

Solar Pool & Shower Heating for Communities and Multifamily Developments

Solar water and pool heaters are simple, efficient, affordable technologies that save on energy bills. Rather than spreading energy payments over time using natural gas or electricity, a solar system places the majority of costs up front. If you are interested in heating your community's pool, or want to offset fossil fuel heating costs, consider installing a solar pool and/or solar shower heater. Solar heaters can typically provide 40 to 80% of hot water needs and 100% of seasonal pool-heating needs for community and multi-family developments in the Southeast.

Swimming with Solar

Solar pool heating is one of the most cost-effective applications of solar energy. The following information answers the most frequently asked questions concerning solar pool heating for community and multi-family developments in the Southeast. Note that individual situations may differ in application.

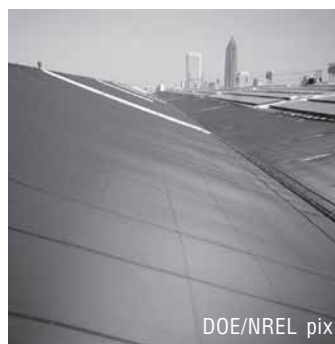
Cost: *How does solar compare with other forms of pool heating on the community and multi-family scale?*

The size and cost of a pool heater depends on the size of your pool and the conditions at your location. Looking at smaller scale community pools, solar pool heaters typically fall in the range of \$1,000 - \$4,000 with installation costs in the range of \$250 - \$900. A heat pump system often costs more and usually falls within \$2,000 - \$4,000 with installation costs between \$150 and \$750. Gas pool heaters can be expected to cost between \$1,000 and \$1,500 with installation costing between \$150 and \$850.

It is important to consider the cost of operation. Solar is an alternative energy source, and other than pump cost, it has no cost of operation. The pool pump must run for the solar heater to function and may increase the electric bill by \$30 to \$75 per year depending on normal filtering time. A solar electric panel may be used to run the pump during daytime hours and compensate for all of the power the pump uses during heating. Grid electricity would only be needed for night pumping and when the sun is not out. Heat pumps are highly efficient and have a low cost of operation. The typical pool averages \$250 - \$500 per year to heat with a heat pump. Gas pool heaters are low efficiency, resulting in high operational costs. The typical pool averages \$1,000 to



DOE/NREL pix



DOE/NREL pix

At the 1996 Summer Games in Atlanta, a solar pool heating system of over 10,000 square feet was installed that maintained the temperature of the Olympic swimming pool within one degree. It is estimated that this system will save \$12,000 annually in reduced heating costs.²

1,500 to heat with propane, while natural gas costs approximately half as much.¹

Function: *How does a solar pool heater work?*

Common solar pool heating systems include the following:

- **A solar collector** — through which pool water is circulated to be heated by the sun, *see Figure 1*;
- **A filter** — removes debris before water is pumped through the collector;
- **A pump** — circulates water through the filter and collector and back to the pool;
- **A flow control valve** — automatic or manual device that diverts pool water through the collector.

Most pool heating systems employ a direct system. Pool water is pumped through the filter and then through the solar collector(s), where it is heated directly by the sun before returning to the pool, *see Figure 2*. In hot climates, the collector(s) can also be used to cool the pool during peak summer months by circulating the water through the collector(s) at night.

Indirect systems run a heat transfer fluid through the collector, and heat from the sun is absorbed by the fluid and then transferred to the pool water. Indirect systems are more common for heating a building's main water supply, see Figure 3.

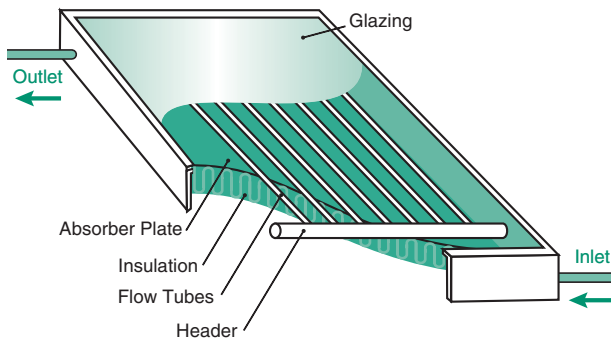


Figure 1: Example of how a flat plate solar collector works.

