Here Comes the Sun

Solar Boat travel in Chichester Harbour, West Sussex

Solar Boat at Emsworth Food Festival, Sept 2004

The launch of the solar powered catamaran, *Solar Heritage*, was celebrated in May 2004 by Chichester Harbour Conservancy (CHC) in Chichester Harbour, West Sussex, as one of their flagship projects for 'Rhythms of the Tide', a series of more than 40 projects financed by the Heritage Lottery Fund.

The objectives of Rhythms of the Tide included increasing people's knowledge and awareness of issues and information about many different aspects of Chichester Harbour. The intention was to give visitors a better idea of how the harbour functions from the viewpoints of both land and sea, and to impart a sense of understanding to younger listeners – the future custodians of the area.

Solar Heritage is used to operate both public and school trips for environmentally aware tours of Chichester Harbour, a designated Area of Outstanding Natural Beauty. Approximately 2000 people toured the Harbour in the first year. Talks onboard tell you more about the villages and natural environment of the local area, and visitors are shown the sites first hand from the quiet, environmentally sympathetic confines of the solar powered boat.

Wheelchair bound people are also able to take part, thanks to a hydraulic wheelchair ramp contributed by the Friends of Chichester Harbour.

Solar Heritage is the first of its kind on the south coast of England, and one of very few commercially operated solar powered tour vessels in the UK. She began life as a Solar powered ferry operating out of Neuchatel in Switzerland's Three Lakes Region (Les Trois Lacs), as part of the Swiss 2002 National Exposition devoted to Nature and Technology.

Three solar powered ferries carried passengers between an exhibition in mid lake (called the Monolith), and the lake side on a continuous basis for six months between May and October 2002. The exhibition was devoted to Alternative Energy, and part of the reason for obtaining a solar powered boat by CHC was to heighten local awareness of and stimulate interest in these matters.

Solar Power: What is it?
Solar power is energy from the sun and since almost the beginning of man, solar power has been used for drying clothes and producing food.. The sun is 150 million kilometres away, but it is over 1 million degrees Celsius at the core. If we could harness it, there is enough solar power reaching the earth to provide our global energy needs 10,000 times over. Photovoltaics is one method of doing this.

Photovoltaics (photo=light, voltaics=electricity). PV is a semiconductor-based technology used to convert light energy into direct current (dc) electricity via solar panels. No moving parts are necessary, conventional fuels are not required, and no pollution is created, hence its appeal to the environmental lobby. The image here is a basic illustration of where solar power and conventional electricity merge in the Solar Boat system.

How do solar panels work?
A solar panel normally has between 32 and 38 solar cells that convert captured sunlight into electricity. A cell about four inches in diameter will produce a little more than one watt/ half a volt of direct current (DC) power per hour of direct sunlight. Linking the panels together produces the required voltage.

Solar Cells
Solar cells were originally developed to provide electrical energy for space missions and are 'first cousins' to transistors and LEDs (Light Emitting Diodes). The cells themselves are constructed from semi-conducting materials, in this case silicon.

Silicon is electrically neutral and requires the addition of impurities to create the positive and negative charges responsible for an electrical current. The bottom layer of the solar cell is mixed with a small quantity of boron to make it positive, while the top layer of the cell contains phosphorous making it negative. The interface between these two layers creates an electrical field known as a junction.

Light consists of photon particles. When light hits a solar cell some of the photons are absorbed, which then knock electrons loose from the silicon atoms allowing them to flow freely (electrons occur naturally in all materials.) If the photons have enough energy when they hit the top layer of the solar cell they are able to hit the electrons hard enough to overcome the electrical field at the junction allowing them to move through the bottom layer of silicon into an external, electrical circuit. As they flow through the external circuit, they give up their energy to the batteries or directly to the motor before returning to the solar cell, completing the electrical circuit.

Cells are usually joined together in groups and covered with a transparent material, such as tempered glass, to form panels, which can generate about 50 watts in bright sunlight - the solar boat requires 48 watts to operate. Panels, in turn, can be joined to form arrays, which can be arranged to generate an unlimited amount of power.

Questions are often asked regarding operation in cloudy conditions. MW Lines have tested their vessel at night and claim it will even pick up an electric charge from moonlight!

How does daylight power the boat?
Two energy sources are used – electromagnetic energy from the sun and conventional energy from the National Grid introduced via a shore mounted 3 phase electricity supply.

Each hull contains its own electrical system independent of the other. Each hull system has its own dedicated solar array from which solar energy is derived, but the 3 phase arrives through one source and is then split between batteries in each of the two hulls.

The battery drives the two electric motors, also one in each hull. Both have their own independent propeller and rudder, though these are linked to the same steering system in the wheelhouse.

A charge controller (C-Series Controller) regulates the continuous electrical input from the photovoltaic array to the 48v rechargeable battery. This protects the batteries from either overcharging or overdischarging, both of which could cause damage.

For domestic use the DC supply is usually converted to AC to blend with electricity supplied by the National Grid, and used to power household appliances. However on the Solar Boat DC is suffucient for most needs – and a converter converts 48 volts to 12 volts that are then stored in a 12 volt lead acid battery on the starboard side, and used to operate the various systems on the boat requiring 12 volts (charging system indicators, battery monitoring display, wheelhouse display).

The exception is the inverter responsible for changing 48v DC to 240v AC. This powers the 240v system operating cooling fans within each hull.

This image shows the components themselves – such as steering station, batteries and electric motors. Everything is extremely clean in comparison with their equivalent on a petrol or diesel driven vessel.

Steering System
The steering system is comprised of two rudders, one in each hull. These are hydraulically operated from the main wheel in the wheelhouse. Also seen here are the throttles, these are linked to a throttle management system on the engine housing and can be operated independently to give tighter turning circles and greater manoueverability.

In the photograph, *Solar Heritage* is moving forward, though this is not hugely apparent due to the lack of either bow wave or wake. This is a notable feature of the vessel due to the twin hull configuration, hence her suitability for an estuarine environment where the damaging effects of bow wave induced erosion are a consideration.

The vessel creates little noise, reducing noise pollution for people and making the vessel less intrusive towards wildlife. This has been particularly noticeable on the Bird-watching trips where birds have displayed complete nonchalance towards the vessel.

MW Lines
Solar Heritage was produced by MW Lines, a Swiss manufacturer specialising in the design of Solar powered vessels and vehicles used in many European countries. Her motors were designed and made in Britain however, demonstrating a useful collaboration between the UK and her European partners.

Known by her manufacturers as an Aquabus C60, the vessel can reach 11 knots while transporting 60 people. This makes her ideal for use in Chichester Harbour where speed is restricted to 8 knots and the passenger license issued by the Maritime & Coastguard Agency permits a maximum of 50 passengers.

Arrival
Solar Heritage arrived in Itchenor on Wed 21st April 2004, after a 24 hour drive across Europe on 3 articulated lorries. On arrival she was reconstructed near the Conservancy by Swiss engineers provided by MW Lines, and launched one month later.

The Solar Boat proved increasingly popular with both public and schools. Most subscribe to the benefits of using an electrically driven Solar Powered catamaran as opposed to more conventional fuel driven vessels.

These can be summarised as follows:

- Silent running – therefore no disturbance to birds, animals or humans
- No exhaust emissions – therefore no CO^2 contribution to greenhouse gases
- The twin hull configuration contributes two major benefits; tremendous stability and no wash. The lack of wash reduces salt marsh erosion and estuary bank erosion.