

# Get a Jump

## On Summer

Chuck Marken

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### With Solar Pool Heating

Solar pool-heating systems offer faster payback from lower initial investment and an easier installation than most any other renewable energy technology.

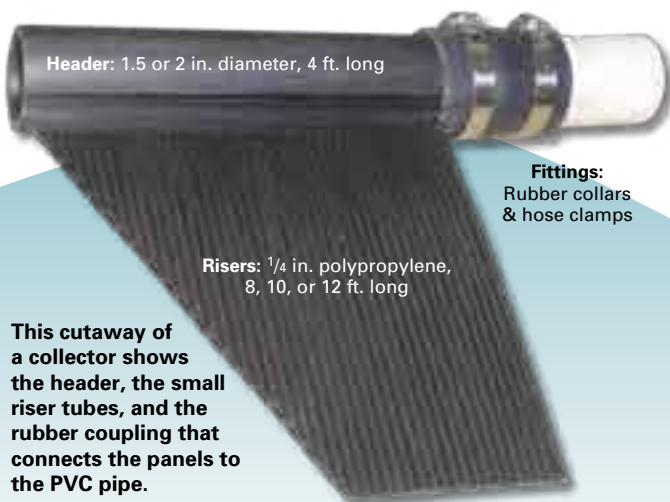
If you have a pool and can't wait for the summer swimming season to start, a solar pool-heating system may be exactly what you need. Besides extending the season by boosting the pool's temperature, these relatively inexpensive, simple systems are efficient, durable, and virtually maintenance free. Even if you're already heating your pool with natural gas or electricity, switching to the sun for heating can save you a bundle. With very few exceptions, you can recoup this investment more quickly than with any other type of active solar installation.

#### The Collectors

Pool collectors are specifically designed to heat large amounts of water to relatively low temperatures, usually between 80°F and 90°F (27–32°C). The collectors are made of polypropylene, a plastic with unique properties that make it well suited for “low temperature” collectors. The collectors differ from their domestic hot-water cousins, as they are composed of just an uninsulated, unglazed absorber plate.

The polypropylene in pool collectors is ultraviolet-light (UV) stabilized for longer life. Pool collectors are usually warranted for ten to twelve years, but I've seen collectors more than twenty years old that are still reliably cranking out heat. When installed correctly, the collectors are virtually maintenance free. In their later years, the collectors can develop leaks in individual riser tubes, but these can be repaired with factory supplied rubber-repair kits. (Polypropylene products are usually thermally welded, and normal sealants like silicone and epoxy will not repair leaks in pool panels.) Copper absorber plates with large headers are still used in some instances, but the higher cost and possible damage from acidic water make the polypropylene collectors a better choice in most situations.

Pool collectors typically come in three sizes—4 feet wide by 8, 10, and 12 feet tall (1.2 x 2.4 m; 3 m; 3.7 m). The collectors have 1½- or 2-inch-diameter header tubes (inlet and outlet) and very small (¼ inch or less) riser tubes. The collectors are manufactured with the riser tubes adjacent to each other, which gives the collectors a much higher wetted surface area



Header: 1.5 or 2 in. diameter, 4 ft. long

Fittings:  
Rubber collars  
& hose clamps

Risers: ¼ in. polypropylene,  
8, 10, or 12 ft. long

This cutaway of a collector shows the header, the small riser tubes, and the rubber coupling that connects the panels to the PVC pipe.



**Roof-mounted solar collectors for pool heating are unobtrusive and a highly effective use of space.**

compared to copper tube collectors. The large wetted surface area compensates for polypropylene's reduced heat transfer properties (the thermal conductivity of polypropylene is significantly less than copper).

Because pool collectors have no glass cover (which can intercept sunlight), under certain conditions, they are actually *more* efficient than standard domestic hot water collectors. Efficiencies of 80 percent or greater are possible when the ambient temperature is 10°F to 20°F (4–9°C) above pool temperature. However, efficiency quickly drops if the pool temperature is more than 15°F (7°C) above daytime temperatures. Because these panels lack insulation, during winter in moderate or cold climates, they are incapable of producing any usable heat for pools. If they were placed in an insulated box with a glass cover and oriented toward the sun, they would be able to produce usable heat in colder conditions. But polypropylene has an upper service temperature limit between 220°F and 240°F (104–116°C). Because of this, pool manufacturers advise that subjecting the panels to the high temperatures possible in an insulated box will void any warranties.

**The basic components of a solar pool-heating system fit right in with the existing pool pump and filter plumbing.**



### The Systems

Solar pool systems deserve a KISS—keep it simple solar. They are one of the most straightforward and easiest do-it-yourself solar projects for homeowners. They're also a favorite with installers—to such an extent that an estimated 60,000 systems were installed in 2005.

