



The hydro-generator can be mounted on either hull, but must be clear of the rudder and prop as on this Lagoon 42 (top); Save Marine's innovative product features a cowl around the impeller to accelerate water flow (below)

WATER POWER

FOR PASSAGEMAKERS, HYDRO-GENERATORS ARE THE ANSWER TO ALL YOUR ON-BOARD POWER NEEDS

BY SAM FORTESCUE



One of the most vexed questions for long-distance sailors is how to keep the batteries topped up without resorting to running the engine. In the past, that might have meant a few amps for navigation lights, GPS and a radio. But these days, yachts are much more energy intensive, burning through hundreds of amp-hours of battery capacity each day.

Hydro-generators are fast becoming a mainstay in the renewable energy mix for cruising boats, after gaining real traction during the 2008 Vendée Globe round-the-world race, when they were widely fitted to the IMOCA 60 fleet. Wind turbines and solar panels still do the lion's share of the work, but they can be problematic. Each is only as good as the weather allows. Solar panels reach their stated output only for a few hours a day, when angled into the sun, and shading only a few cells on a panel will dramatically slash its output. Meanwhile, wind turbines boast impressive power output, but only at wind speeds that most sailors would quail at. The Leading Edge 600, for instance, can put out 750W of power in 35 knots of apparent wind, but at a more rea-

sonable 16 knots of wind, it can manage just 160W. Sailing downwind, in little apparent wind, a wind turbine's output can be disappointing.

A hydro-generator is a very different beast. Dragged through the water behind the boat, its impeller is pitched specifically for boat speeds between five and 30 knots. This technology can even be combined with the boat's auxiliary propeller to generate power via an electric or hybrid engine set-up, but we're looking here at the stand-alone units that can be easily retrofitted. As Sabrina Huet of Watt & Sea points out, hydro-generators are popular, "for the silence, the high production of (green) energy on fast boats and the possibility to get energy during the night, cloudy days and even when going downwind."

Looking at the power curve for the company's cruising unit, 5 knots of boat speed will produce around 130W. This may sound like a low figure compared to wind and solar, but remember that as long as the boat is sailing, this is a stable output, 24 hours a day—amounting to around 240 amp-hours on a conventional 12V system.

But no-one buys a multihull in order to realize average passage speeds of 5 knots. With a much higher length to beam ratio, trimarans and catamarans have higher hull speeds and, consequently, greater generat-

ing capacity. So, at 7.5 knots of boat speed, the Watt & Sea produces around 300W, and at 9 knots it cranks out north of 500W—on a 12V system, that's an impressive 40 amps. Stewart Coates is delighted with the performance of the smaller 300W unit on his double-ended Wharram Tiki 38 catamaran. "The amount of charge we get from it at 5 knots of boat speed, in as little as 10 knots of wind, would require 18 knots of apparent wind using a good quality wind generator."

A QUESTION OF SPEED

Each of the main manufacturers—Watt & Sea, Save Marine, Eclectic Energy and Swi-Tec—offers units capable of broadly similar performance at the top end: some-

thing of the order of 500W to 600W. But just as with wind turbines, you should check the cut-in speed and the top generating speed to ensure that it will suit your boat and the sailing you intend to do. There's no point in installing a generator that only gets going at 7 knots if your cruising speed is 5 knots. Similarly, for racers or speed demons, you may need a different impeller to



The Sail Gen from Eclectic Energy has an adjustable trim tab that keeps the unit at the right depth and makes recovery easier