Options: What are the general types of swimming pool collectors, and how do they vary in performance?

Solar collector panels made of ABS pipes on black polypropylene plastic sheets are popular. Other types of collectors use flexible rubber mat or tube-on-sheet panels made of copper or aluminum.

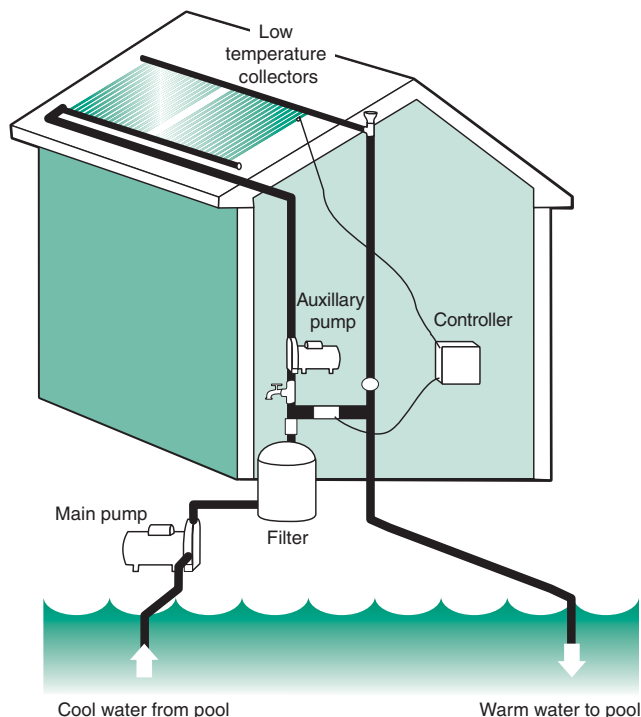


Figure 2: Typical direct solar pool heating system with automatic control

Unglazed collectors are subject to poor performance or damage under freezing conditions if not properly protected, operated and maintained. Freeze protection is discussed in more detail under *Durability*. Indoor pools used year-round that employ unglazed collectors as a primary heat source should consider having a backup heater for use under freezing conditions.

Unglazed collectors are designed to heat thousands of gallons of water to temperatures around 80°F. Glazed, or glass covered, collectors are designed to raise hundreds of gallons of water to temperatures around 130°F. This difference in design makes it difficult to have one system to heat both pool and domestic water. Glazed collectors commonly used for domestic water heating are not as cost effective for pool heating as unglazed collectors.

Sizing: What size collector do I need and what factors should be considered?

Sizing a solar pool collector is dependent on many variables including climate, length of swimming season, solar availability, and use of a pool cover.

Table 1 is an example of how one solar pool supplier gives a rough estimate of necessary collector size.

Pool covers

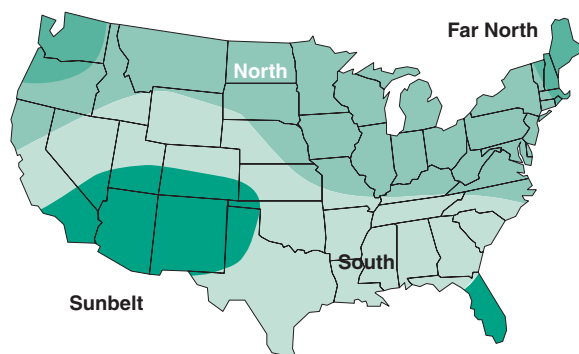
Pool covers save water by preventing evaporation, thus retaining two-thirds of the collected pool heat. If a pool cover is used, the size of the collector is usually around half the size of the swimming pool surface area. If a pool cover is not used, the collector area is usually between three-fourths to three times the size of the pool surface area.

Covering a pool when it is not in use is the single most effective means of reducing pool-heating costs. Savings of 50%–70% are possible. By minimizing evaporation loss from both indoor and outdoor pools, these covers are very effective in lengthening the swimming season. Pool covers on indoor pools not only can reduce evaporation but also the need to ventilate indoor air and replace it with unconditioned outdoor air. You can also shut off exhaust fans when an indoor pool is covered, saving even more energy.