I like to call the technology “glue and screw.” White PVC pipe, fittings and valves (glue), and hose clamps (screw) are all that's needed to put a system together. In many cases, the existing pool pump can be used. Pool water is piped from the pump to the collectors, and then back into the pool. PVC pipe and fittings glue together for the piping system, and rubber couplings secured with hose clamps join the collectors together.

The collectors need to be mounted securely, and are normally placed on a roof. They can also be mounted on racks on the ground or on flat roofs, or integrated into a patio cover next to a pool. The panels are strapped to the mounting structure in a manner that allows the large polypropylene collectors to expand and contract with temperature swings. Failing to allow for expansion and contraction can cause the panels to fail prematurely and void warranties.

Systems using polypropylene panels are configured as drainback systems, which only fill the collectors when water is being circulated. When it is no longer being pumped through the collector, the water in the collectors and piping drains back into the pool. In colder climates, this keeps the collectors and pipes from freezing.

Many solar pool systems use a differential controller, which measures the temperature difference between the pool water that enters and exits the collectors. Because of the relatively high flow a pool pump provides, this differential is low when compared to most solar water heaters—the high volume of water moving through the panels doesn't raise the temperature much on each pass. A rise of only 5°F (2°C) or so is normal in many systems. The controller energizes a motorized valve that diverts the pool water to the collectors.

Courtesy www.solarexpert.com (3)



Don Keefe and Jason Urias of AAA Solar in Albuquerque, New Mexico, install a pool system. Note the strapping that secures the collectors to the roof.

Whenever there is enough heat in the collectors to add heat to the pool, the valve is actuated. If not, the valve returns the pool piping to its original configuration for filtering the pool without adding heat.

## Sizing the System

Many solar pool-heating systems are the sole source of heat for backyard pools. A properly sized system will keep a pool in the 80s and 90s during swimming season. In some regions, pool systems are configured to allow a backup boiler to heat the pool when the sun's energy isn't enough to do the job.

The basic rule of system sizing is predicated on the physical size of the pool and assumes that the pool is covered when not in use (see the "Cover Up" sidebar). Sizing is calculated by using the pool's square footage, as opposed to the volume. Most of a swimming pool's heat loss is due to evaporation—and more surface area equals more evaporation.

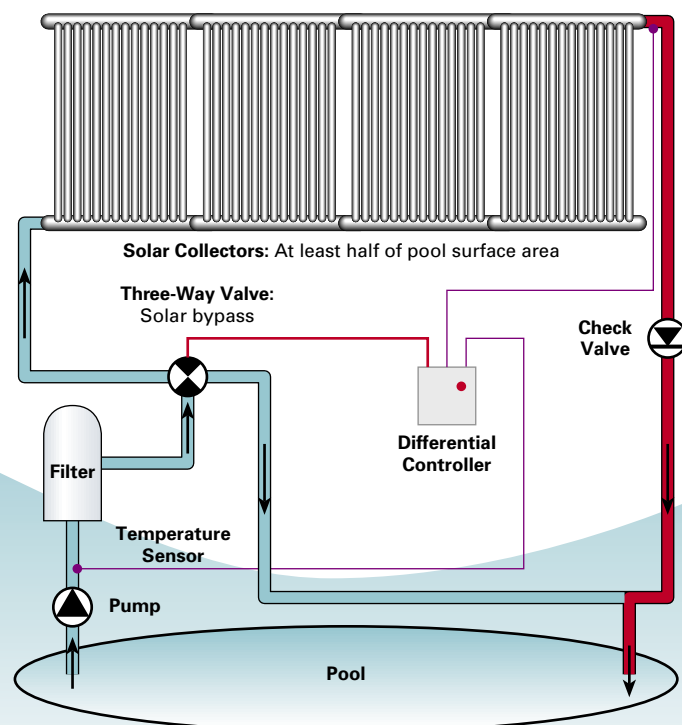
In the southern United States, basing the system size on 50 percent of the pool's surface area will provide adequate heat. This assumes that the pool is not shaded at any time, is protected from the wind, and that the collectors will be oriented to the south. These factors are important in sizing a pool because they affect heat gain and loss.

## Heating Indoor Pools

In most regions of the United States, glazed and insulated solar domestic-type hot water collectors are the only choice for indoor pool heating because the pools are used during cold winter temperatures. These hot water collectors are constructed with a copper-tube absorber plate in an insulated enclosure that's faced with a pane of glass and oriented to the sun. Indoor pool systems are sometimes installed as closed-loop antifreeze systems. If there is any chance that the pool water's pH will fall below 7 and become acidic, damage to the copper-tube collector is likely. Using a stainless steel heat exchanger between the pool water and the closed-loop antifreeze solution solves the problem. (See *HP84* for more information on hot water collector construction.)