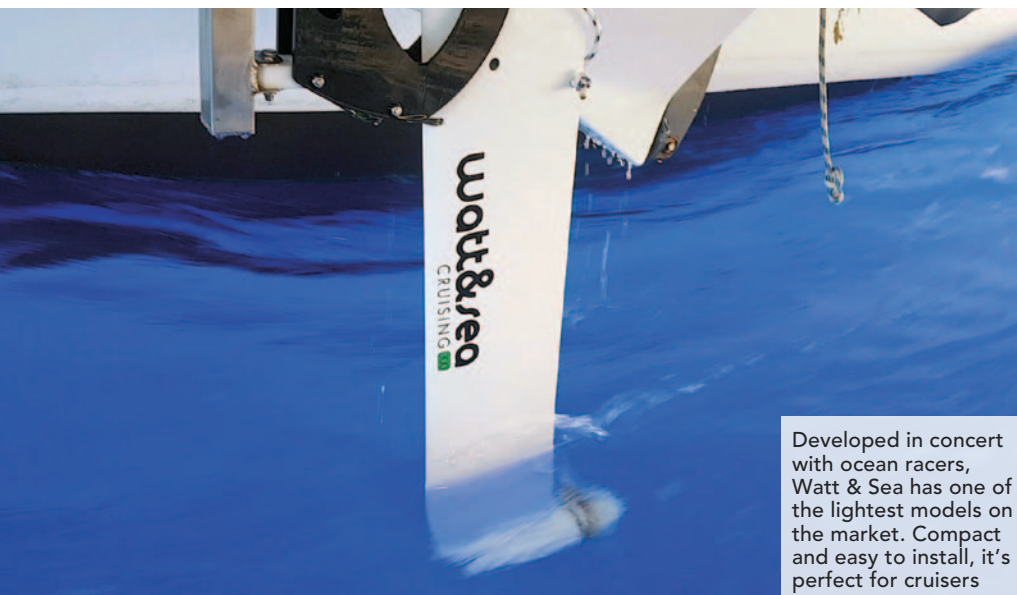
suit higher sailing speeds. Peter Anderson of Eclectic Energy explains: "Physics tells us that the amount of energy rises as a cube of

the velocity, so from 10 to 12 knots, you have more than 70 percent more power coming into the system. Not only does output rise, so does drag. The faster you go, the bigger a component drag becomes."

There's more on drag below, but the manufacturers get around the output issue by offering cruising or racing versions. Depending on the boat's speed, the impeller blades are pitched differently—that is their angle of attack, where a lower pitch gives better acceleration (earlier start-up) and higher pitch gives a higher top speed. Watt & Sea's product was proven in the 2008 Vendée Globe, and features a variable pitch propeller controlled by a microprocessor. "Drag is minimized and energy output optimized," says Sabrina Huet.

Swi-Tec has optimized its generator for cruisers, with a very sturdy bracket to resist heavy seas. “Cruisers can manually adjust the pitch to the average speed of the boat of six, 10, 12 knots or more, to reach the optimum charge,” Domingo Zaengerle, who developed Swi-Tec’s Hydro Charger for his RM1270, says. Intriguingly, the

belief that they rob the boat of speed, costing a knot or more. For racers this would be unacceptable, and even cruisers would tire with extra days added to ocean passages. Whether this was ever true is debatable, but today’s hydrodynamic units have been shown to produce very little drag. It is hard to measure exactly,



Developed in concert with ocean racers, Watt & Sea has one of the lightest models on the market. Compact and easy to install, it’s perfect for cruisers

because drag in a tank test does not reflect real life conditions, but claims vary from the “less than 0.4 knot” reported by Save Marine for its H240, to “less than 30lb at 6 knots” for Sail-Gen—roughly equivalent to 0.1 knot.

“For cruising monohulls on a typical tradewind passage, the speed loss is absolutely unmeasurable because the boat is at hull speed,” Anderson says. “Non-displacement craft, like a catamaran, also report negligible speed loss. The only time you might notice speed loss is at extremely low speeds.”

For racers, the issue is more likely to be one of brute weight, rather than drag. These units can be heavy. Watt & Sea produces a carbon version of its short-leg hydrogenerator that weighs just 14lb (6.5kg), although you have to add 4.5lb (2kg) for the regulator and the same again if you want the hydraulically-controlled, variable-pitch prop.

By contrast, the Sail-Gen weighs 36.8lb (16.7kg) excluding the mounting or the regulator, Save Marine’s H240 weighs 30.8lb (14kg) (without?) any of the accessories; and the Swi-Tec weighs 33lb (15kg) all-in.

