Florida Solar Energy Center

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Solar Swimming Pool Heating in Florida Collector Sizing and Economics[1]

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POOL HEATING

There are over 200,000 swimming pools in Florida, and most of them must be heated during winter months to maintain comfortable swimming conditions. For the average user, temperatures ranging from 78°F to 80°F for spring and fall and 76°F for winter are usually considered comfortable. This publication presents a simple method that can be used to determine the solar collector area (within ± 20 percent) needed to heat a swimming pool to comfort conditions assuming average weather patterns.

Collector Sizing

Define "R" as the ratio of square feet of collector area needed divided by the pool surface area.

$$R = \frac{\text{collector area}}{\text{pool surface area}}$$

An R of 1.0 corresponds to the collector area being equal to the pool surface area. An R of 0.5 corresponds to a collector area half the size of the pool surface area. Most of the heat loss from a pool occurs at the water's surface; the amount of solar heat put into the pool depends on the size of collector used. A higher R value means more heat gained, warmer water, and a longer swimming season. Table 2 shows typical R values for different regions of Florida and for various swimming seasons.

To size the collector, first determine if the pool is screened or not. Find the appropriate R value from Table 2 and multiply it by the surface area of the pool. The result is the approximate collector area needed.

A screened pool with a cover in Orlando has an R value of 1.05 for year-round (i.e., 12-month) swimming. If the pool dimensions are 30' × 15', or 450 square feet of surface area, the pool needs (1.05 × 450 = 472.5) about 470 square feet of solar collector.

The values in Table 2 are applicable for covered pools only. If you heat a pool use a pool cover. Not to do so is much like heating a house without a roof — the heat just goes right out the top. Use of a cover retains

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more than two-thirds of the collected heat needed to maintain a comfortable swimming temperature. For safety reasons, covers should be completely removed before swimming. Manual and powered rollers are available for removing and replacing the cover.

Table 2. R values for two common pool configurations in Florida.

Region	Months of Swimming Covered/Unscreened Pool				Months of Swimming Covered/Screened Pool			
	9	10	11	12	9	10	11	12
N. Florida	.47	.68	.80	.94	.80	1.0	1.10	1.25
C. Florida	.37	.55	.65	.75	.70	.85	.95	1.05
S. Florida	.25	.40	.50	.60	.55	.68	.75	.83

If a pool cover is not to be used, determine the R value as before for a screened or unscreened pool. Then multiply this value by 2.9 for a nine-month swimming season, 2.4 for a 10-month season, 2.2 for an 11 month season, or 2.1 for a 12-month swimming season.

For the previous example, about 470 square feet of solar collector area were required if a cover was used. For an uncovered pool, multiply by 2.1 (470 × 2.1 = 987). About 990 square feet of collector area are required. The importance of pool covers should be quite apparent.

Economics

Knowing the collector area, we can calculate its heat energy output as follows.

Energy (in BTU*) =	collector rating** (BTU/ft^2) x collector area (ft^2) x number of days system is utilized per year

** British thermal unit. One Btu is the amount of heat required to raise one pound of water one degree Fahrenheit and is about equivalent to the amount of heat produced by an ordinary kitchen match.*

*** Collector rating (BTU/ft^2) is the measured heat output of the particular collector to be used. It can be obtained from the Florida Solar Energy Center's publication: "Thermal Performance Ratings (Pool Collectors)" FSEC-GP-16-85. If the annual collector rating is unavailable, use 850.*

This formula gives the energy provided by the solar system, which is also equal to the energy that would be required from a fossil-fueled or electric pool heater to maintain the same comfort level.

Table 4 presents the approximate number of days the pool heating system must be operated for different regions of Florida.

Table 4. Approximate days of heater operation.

Region	Months of Swimming			
	9	10	11	12
N. Florida	150	180	210	240
C. Florida	120	150	180	210
S. Florida	90	120	150	180

For our 30' × 15' covered pool in Orlando, we have found that we need 470 square feet of collector for a 12-month swimming season. Say we select a panel that produces 882 Btu/ft^2. Using our formula, the swimming season usable heat production of this solar system would be:

Btu = 882 × 470 × 210 = 87,053,400 Btu
or about 87 million Btu (MMBtu)

Energy Savings

The annual energy cost savings can be calculated, knowing the cost of gas or electricity in dollars per million Btu ($/MMBtu). Table 5 gives the cost of natural gas, propane, fuel oil and electricity (for typical gas or oil heater efficiencies of 60 percent and electric heater efficiencies of 100 percent).

For costs of fuels and electricity other than those presented in Table 5, use ratios to compute the approximate values.

In the previous section, we found that our example 30' × 15' pool requires about 990 square feet of

Table 5. Cost different fuels ($/MMBtu).

Fuel	Purchase Price* in Traditional Units	Cost** in $/MMBtu	Cost** in $/therm***
Natural gas	55¢/therm	$9.13	$0.91
Propane & LPG	$1.25/gal	$22.81	$2.28
Electricity	8.9¢/kWh	$26.08	$2.60
Fuel oil	$1.15/gal	$13.69	$1.37

* Purchase price as of May 1984.
** These costs reflect the efficiencies of gas and oil heaters.
*** 1 therm = 100,000 Btu.

Table 6. Simple payback periods for solar pool heating.

Fossil Fuel Replaced	Annual Savings	System Cost of $2,500	System Cost of $3,500
Natural gas @ 55¢/therm	$795	3.1 yr	4.4 yr
Propane & LPG @ $1.25/gal	$1980	1.3 yr	1.8 yr
Electricity @ 8.9¢/kWh	$2270	1.1 yr	1.5 yr
Fuel oil @ $1.15/gal	$1190	2.1 yr	2.9 yr

collector panel if no cover is used for a 12-month swimming season. With a cover, only 470 square feet of collector area are needed. A typical price for solar pool system is about $6 per square foot of collector area. Therefore, the system would cost about $2,800. It may be necessary to shop around to get a system price lower than this, but one should be available for less than $3,500.

We have determined that this collector would produce about 87 million Btu per season. By multiplying the cost of a million Btu from Table 5 ($MMBtu) for each type of fuel, you can calculate the annual savings or equivalent cost of fuel provided by the solar heater.

For example, for natural gas:

87 MMBtu × $9.13/MMBtu = $795.

By dividing these annual savings into the cost of the system, we can find the simple payback period for the system. For example: $2,800 ÷ $795/yr = 3.5 years.

Table 6 presents simple payback periods for $2,500 or $3,500 solar systems of about 470 ft^2 collector area compared to various fuel alternatives.

Table 6 obviously shows the economic attractiveness of solar pool heaters. It also shows the tremendous use of energy and cost of heating a pool by other means. If you plan to heat your swimming pool in Florida, solar's the way to go.

For more information on solar pool heating in Florida, you may wish to write the Florida Solar Energy Center Public Information Office. They provide the following publications free of charge:

FSEC Approved Solar Energy Systems: Domestic Hot Water and Pool Heating; Order no. FSEC-GP-15- 85.

Florida Solar Industry Directory; Order no. FSEC-GP-2-85.

Solar Heating of Swimming Pools: A Question and Answer Primer, Charles J. Cromer; Order no. FSEC-EN-6-80.

Thermal Performance Ratings (Pool Collectors): Order no. FSEC-GP-16-85.

Turning on the Sun: A Comprehensive Consumer Guide to Solar Water Heating, Colleen McCann Kettles; Order no. FSEC-GP-1-81.