Guide to Renewable Energy by Dan Chiras
To order, see Page 121.

"Solar Hot Air System Design" and "Solar Hot Air Systems, Part II" by Chuck Marken; *Home Power* magazine, Dec. 2003/Jan. 2004 and Feb./March 2004.

Consumer Guide to Home Energy Savings by Alex Wilson, Jennifer Thorne and John Morrill; American Council for an Energy-Efficient Economy, 2003. (*www.aceee.org/consumerguide*)

Contributing editor Dan Chiras lives in Evergreen, Colo., in a state-of-the-art environmental home. He's written numerous books on green building and renewable energy — several are available on MOTHER's Bookshelf (see Page 121 or *www.MotherEarthShopping.com*). Visit Dan and his company, Sustainable Systems Design, at *www.danchiras.com*.