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Solar-powered chlorination of swimming pools

Fact sheet
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Allchlor Pty Ltd

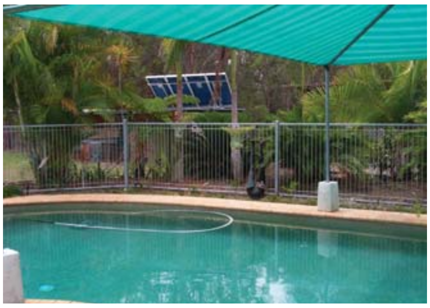
QSEIF funding:

$108,950

With Queensland's tropical and sub-tropical climates, swimming in private and public pools has become an integral part of our culture.

About 25,000 new in-ground pools are installed each year in Australia. Maintaining a well-filtered and sanitised pool requires a considerable amount of energy. During summer months, a typical backyard swimming pool in Queensland would use half as much electricity as all other appliances in the household combined. Besides pumping and filtration, electricity is also used increasingly to generate chlorine in salt-water pools to kill bacteria and prevent growth of algae.

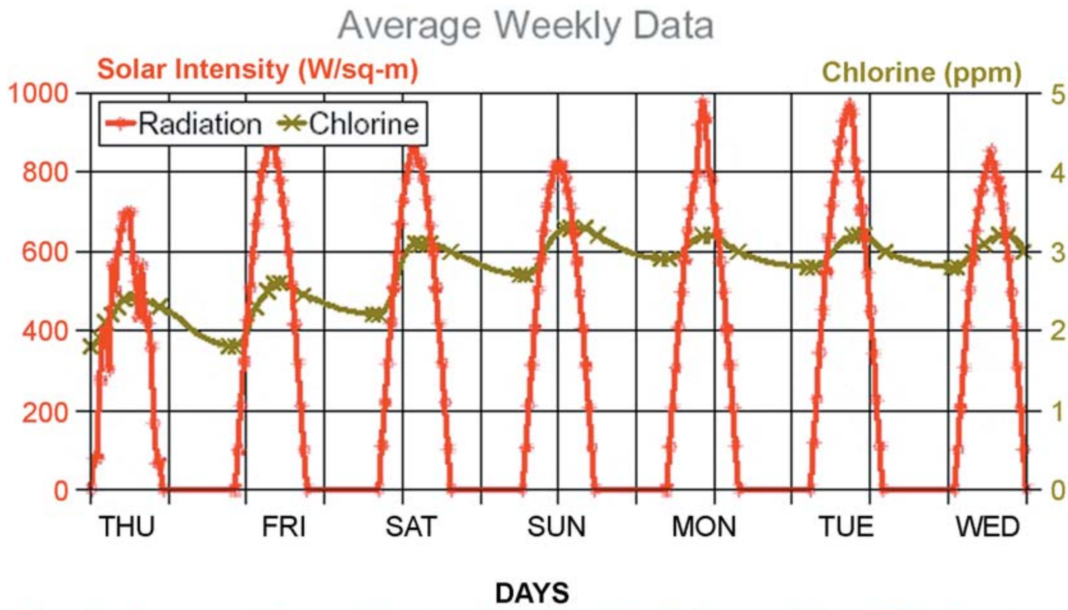
A standard backyard swimming pool with a motor-driven pump uses about one kilowatt of power, and a chlorinator unit uses about 350 watts. The pump and chlorinator might



operate for ten hours a day in summer, and four to five hours a day in winter. Thus, annual energy use would typically be about 3000 kilowatt-hours at a cost of about $350. (Larger pools operated by local councils or private fitness clubs might have several times this energy requirement.)

Because swimming pools have their greatest need for chlorine on sunny days, the energy requirements for pool chlorination are a near-perfect match with solar power production. Enough chlorine can be produced when the sun is shining to maintain chlorine levels throughout the night so batteries or back-up systems are generally not required.

The ideal match between pool chlorine requirements and solar power availability was recognised by Dr Kame Khouzam, a lecturer in Electrical Engineering at Queensland University of Technology (QUT). He noted that existing power supplies for chlorinator units, operating off mains voltage, were only about 50 percent efficient and provided poor regulation and overload protection.



Results Represent Annual Average Levels of Radiation and Free Chlorine at Salt Concentration of 6,000 ppm.

After undertaking initial trials in QUT's laboratories, Dr Khouzam approached Allchlor Pty Ltd, a small manufacturer of chlorinator units. Together they successfully sought funding through the Queensland Sustainable Energy Innovation Fund (QSEIF) to develop, trial and optimise solar-powered pool chlorinator units for commercial application in public and household swimming pools.

The project required Allchlor and QUT to install solar-powered chlorination systems at six public and private pools, and to monitor chlorine levels, solar radiation, pool usage and responses by pool operators.

A number of project conclusions include:

- Household pools required solar power capacity of 25 to 30 watts to chlorinate each 10,000 litres, or about 125 to 150 watts for an average size pool. In public pools that are intensively used, solar capacity of 45 watts per 10,000 litres is needed (slightly more for heated pools).
- If the system is properly sized, little or no back-up power is required for cloudy periods. A back-up chlorination system (either operating the chlorinator on mains power or adding granular chlorine to the pool) is only required when daily solar radiation falls below 2 kWh/m^2 for several consecutive days (compared to average daily solar radiation of 5.5 kWh/m^2). During the trial, one pool installation operated without any back up for more than a year.
- Two potential problems to avoid during installation are:
  1. Shading losses due to neighbouring buildings or trees, depending on the layout of the specific site.
  2. The length of cable from the solar modules to the chlorinator unit should be limited to six metres where possible, and heavy gauge wire should be used to reduce power losses in the cables.
- In installations where both the pump and chlorinator unit are solar-powered, mains or battery back up are required for cloudy periods to maintain water filtration.

Existing power supplies of some pool systems were difficult to integrate with solar power, so as to achieve maximum advantage of solar power production. Based on experience gained during the project, QUT developed and tested a prototype power supply unit that operated on two power sources, using mains power only when insufficient solar power was available. The power supply unit included sensors to activate the motor pump and chlorinator, and to reverse the polarity of the chlorinator cell (to minimise the need for cleaning).

The advantages of solar-powered chlorination are:

- savings in electricity costs, providing a simple payback for the cost of the solar power system in about five or six years;
- reducing greenhouse gas emissions (as well as regional air pollution) by about 800kg of carbon dioxide each year;
- limiting distribution of electricity at mains voltage around the pool, providing a potential safety benefit; and
- opportunity to integrate the solar modules within a structure shading the pool and reducing chlorine loss.

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