

Sun, sails and a sea breeze – it's all a modern ferry needs, says Tim Thwaites

Hello, solar

● THIS is surely a Hollywood movie-in-waiting. It's a heartwarming story about a country doctor with an obsession for sailing, the generosity of the people in the small town where he lived, and an absurdly simple idea that has made some of them a lot of money. The story even has exotic locations: it begins in a charming Australian seaside town and ends at Alcatraz in San Francisco Bay. And the star of this tale? A boat with wings.

Not that it flies: the wings are solid sails covered with solar panels. These allow the boat to harness both wind and sun, and thereby use anywhere up to 90 per cent less fossil fuel than similar vessels. It runs pollution-free when it can, and the concept, known as solar sailing, will work for everything from cruise boats and ferries to bulk carriers and uncrewed surveillance craft. The first solar sailing ferry has been operating in Australian waters for six years now and its designer has just won a contract to build another – this time to carry passengers between San Francisco Harbor and Alcatraz Island, the world's second busiest ferry run. Solar sailing is about to hit the big time.

The solar sailing story began a decade ago when Robert Dane, a doctor in the fishing town and seaside resort of Ulladulla in New South Wales, found himself on the shores of Canberra's Lake Burley Griffin. He was watching the city's annual race for solar-powered boats and, as a keen sailor, was sorely disappointed by the spectacle. As far as he could tell, it was nothing more than a bunch of boffins piloting boats clumsily loaded with banks of solar cells. There was no feel for sailing, no integration of the solar technology with the boats and no understanding of what it takes to push a vessel efficiently through

water. The winning boat had a panel that tilted to the sun but, as soon as the wind got up, the panel became a liability and had to be pulled down. Surely, Dane mused, there was a way to use sun and wind at the same time.

As a sailor, Dane knew all about harnessing the wind. It occurred to him that he could outstrip anything he had seen in Canberra if he had a boat that not only had a solar-powered electric motor but could sail too. Thus the concept of solar sailing was born.

The concept was one thing; designing such a craft is another matter. How could you make best use of the ocean's abundant sun and wind



to power a modern, seaworthy boat? The answer came while Dane was reading a book about evolution. The passage that grabbed his attention was about the development of flight in insects. Insect wings, the book asserted, grew from structures that had nothing to do with flight. The large flaps that eventually became wings initially served to absorb heat from the sun to power an earlier start to the day for a cold-blooded animal. Those flaps could also catch the wind, so as a spin-off they allowed insects to glide away from predators and other dangers. It was but a short step from there to active flight.

It was another short step for Dane to envisage a boat sporting wings covered with solar cells, which could track both wind and the sun. If the weather became too rough, then – just like a beetle – the boat could fold its wings away. He patented the idea, and sold his medical practice to devote all his energies to the ambitious new project. “The plan was to win the solar boat race, build a boat for Sydney Harbour for the 2000 Olympics and commercialise the technology,” Dane says.

Dane’s plan was big news in Ulladulla, and the local paper ran a story about their doc’s

crazy scheme. The publicity provided Dane with his first supporter. Marjorie Kendall, a dairy farmer and solar power enthusiast, read about Dane’s ideas and invited him over. Kendall used sunlight to power electric pumps on her farm, and when Dane visited, the pumps were “blasting water from a creek like a fire hose”, he recalls. He was convinced his idea would work.

Kendall also convinced him of something else: if he was serious he would need to form a company to commercialise his innovation, and to encourage people to invest in it. She became his first shareholder.

Other locals soon became involved. Dane showed neighbourhood surfboard craftsman Bruce Heggie a sketch of the solid wings for his boat and asked if he could make them. “No worries,” Heggie said. Dane sourced lightweight photovoltaic cells from BP in Sydney and recruited a local model-maker and

On sun alone the Solar Sailor cruises at 5 knots. Raising the sails can add another 3 knots

railway enthusiast, a man who could weld and solder with the best of them, to attach the cells to Heggie’s wings.

Dane needed some sort of movable mechanism to allow his wings to move in two dimensions to track the sun and wind. Being a doctor, Dane immediately thought of a shoulder joint, and Butch Johnston, a boatbuilder and Sydney-to-Hobart yacht race sailor, assured him he could handle adapting the idea. Then an ad in the paper drew out a computer whizz who had just quit his job at British Aerospace to become a Buddhist monk. He knew how to manage projects, and took over coordinating the local workers. The people of Ulladulla invested time and money in return for one-dollar shares – although Dane paid some in cash, he also handed out ▶

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bits of paper to about a dozen people: a thousand shares for a week's work. When the boat was finished, Dane christened it the Marjorie K in honour of his first investor.