INSTALLATION MATTERS

Monohulls can make for more complicated installation, heeled on their cluttered transoms. By contrast, it is usually simpler to mount a hydro-generator on a multihull. Not only do you have a choice of transoms, but the narrow beam of each hull makes for less disturbed waterflow and therefore higher generating capacity. Installation between the hulls exposes the unit to debris and is not usually recommended, although we’ve seen some neat solutions on cruising cats.

That said, there are a few key points wherever you place the unit. Firstly, you need to be able to launch and retrieve it easily. Each manufacturer has taken a slightly different approach. Eclectic Energy in the UK mounts the impeller of its Sail-Gen on the end of a long 5ft 7in (1.7m) shaft that pivots up by hand. This is a key selling point, as



system was originally based on backwards-engineering a Torqeedo 503 electric outboard, then modding it with a new impeller.

Save Marine takes a unique approach when it comes to impeller design. It features a circular impeller housing—like a propeller guard—which exploits the venturi effect to accelerate water through the turbine. The housing also protects the impeller against floating debris, although the system is designed to rise in the event of a collision.

WHAT ABOUT DRAG?

A durable myth around hydro-generators has been the

the cradle allows the impeller head to pivot vertically and horizontally, riding with the seas rather than transferring sideways loads through the bearings, up the shaft and into the hull. The Sail-Gen also features an adjustable dive plane, so the impeller trims itself at the optimum 50cm underwater. Tweak on the control line however, and the impeller surfaces by itself for easy recovery. This can also be triggered by a collision wire, so the impeller rises after striking an underwater object.

Watt & Sea use a special bracket that allows the generator leg to pivot up out of the water by pulling on a line; Swi-Tec uses the same method, but with a hefty 4:1 purchase. Some sailors prefer their own solution to mounting, with some using mast track to slide the leg into or out of the water. It is worth noting that there are different leg lengths available to suit different transoms—much as with an outboard motor.

Stewart Coates had encountered a lot of Sargasso weed during his Caribbean cruising, and said that weed caught on the hydro-generator leg would usually clear itself. “I would advise anyone installing one of these units and sailing in weed prone areas, to make sure that raising and lowering the unit is as efficient and safe as possible.”



The Hydro-Charger offers the combination of water power and solar power (transom mounting bracket and support for swim platforms optional)

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Swi-Tec's unit allows you to adjust pitch to match your boat speed. It has a heavy mounting designed to withstand cruising loads



All the units require an external regulator to be mounted inside the boat. Watt & Sea's smart regulator helpfully accepts solar input as well, with three-stage charging that dumps excess power as heat (no fan required, so operation is silent). Swi-Tec's regulator also accepts wind and solar input, but simply sounds an alarm when the battery reaches the final float stage of charging. "You can switch manually to free-wheel mode, for no drag and less wear," says Domingo Zaengerle.

With a roll-call of prestigious racers and cruisers using hydro-generators, on boats from cruising cats to one-off carbon racers, the technology is proven. They combine high generating capacity with very low drag, and are flexible enough to suit most installations. In the end, though, the chief consideration will be cost

and sailing style. A 600W Watt & Sea will set you back more than \$5,000, while solar panels and wind turbines cost much less. Equally, if you anticipate spending a lot of time anchored up in quiet coves or going stern-to in the Med, a hydro-generator may not be the best option. But if your wallet will stand it, and you want renewable energy to cover your full power requirements during a long passage, look no further. *

Sam has been sailing his entire life. He crossed the Atlantic on a Sadler 34, which he currently cruises with his family. He regularly edits and contributes articles on cruising, equipment and new boats.

INSTALLATION CHECKLIST:

- *Impeller 1ft-1.5ft (30-50cm) below the water's surface
- *Vertical mounting (not on a sloping transom)
- *away from turbulence caused by rudder or prop
- *Additional regulator to control charging

CONTACTS:

Watt & Sea: wattandsea.com
Swi-Tec: swi-tec.us
Sail-Gen: eclectic-energy.co.uk
H24O: save-marine.com



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