Going hybrid

What does installing a hybrid drive involve, and will it fit your boat?

Graeme Hawksley has installed a hybrid drive in his custom-built Wylo, *Maud*

Diesel-electric and serial hybrid systems are fine for the purist, and there's no arguing that the ability to redistribute the weight of your engine installation is a great advantage for yacht design, but to install such a system on an older boat requires major work and expense. The best retro-fit solution at present seems to be the parallel hybrid which, if you opt for the type which drives the original propeller shaft via a belt, can fit to an existing engine.

One such system is offered by UK company Hybrid Marine. The brainchild of electronics specialist Graeme Hawksley, Hybrid Marine started life as many businesses do – with a chance remark.

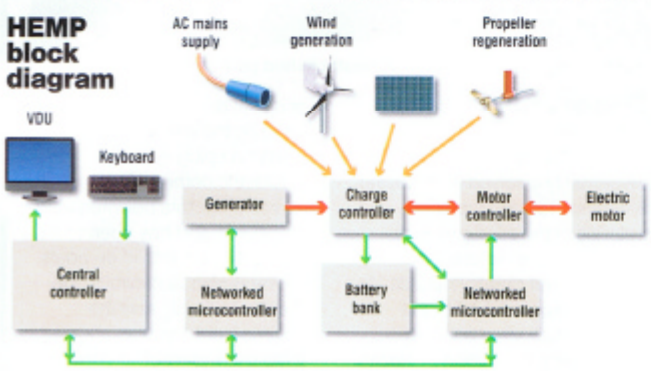
Having cruised extensively in his South Coast One Design, eventually reaching New Zealand, Hawksley had returned to the UK thoroughly bitten by the cruising bug but equally persuaded that he needed a bigger boat. After a thorough search he concluded that the only yacht that met his needs was British designer and ocean cruiser Nick Skeats' 32ft (9.7m) Wylo design, a steel gaff cutter which is only available as a home build. Knowing Hawksley's expertise, Skeats suggested that the new Wylo, *Maud*, should have electric drive. Hawksley accepted the challenge, and after extensive research and development decided to launch his ideas as a commercial product, with support from a government Smart Award.

The system

Hawksley's system, which he refers to by the acronym HEMP, for Hybrid Electric Marine Propulsion, has evolved from something very different. In fact, even *Maud* doesn't have the full parallel hybrid installed, and is fitted instead with a serial hybrid run from a generator forward in the boat. 'I don't need a lot of engine power,' explained Hawksley. 'Serial hybrids are easy to fit on a new boat, and it saves a lot of space at the engine box.'

In either guise however, the HEMP system is built around a few basic components: Lynch motors, Odyssey batteries, and Hawksley's proprietary control system. He's rather proud that this combination makes HEMP an almost exclusively British product, and although he is prepared to negotiate on which batteries are used, he strongly recommends the use of sealed gel or AGM (Absorbed Glass Mat) cells. The number of batteries required and the heavy charge/discharge cycles to which they are subjected cause significant outgassing from lead-acid cells, requiring a sealed battery bay and forced ventilation.

To make a parallel hybrid, Hawksley fits a Lynch motor to a bracket on the back of the engine, connecting to the propeller shaft via a toothed belt. An electro-mechanical clutch engages or disengages the electric motor, and another clutch in the shaft can disengage the propeller entirely to allow the engine and motor to be used for stand-alone generation.



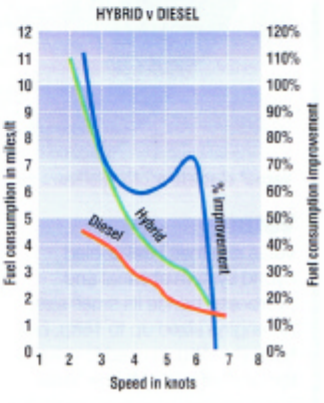
Does it work?

Hawksley has been concentrating on canal and river use as his primary market, largely owing to engine manufacturers Beta Marine. They have recently signed a year's contract for the HEMP system, so if you're looking at a new engine for a canal boat, you can opt for a 43hp or 50hp engine complete with a 10kW motor which doubles as a 5kW generator.

This focus on powered craft means that regeneration from a spinning propeller under sail has taken a back seat, so in its seagoing form, a true parallel HEMP drive is yet to be a reality. However, we were able to test a prototype on board *Maud* with notable success as we were taken under tow in the Medina river by the Folly Waterbus, in the capable hands of skipper Dave.

Hawksley was quick to point out that this part of the system is still partly experimental, and our test would not have satisfied many of the requirements of science, but we were able to demonstrate that regeneration could provide a useful input when cruising. As *Maud* neared her hull speed of around seven knots, the regenerative power peaked at around 700W. A roughly linear set of results gave an increase in power from a zero point at 4.5 knots, when there was insufficient power turning the propeller for regeneration.