In the end, it didn't win the Canberra race. The Marjorie K came in first all right – in fact, it lapped all the other contenders five times. But unfortunately in doing so it had a minor collision with another entrant, and was relegated to second place.

Dane wasn't concerned. He had proved the worth of his idea, and the solar boat race was just the first step in his campaign. He was now an entrepreneur with a proven product to sell.

One of his first steps towards commercialising the boat was to contact Grahame Parker, a naval architect whose sleek, slim, low-wash ferries plied the Brisbane River and Sydney's Parramatta River. Parker was quickly convinced that solar sailing technology could be incorporated into his designs and scaled up to commercial level. "It's not a high-speed solution – the boat needs to carry quite a bit of weight," Parker says. "But water's good with that. It's flat: there are no hills to go up."

Much of the Solar Sailor's weight comes from the bank of batteries it uses to store the energy from the solar panels. That's not a problem in a boat, though, because their weight provides ballast. What's more, the electric motor they power can drive the propeller directly. A standard marine engine requires a gearing system between the engine and the propeller's driveshaft. The absence of gearing makes the boat efficient and incredibly easy to manoeuvre. "It was my first experience with electric motors on a boat and they're fantastic," Parker says. "There's full-on torque straight off, you can reverse them instantly and you can't stall them. It's nice to know you can just pump it in reverse and she'll pull up in a matter of moments."

Scary money

With concept drawings from Parker in hand, Dane began to trawl Sydney for money to build a ferry for the tourist market. It took 18 months to secure A\$2 million (US\$1.5 million), enough to start construction on a 100-seat boat. The total cost would be A\$3 million, which made things a little scary until, three months before launch, the Australian Greenhouse Office – which handles national climate change programmes – came good with a grant of A\$1 million. The Solar Sailor sailed into Sydney Harbour in June 2000, just in time for the Olympics.

The ferry has been serving the charter and cruise trade in the harbour ever since. Moored at Pier 6 at Circular Quay, the Sydney ferry terminal between the Harbour Bridge and the

Opera House, the Solar Sailor is a beauty, a rectangular white fibreglass catamaran studded all over with solar panels. Four solid wings stretch out on each side, ready to be raised to catch the breeze. The sails can be used in winds of anywhere between 6 and 35 knots, which is fine for Sydney harbour. A computer system factors in prevailing conditions to control the positioning of the sails and the way the solar cells track the sun and the batteries charge up, as well as the best mix of energy given the weather and the demands of the journey. Wind can provide 3 to 6 knots, and adds between 1 and 3 knots when the boat is travelling at 6 to 10 knots. Solar power can provide 100 per cent of power at 5 knots, and 20 per cent of power at 10 knots: the rest comes from a liquid petroleum gas-powered engine – and, of course, the wind. Manoeuvring around the harbour, the vessel uses only wind and solar power to keep pollution to a minimum.

The boat has performed so reliably that the Solar Sailor technology has attracted serious interest from businesses in several countries, including Germany, China and some Middle Eastern states. But it is in California that Dane has really struck gold.

The state of California has become seriously

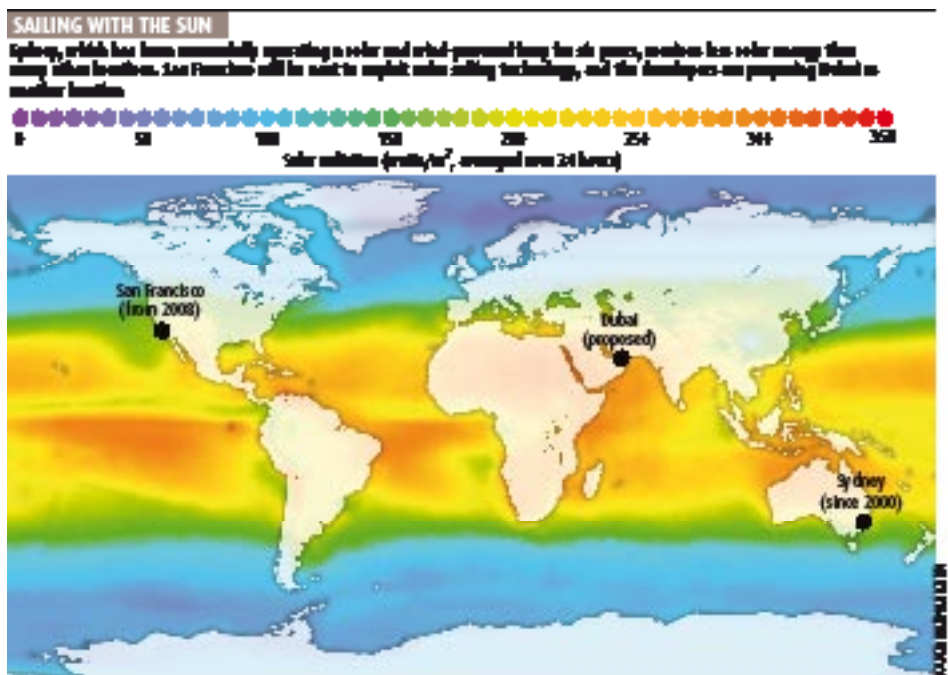
concerned at the toxicity of the pollution spewed out by marine diesel engines at wharves. There are now several studies showing that the level of pollution around docks – from toxic chemicals and particulate matter – constitutes a serious health hazard.