There are several options for pool covers. It is best to use a cover designed specifically for pools. In addition to the various choices in material, they also come in transparent or opaque. While any pool cover will decrease solar heat gain to some extent, an opaque cover will do this significantly more than translucent. This is important when making a selection. You also need to decide amongst manual, semi-automatic and automatic, taking into consideration the electrical power required by automatic. A pool cover reel can assist in manually rolling up the pool cover.

Depending on materials and the number of hours of use, temperature increases of 5°F to 10°F may be expected from a pool cover. A 5°F increase is reasonable when the cover is used 12 hours a day; 10°F when it is used 20 hours a day.

Table 1: Sizing unglazed solar pool collectors



Pool Area - Measure the widest and longest points, multiply to get approximate pool square footage. Multiply this number by the region factors below to estimate collector size needed

Collector Size x Pool Area by region

Sunbelt	0.65	factor
South	0.80	factor
North	1.00	factor
Far North	1.15	factor

Increase Collector Size 10% for each of the following

- Pool is screened in or shaded
- Pool is in exceptionally breezy spot
- Pool cover is not used

King Solar, another supplier, uses the following as a quick estimate: Estimate the surface area of your pool in square feet. Then divide by 100 square feet, and round up. The result equals the number of 4x12 pool panels usually recommended for your pool size.

Chart courtesy of Solar Developments (www.solardev.com)

pump larger than your current one or a separate, smaller pump to move the pool's water to and through the collectors.

Indoor vs. Outdoor

The evaporation rate from an outdoor pool varies depending on several factors. Increases in pool temperature and wind speed, as well as decreases in humidity, will increase the rate of evaporation.

Indoor pools aren't subjected to the environment but can still lose a lot of energy from evaporation. They even require room ventilation to control indoor humidity caused by the large amount of evaporation. The ventilated air also must be conditioned, which adds to energy costs.

Collector Location

Solar availability, and thus system size, is influenced by collector location. The ideal location for a collector is on a south-facing roof, not shaded by trees or buildings during most of the day. Anywhere that is within a 30° angle east or west of due south is best. If your angle is more, a slightly larger collector will compensate.

Durability: *How long will solar pool heaters last, and what are the maintenance considerations?*

After installation, properly maintaining your system will keep it running smoothly for 10–20 years. The system should be certified by the Solar Rating and Certification Corporation (SRCC). A solar pool heating system that includes appropriate freeze protection and is properly installed should require very little, or no maintenance. Both glazed and unglazed collector systems should include freeze protection. This can be achieved by using either an antifreeze solution or a system that drains the collector and piping when temperatures approach freezing. Closed loop antifreeze pool heating systems should use glazed collectors since the heat collection loop is normally charged to a pressure not suitable for unglazed collectors.

Regular maintenance of the pool and its filtration system is crucial. Pool pH and chlorine levels must be maintained within the limits specified by the pool water test kits. Chemicals should be added to the pool water far from the collector intake pipes. The filter should be cleaned as frequently as recommended by the manufacturer to ensure that adequate flow is supplied to the collectors. Check the solar heating system for proper operation at the beginning of each swimming season, particularly if it has an automatic control. Remember, a properly operating solar collector feels cool to the touch. The temperature rise of the water going through the collectors should be from 3°F to 5°F for most efficient operation.

In addition to saving energy, pool covers:

- Conserve water by reducing the amount of make-up water needed by 30%–50%
- Reduce the pool's chemical consumption by 35%–60%
- Reduce cleaning time by keeping dirt and other debris out of the pool.