Sizing the system for an indoor pool is much more complex, and must take into account the building that houses the pool. It is best to leave this job to professional installers.

## Solar Pool Heating System Overview



A shaded pool will have little or no passive solar gain, so the basic sizing parameter of 50 percent must be increased by at least 15 percent. If the pool is not protected from prevailing winds, it will also suffer increased heat loss from evaporation. In this case, plan to adjust the basic sizing figure by about 10 percent. In some locations, orienting the collectors due south (or within 20 degrees east or west) may be impossible. If all of the collectors must be placed on an east- or west-facing roof, increase the amount of collector surface area by an additional 50 percent.

## Cover Up & Save

Evaporation of swimming pool water accounts for a whopping 70 percent of a pool's total heat loss. This goes for both indoor and outdoor pools. The best solution to curb this energy and money drain is to invest in a pool cover—and use it! Adding a pool cover decreases the need for heating, lowering the initial cost of a solar heating system and the daily cost of heating a pool with gas or electricity.

Covers come in a couple of different styles, each with its own costs and benefits. A simple “bubble” cover (similar to bubble packing material) usually can be purchased for less than US\$100. Its transparent design also aids pool heating by directly trapping solar gain. Heavier-weight bubble covers may last a few years.

Vinyl covers are more durable and long-lived, but also are more expensive. They are available insulated or uninsulated, and can be integrated with an automated roll-up system to make cover placement and removal hassle free. Prices range from a few hundred dollars for a basic cover to more than US\$1,000 for covers that come with a motorized reel.

For more information on pool covers, visit the U.S. Energy Efficiency and Renewable Energy Web site at [www.eere.energy.gov/consumer/your\\_home/water\\_heating/index.cfm/mytopic=13140](http://www.eere.energy.gov/consumer/your_home/water_heating/index.cfm/mytopic=13140)



Courtesy Pool Cover Specialists, [www.poolcovers.com](http://www.poolcovers.com)

**A differential control with a narrow temperature difference actuates the three-way valve.**



Here's an example: A pool system is installed on a west-facing roof to heat a 16- by 30-foot (5 x 9 m) pool. The pool is not shaded and is protected from the wind.

Using the general rule of basing the system size on half of the pool surface area gives a collector size of 240 square feet (16 x 30 = 480; 480 x 0.5 = 240). But this system has to be installed on a west-facing roof, so we factor in an adjustment of an additional 50 percent, which gives us 360 square feet of collector area (240 x 1.5 = 360). If we plan to use 4- by 10-foot panels (40 ft.<sup>2</sup>; 3.7 m<sup>2</sup>), we divide the 360 by 40 to get nine panels to do this job. If we were able to mount the collectors on a south-facing roof, we would have been able to do the same job with only six 4-by-10 collectors.

In Florida, Arizona, and southern California, where solar pool heating is possible ten to twelve months out of the year, pool-heating systems are sized at about 100 percent of the pool's surface area. This extra collector surface area yields enough heat to keep the pool warm during what the rest of the country calls winter.

**A “three-port” (also called a three-way motorized valve) diverts the pool water to the collectors.**



This basic rule is a coarse method of system sizing, but seems to work well in most circumstances in the southern states. But many local conditions can affect sizing a pool collector system, and the advice of a local installer can provide you with a more accurate assessment of how much and what equipment is required to heat your pool.

## *Recouping Your Investment*

The return on investment (ROI) of a pool heating system is fast—faster than any other type of solar energy system, unless government or utility incentives change the equation. Recouping your investment in two to five years is commonplace when you've displaced gas, propane, or electricity used to heat a pool. For an installed system, expect to pay from US\$3,000 to \$5,000. Do-it-yourself kit prices typically range from US\$1,500 to \$2,500. Your ROI will vary depending on the complexity of the installation. And, as with all paybacks on solar energy systems or energy efficiency measures, the return is tax free.

Pool systems are the solar thermal industry's biggest success—by far. It's no wonder—these simple systems made with inexpensive parts represent fast payback and great value. Only a few homes with pools have too many shade trees or roofs that are not compatible with a pool system. In most cases, you can use the sun to heat your pool and save. If you have a pool or are planning to install one, you owe it to yourself to check out solar pool heating.

## *Access*

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For a listing of pool collector thermal ratings and a list of manufacturers, go to [www.fsec.ucf.edu/Solar/testcert/collectr/tprpool.htm](http://www.fsec.ucf.edu/Solar/testcert/collectr/tprpool.htm)

For more detailed articles on solar pool heating, see the two-part series in *HP94* & *HP95*

