What goes into an Energy-Efficient Spa or Hot Tub?

Prospective and current owners of spas or hot tubs need information about energy-efficiency features so they can make informed decisions when they are ready to buy or upgrade.

Many people base their purchasing choice on the lowest retail price. Often, this has an immediate—and negative—effect on their monthly electric bill. Fortunately, there are features available that will reduce energy use and lower their operating costs.

According to the National Spa and Pool Institute, spas consume an average of 2,514 kWh per year, making the average cost of heating it more than $250 a year (at 10 cents/kWh).

According to a spa study by the Davis Energy Group[1], if you own a spa, it is the biggest electrical consumer in the house. Until recently, unbiased information on spa energy use was very difficult to find. Consumers Union (publisher of Consumer Reports) has not rated spas.

The test data from one study, *Thermal Performance Test of Spas*[2] is shown in Table 1 (see page 2). California now regulates spa energy use (Title 20, Appliance Efficiency Regulations). As a result, a hot tub testing program[3] is underway at California Polytechnic University (Cal Poly). While the new California standard is not especially stringent, it should eliminate the least-efficient spas over time and provide a consistent standard by which to compare spas on the market. Other states are considering similar standards.

How spas and hot tubs use energy

To understand how to reduce operating costs, start by learning how spas and hot tubs use energy. They typically use electric energy to heat and continuously circulate the water, and a very small amount of electricity for lighting. Tubs are covered and unused more than 95 percent of the time, yet this is when they use 75 percent of their energy. Thus, energy conservation starts at this “steady-state” mode and at reducing heat losses from the cover and walls. While most of the energy used in spas goes into the heater, the energy for pumping is also significant.

When the cover is removed and the tub is in use, heat losses increase six-fold or more. If the jets are activated and a couple of people get into the tub, evaporative heat losses from the surface increase even more. Pumps for the high-speed jets use many times the energy of circulating pumps. An activated air pump or bubbler increases heat loss beyond the capacity of most heaters, and water temperature begins to drop.

Features to consider

When considering the energy efficiency of a spa or hot tub, the key elements to look at are the cover, tub wall insulation and pump system efficiency.

- **Cover –** The insulation value of the cover and the tightness of its seal to the tub are the most important construction details in terms of overall energy use. Designing a cover that is well insulated, provides a good air sea, and is light enough for a single person to handle is a real challenge.

  The warm, humid air trapped between the cover and the water surface is rich in energy – a small air leak in the seal increases evaporation from the water surface, bypassing the cover’s insulation and increasing heat loss from the tub. The cover insulation should be good-quality, closed-cell foam that will not absorb water. It should be supported adequately so it does not sag in the middle, and one person should be able to remove it alone.

  Some insulation absorbs water as the cell structure breaks down from chemicals used in the tub. If the manufacturer offers a “premium” or “upgraded” cover with a longer useful life and higher R-value, it is usually a very good investment.

  If you currently own a tub and notice that the cover is becoming heavier from water saturation, replace it – water-logged insulation loses effectiveness and wastes costly energy.

- **Tub walls –** Spa and hot tub walls are not always insulated to optimum levels, so they can be a significant source of energy loss.

  Thermal insulation can perform two different functions: reducing heat losses and, if it is rigid foam insulation, physically supporting the tub. As insulation thickness increases, the benefit from each additional unit of insulation decreases relative to its cost. These diminishing returns make the optimum insulation thickness somewhere around six inches, depending on the average ambient temperatures and energy costs.

Some spas and hot tubs use a two-inch layer of rigid foam insulation and fill the rest of the cavity with fiberglass insulation; this saves a few dollars—until it gets wet. Then the insulation value drops almost to zero, significantly increasing in your electrical bill.

- **Pumps –** The circulator pump(s) move water through a filter and heater continuously during steady-state operation. Some tubs have a two-speed motor, using the same pump for low-speed circulation in steady-state mode and for high-speed operation when the jets are on. These pumps are not usually very efficient in any mode, but particularly in steady state because the motor is very lightly loaded and running at low efficiency most of the time. Since these are air-cooled motors, getting rid of the waste heat from the motor in the summer is a problem too.

  Some manufacturers use separate pumps for circulation and jets. While initial costs are slightly higher, this helps optimize the circulation pump and can yield good savings during steady-state operation.

Table 1. Preliminary spa energy performance results

Product Name	Volume* Liters	Volume* Gallons	Measured Watts*	Standby Watts	CA Title 20 pass /fail**
Beachcomer, 740	1474	389.4	200	266.6	pass
Sundance Cameo	1719	378.9	260	261.8	pass
Coast Spas, Lanai Silver	1434	454.2	352	295.4	fail
Arctic Spas, Kodiak SS-1	1478	390.5	199	267.1	pass
Hotspring, Vanguard	1288	340.3	135	243.7	pass
Arctic Spas, Coyote C-60	1579	417.2	193	279.2	pass
Cal Spas, Atlantic	1476	390.0	503	266.9	fail
Arctic Spas, Kodiak SS-2	1579	417.2	149	279.2	pass

* Data from Thermal Performance Test of Spas, Advanced Materials, Advanced Research Council, Inc., Edmonton, Alberta CANADA, 2004.

** Fact sheet will be updated as additional results become available.

Potential savings

A few studies have looked at the potential for reducing spa energy use.[4, 1] The Davis study estimated the long-term savings of several efficiency measures:

- Improving spa covers is estimated to save 10 percent, or about 250 kWh annually – the same amount of energy as improving tub insulation.
- More efficient pumping systems save even more – 15 percent, or about 375 kWh/yr.
- Improved controls can save an estimated 5 percent, or 125 kWh/year.

If you are paying .085/kWh for electricity, you can save $21/year with spa covers, another $21/year with tub insulation, $32/year with improved pumping systems and about $11/year with improved controls. Other than replacing the cover, these efficiency improvements will only be available at the time of purchase – so make sure you take advantage of them. More efficient pumping systems would include a separate pump for continuous circulation. Improved controls would incorporate the ability to set back tank temperature and minimize other electrical uses.

For more information, check out the publication Hot Tub and Pool Conservation Tips at **www.energyideas.org/documents/factsheets/spatips.pdf**

End notes

1. *Codes and Standards Enhancement Initiative for PY2004: Title 20 Standards Development, Analysis of Standards Options for Portable Electric Spas.* Prepared by the Davis Energy Group and Energy Solutions, San Francisco CA, Pacific Gas & Electric, 2004.
2. *Thermal Performance Test of Spas* Advanced Materials, Advanced Research Council, Inc., Edmonton, Alberta, Canada, 2004.
3. "Hot Tub Energy Efficiency Testing Begins (Update)," Spring 2008. **www.apsp.org/clientresources/documents/hottub-testing-begins.pdf** The Cal Poly test consists of bringing the spa to 102°F in a 60°F room and holding it there for four hours. The test starts at the end of the first heat cycle and ends at the end of the last heat cycle after 72 hours have elapsed. At the end of the test, the total energy use is divided by the total number of hours. The result in watts can be no more than 5 x V2/3 (where V is the volume of the spa in gallons).
4. Opportunities for Appliance and Equipment Efficiency Standards in Texas American Council for an Energy-efficient Economy and Appliance Standards Awareness Project, September 2006. **www.seco.cpa.state.tx.us/zzz_sa/sa_codesappliancestandards.pdf**

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