Pumps

You'll also want a properly sized pool pump for a solar system. The pool's filter pump is used to pump the water through a solar collector. If you're replacing a conventional pool heating system with a solar system, you may need a

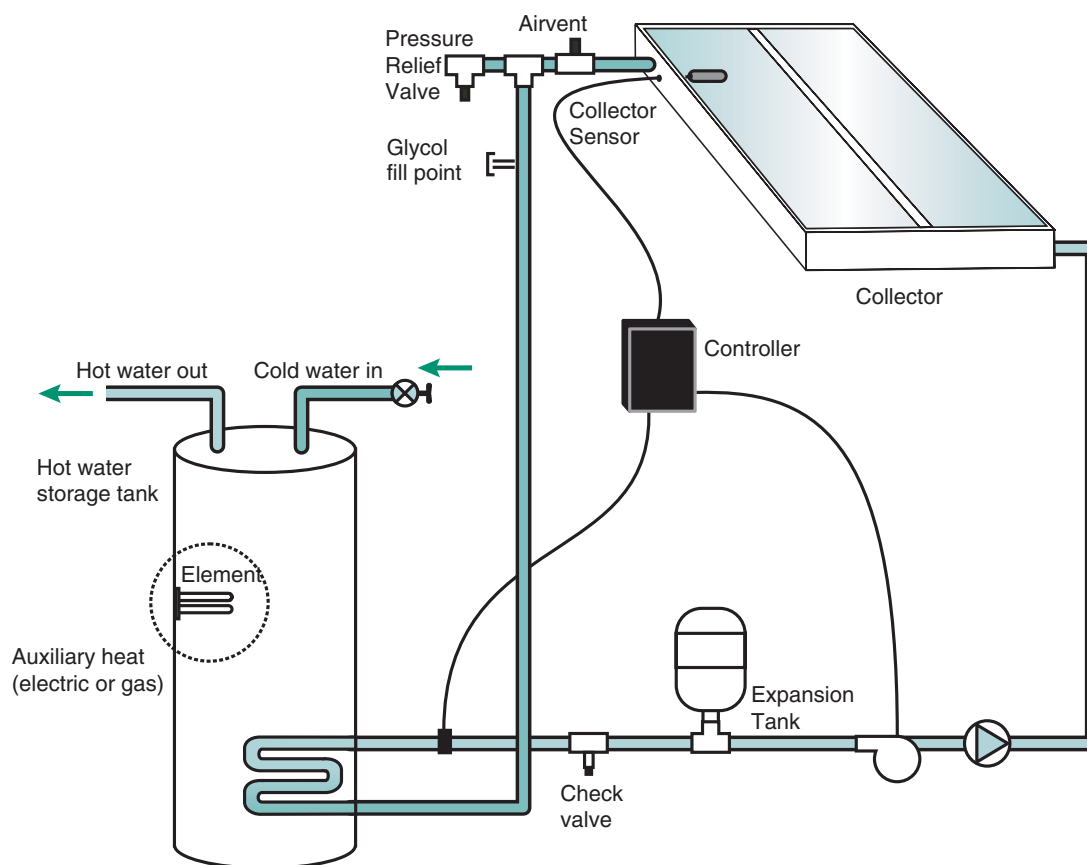


Figure 3: Indirect pumped system using antifreeze protection

Solar Water Heating for Showers and Beyond

A solar water heater could provide all of your community center's hot shower needs or even meet much of your total hot water demand. By reducing the amount of heat that must be provided by conventional water-heating, solar water-heating systems directly substitute renewable energy for conventional energy, reducing the use of electricity or fossil fuels by as much as 80%. While systems for heating the main water supply are similar to solar pool-heating systems in many ways, there are important differences to consider.

Cost

The cost of a solar water heating system depends on a number of factors including size of the system, manufacturer, retailer, and installer. Solar rebates and other incentives available in your area may reduce total cost. Take into consideration the price of the fuel used to back up the system. Solar water heating is economically competitive with electrical and propane heating. It is also competitive with dedicated heat pumps and heat recovery units, depending upon the individual situation.