A million people a year travel on the ferry service from San Francisco to the former prison on Alcatraz Island. Small wonder, then, that the US National Park Service called for stringent control on pollution, in line with state regulations, when it framed specifications for a tender for the service.

Of 38 technologies assessed, only one met the specifications – a trimaran version of the Solar Sailor. The central hull has a conventional diesel engine to ensure the US Coast Guard are happy with the design. The two outriggers have solar-powered electric engines. Docking using its electric engines, with its diesel engine switched off, the Solar Sailor ferry will emit zero pollution in the port. Over the whole journey, the solar panels will save the operators around 10,600 litres of diesel a year. The wind will provide propulsion equivalent to another 20,000 litres of diesel a year.

The first San Francisco version of the Solar Sailor will go into service in September 2008. Solar sailing is the inevitable future of ferry

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services around the globe, says Anthony Haworth of Captain Cook Cruises, the company that operates the Sydney Harbour Solar Sailor. “I’ve got no doubts that solar-electric hybrid marine power is the answer to having a sustainable transport system on the water,” he says. “It’s just a question of time.”

The technology still needs refinements, Haworth says. The craft needs more efficient batteries and solar panels so that it can use even less conventional fuel, and thus offset the additional cost of construction.

For Captain Cook Cruises, a ferry has to be guaranteed to do 10 knots for 10 hours a day. Running on sun and wind alone, Solar Sailor can manage 6 knots for 4 hours; conventional fossil fuel motors are still needed to ensure the Solar Sailor runs to schedule on dull and calm days, and in the evenings. “If you could charge the vessel from the grid and store sufficient power to be able to operate for 6 or 7 hours at the right speed, with the price of fuel going the way it is, then it would become a very attractive proposition,” he says.

Dane is confident that day is coming soon. One of the benefits of Solar Sailor’s simple design is that refits and upgrades are easy to carry out, so advances in technology are incorporated as they become available. The

Sydney Harbour Solar Sailor, for instance, has just had a more efficient electric motor installed. As a result, solar sailing is getting better all the time, Dane says.

It’s also getting pretty lucrative. The good folk of Ulladulla who did a couple of weeks’ work on the Marjorie K now have 10,000 shares, each worth more than 20 times the face value of the bits of paper Dane handed out. Not that everybody still has them. “Several people have sold to third parties,” Dane says.

With the contract for the second-biggest ferry operation in the world under its belt (New York’s Staten Island Ferry, which takes in the Statue of Liberty, is in first place), Dane’s feel-good, eco-friendly company is now worth about A\$40 million. It’s a sail-off-into-the-sunset Hollywood ending, though Dane is already planning the sequel. He has drawn up preliminary designs for pleasure boats, water tankers and unmanned ocean vehicles that have already attracted the attention of the US military (see “Crew not required”). The only remaining question when the movie moguls come calling is who to cast in the lead role. ●

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Crew not required

When former US Navy submarine commander Payne Kilbourn retired from service, he set up as a shipping consultant. In the course of business he met Robert Dane, who suggested applying the Solar Sailor technology to autonomous craft. Kilbourn’s military ears pricked up.

The result was a Virginia-based company called UOV (Unmanned Ocean Vehicles) run by Kilbourn, and in which Solar Sailor Holdings has a significant interest. So far it has four designs for uncrewed boats powered by “energy-scavenging” technology – mainly solar, wind and wave energy. The vessels can rely wholly on renewable energy because they rarely need to move at high speed. They could remain at sea for at least two years, until their batteries have to be serviced or replaced, and satellite communications and a GPS navigation system would allow their movements to be controlled from a base, to which they could report on their position and what they sense around them.

Significant interest has come from several quarters, including the US Office of Naval Research and the Naval Sea Systems Command, the procurement arm of the navy. “There has also been some interest from the mine warfare community and special forces community – for ocean surveillance and communications links,” Kilbourn says. The vehicles could also be used to collect data for climate research, ocean exploration, offshore oil exploration and production, and even surveillance of pipelines and telecommunications.

Unlike vessels using marine diesel engines, Solar Sailor emits no pollution in port for a safer, cleaner trip