When using the system in regenerative mode, you effectively set the propeller to rotate at a constant speed. When enough water is flowing past the hull, the propeller tries to rotate faster and produces power, but conversely if your speed drops power will be used to try to maintain revolutions. This should work particularly well in waves, giving you a welcome shove uphill and controlling your speed down the wave. The charging current is monitored on a small screen on the throttle control box: a positive value means it's charging, while a negative value means that power is being used to keep the propeller spinning. This approach also allows you to set the drag of the propeller. We tried to measure this on our test but the results were inconclusive – data



The Folly waterbus gives *Maud* a tow to determine drag during regeneration

from other manufacturers suggests a loss of speed of between half a knot to a knot. This will reduce towards zero as you approach hull speed and other sources of drag become more important.

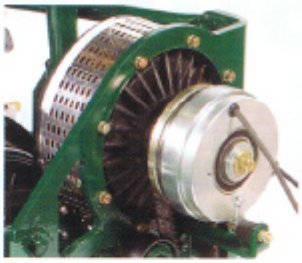
Other parts of the system also worked well. *Maud*'s generator is a 13hp Kubota engine driving a 10kW Lynch motor, effectively the same arrangement that would be used in the parallel hybrid. The computer control system can charge the batteries with a current up to 140A, using an intelligent algorithm which Hawksley says reaches 92% of the batteries' capacity, leaving the remainder to a trickle charger such as a solar panel.

Experiencing silence

You can argue the case for hybrids any number of ways. Increased fuel efficiency is partially offset by increased weight. You need to find space for a considerable battery bank, but by doing so a parallel hybrid gives you a backup engine – you can get yourself out of trouble using sails, electricity or diesel. It also adds so much capacity that it's feasible to run mains appliances via a suitable inverter. But then there's the cost: HEMP has been designed to be as cost effective as possible, but to install the basic system, excluding brackets, batteries and the clutch to allow stand-alone generation will set you back £4,000 ex VAT – the price of a new engine.

But all this is insignificant when you step on board and experience the silence. After our noisy tests towing up and down the Medina, we slipped the mooring lines, engaged electric drive and made our way upriver to *Maud*'s berth in Newport. It seemed appropriate that we made little more than a whisper as we ghosted into this neglected harbour, a haven for classic yachts new and old. She can reach around six knots in smooth water under electric power, but as Hawksley points out, that isn't really the purpose of a hybrid – by that time there is no advantage over using the diesel. Where it really comes into its own is enjoying the scenery at low to moderate speeds, slipping away from a mooring or berth, or avoiding those awkward early morning starts as you wake the neighbouring yachts with a seemingly deafening roar. For those situations, it's pure magic.

Best of British

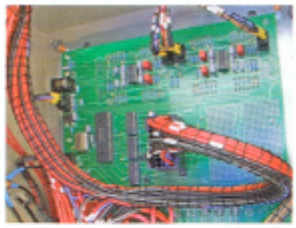


A Lynch motor/generator

■ The first Lynch motor was designed by British inventor Cedric Lynch to win a competition to propel a vehicle the furthest in two hours on a pair of small car batteries. It has now evolved into one of the most efficient drive motors around, with almost equal efficiency when used in reverse as a generator.

Odyssey PC2250 AGM battery

■ Odyssey might be a US-owned company, but their battery manufacturing plant is actually in Newport, Gwent. Their design uses thin, flat plates of lead divided by Absorbed Glass Mat (AGM) to produce a battery which, they say, has 15% more plate area than its spiral-wound equivalents, is proofed against spillage and highly resistant to vibration. Quoted performance figures are 400 charge cycles at up to 80% discharge, but Odyssey say that in a hybrid environment they have achieved 1,700 cycles at 60% discharge, taking just four hours to recharge.



Graeme Hawksley's customised electronic control system

■ HEMP's complex control system has been designed and built entirely by Graeme Hawksley from his base in Sandown on the Isle of Wight. Dedicated software monitors every aspect of the power used and generated by the system, and on *Maud* also has control of starting the generator, allowing it to charge as necessary. A computer interface provides any information about the system's status at the click of a mouse.

Control from the deck however is delightfully simple. There's no need even to have a computer on board – a neat throttle control gives full access to all the basic functions, leaving the rest to the automatic system. Just push the lever forward or back for a burst of power, or for prolonged motoring push it forward until you reach the revs you need and press a button to lock.

Can I fit HEMP?

You need:

- ☑ **A minimum of 100Ah of batteries at 48V, usually achieved by connecting four 12V batteries in series. If you can fit in more, you can use electric power for longer**
- ☑ **About 15cm (6in) of clear propeller shaft to fit the clutch**
- ☑ **About 40cm (16in) of clearance above the shaft to fit the electric motor and bracket**

Quick converter

kW	hp
1.5	2
3	4
4.5	6
6	8
7.5	10
11	15
15	20

Hybrids at the Southampton Boat Show

Fischer Panda, stand E21; Hybrid Marine, stand H15 Lagoon, berth 141; OSSA Powerlite, Broadblue catamarans, berth 80; Steyr, stand G33; Vetus, stand E54