For example, the average hotel pays 15 cents/kWh for electricity and has an annual electric hot water cost of

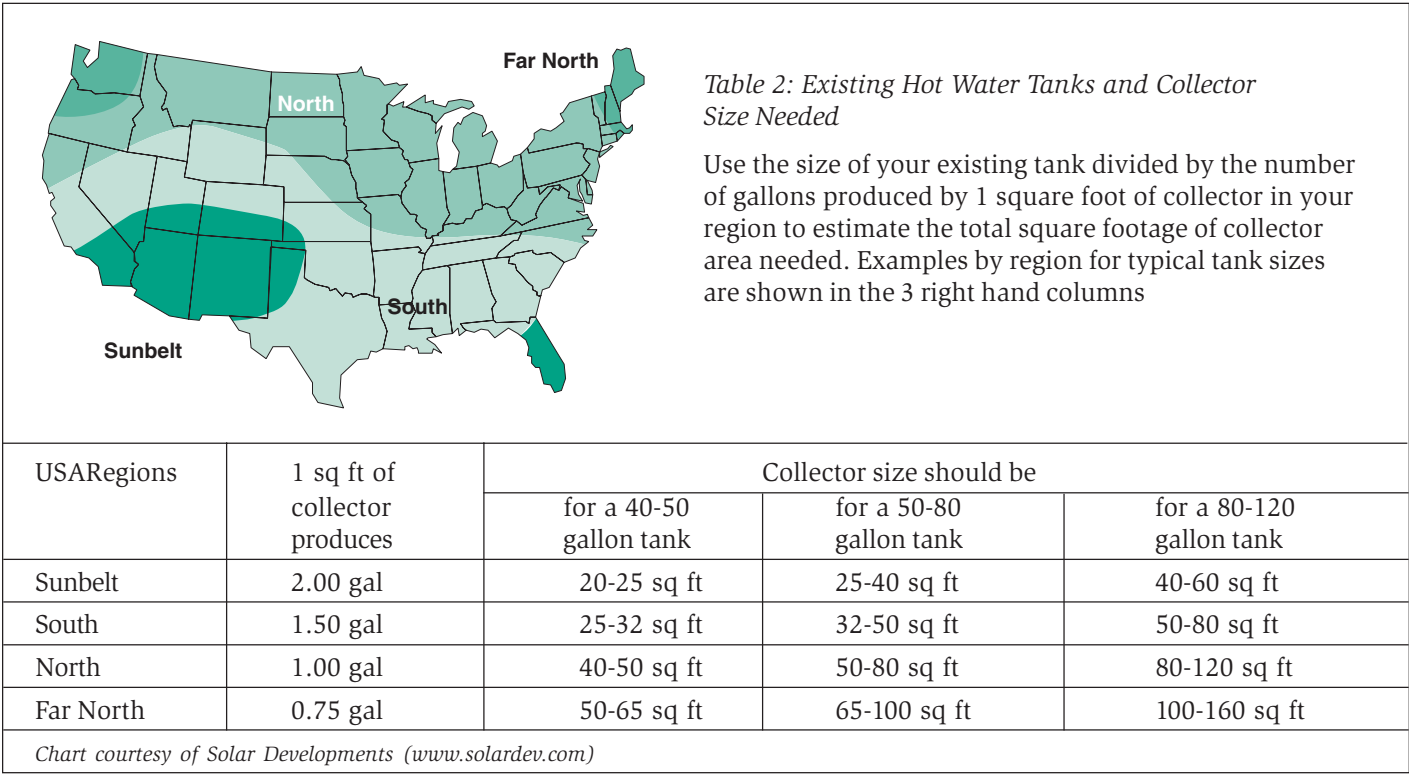
\$2,220. The one-time cost to install a solar hot water system to meet that same demand is as low as \$6,000. This means that the payback time for the solar system can be less than three years. Thereafter, the solar system saves the hotel over \$2,000 each year. (www.solardev.com)

To get an idea of how much you will save, subtract the amount of heat your new system will produce from your current annual consumption—the total amount of electricity and gas you use. Data on your current annual consumption should be available from your utility.

Financial incentives

As part of the Energy Policy Act of 2005, federal tax credits are available for solar hot water systems, excluding solar pool heating. For businesses, the tax credit is 30% with no cap. Systems must be placed into service between January 1, 2005 and December 31, 2007. However, keep apprised of legislation to extend this period.

To find out about solar incentives in your state, visit the Database of State Incentives for Renewable Energy (DSIRE) at www.dsireusa.org, and contact your state's energy office. Your local utility can tell you about financial assistance available in your area.



Function and Options

For year-round water heating in areas where freezing occurs, an indirect or drainback system with glazed collector and anti-freeze protection is needed, *see Figure 3*. If you will only be heating your shower water during the warm outdoor swimming season, you may consider the less expensive, more efficient direct system with a glazed collector, *see Figure 2*.

Sizing

Adopting water and energy efficient measures will help reduce the size, and thus cost, of the system. For example, low-flow shower heads, aerators, and front-loading washing machines can drastically reduce the amount of hot water used. Insulating water tanks and pipes helps reduce the amount of heat loss.

Size the collector to match the existing tank's storage capacity. A general rule is 10-15 square feet of solar collector area for each person in the household, and 20-30 gallons of water storage per person. *Table 2* is an example of how one solar pool supplier gives a rough estimate of necessary collector size.

Durability

Properly designed and installed systems with glass-covered collectors should perform well for more than 20 years. The solar system should be certified by the SRCC. The pump and hot water tank may have to be replaced after 10 years, as with conventional water heaters. Water tank replacement costs are not unique to solar water heating systems.

Other Considerations for Solar Water and Pool Heating Systems

Building Codes and Regulations:

Before installing the system, you should investigate local building codes and zoning ordinances, as well as any special regulations pertaining to the site. Even if a statewide building code is in effect, it's usually enforced locally. You will probably need a building permit to install a solar water or pool heating system onto an existing building.

To check the status of state energy codes, consult the DOE Building Energy Codes Program at www.energycodes.gov.

Choosing a Solar Contractor

Visit the Solar Road Map at www.southface.org/solar to find contractors in the Southeast. To find contractors in other parts of the U.S. and Canada, visit Findsolar.com. Get several estimates, and compare the amount of collector area specified by each contractor. Ask how much experience they have installing and maintaining the type of system you want. Request references and a valid plumber's and/or solar contractor's license, if required by your state and local contractor licensing board.

The North American Board of Certified Energy Practitioners (NABCEP) is considering development of a certification/license for solar thermal professionals. Currently, NABCEP only certifies photovoltaic (PV) installers.

Additional Resources

For more information on solar water and pool heating, contact:

American Solar Energy Society

Solar Today Magazine
2400 Central Ave., Ste. A
Boulder, CO 80301
(303) 443-3130
www.ases.org/solar

Database of State Incentives for Renewable Energy (DSIRE)

www.dsireusa.org

Florida Solar Energy Center

Public Information Office
1679 Clearlake Rd.
Cocoa, FL 32922
(321) 638-1000
www.fsec.ucs.edu
Findsolar.com

Home Power Magazine

PO Box 520
Ashland, OR 97520
(541) 512-0201
www.homepower.com

Interstate Renewable Energy

Council (IREC)
P.O. Box 1156
Latham, New York 12110-1156
(518) 458-6059
www.irecusa.org

National Renewable Energy Laboratory (NREL)

1617 Cole Boulevard
Golden, CO 80401
(303) 275-3000
www.nrel.gov

North American Board of Certified Energy Practitioners (NABCEP)

10 Hermes Rd. Suite 400
Malta, NY 12020
(518) 889-8126
www.nabcep.org

North Carolina Solar Center

Box 7401
North Carolina State University
Raleigh, NC 27695-7401
(919) 515-5666
www.ncsc.ncsu.edu

Solar Energy Industries

Association (SEIA)
805 15th St. NW, Suite 510
Washington, DC 20005
(202) 682-0556
<http://www.seia.org>

Solar Rating and Certification Corporation (SRCC)

www.solar-rating.org

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Atlanta, GA 30308
(404) 872-3549
info@southface.org
www.southface.org

U.S. Department of Energy

Energy Efficiency and Renewable
Energy (EERE)
www.eere.energy.gov

References

Canadian Renewable Energy Network – www.canren.gc.ca

Colorado Solar Energy Industries Association –
www.coseia.org

Florida Solar Energy Center – www.fsec.ucf.edu

Southface Energy Institute – www.southface.org

U.S. Department of Energy, Office of Energy Efficiency and
Renewable Energy – www.eere.energy.gov

Footnotes

¹Source: <http://www.solardirect.com/ph/ph-faq/ph-faq.htm#cost-operate>

²Source: <http://www.solardev.com/SEIA-takingcare.php>