EXPERT ON BOARD

A professionally qualified skipper with 50,000 miles under his belt, Will Bruton is *YM*'s sailing editor

ELECTRIC REVOLUTION

Could YOU ditch the diesel?

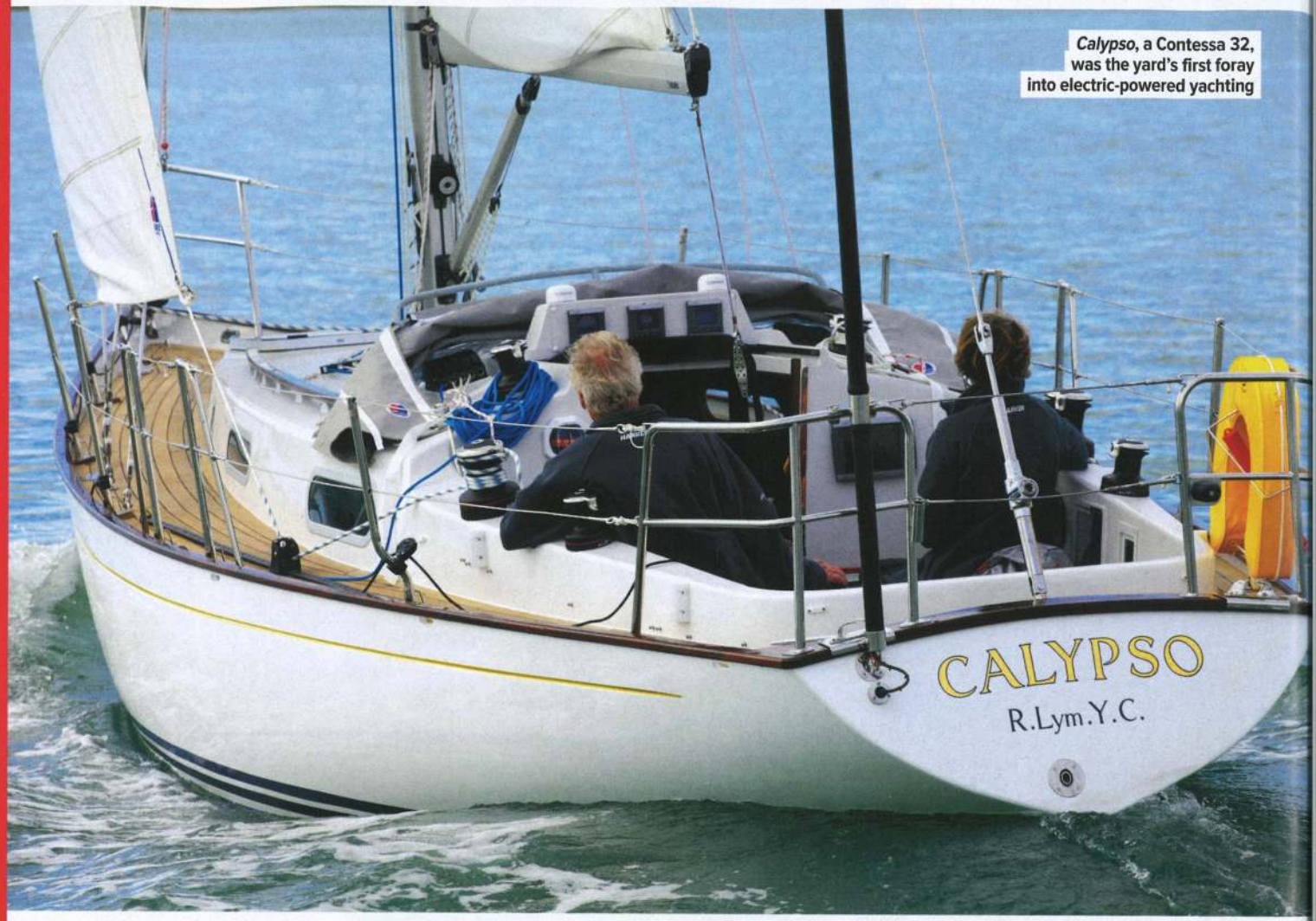
Electric and hybrid yachts are growing in popularity; we outline the current options for those making the switch

The iron sail, the donkey and the stinker; all pejorative terms for an inconvenient truth in yachting. Sometimes, like it or not, we end up motoring more than we would like to. For many afloat, when the wind dies and the sails start to flap, the engine goes on. Sat in the cockpit with just enough wind to waft diesel fumes from the exhaust into our lunch, but not enough to propel us home, the dream dies a little. Surely there must be another way?

Revolution has a habit of creeping up on the complacent. At first glance the electric yacht market could appear in its infancy as the vast majority of cruising yachts still have diesel engines, and even on new yachts, fitting electric propulsion would be a bespoke project. But like every revolution, a desire to leave fossil fuels behind – as is happening in the automotive industry – is driving forward technology that only a few years ago was seen as the stuff of fantasy. The market has responded to demand and battery and motor technology has come on in leaps and bounds, driven in part by the rapid development of electric cars. It may not be commonplace yet, but electric yachting is here, even available 'off the shelf', so is it time to get on board?

The Arcona 380Z is a standard production yacht that has been adapted for electric propulsion. Notably, it adds more solar panel surface area with soft panels bonded to the sails

Jukka Pekkarinen, Illustration Division Ltd



Calypso, a Contessa 32, was the yard's first foray into electric-powered yachting

Old dog, new tricks

Electric dreaming in a Lymington boatyard

Jeremy Rogers' yard in Lymington: birthplace of the iconic Contessa designs and a veritable temple to long-keeled craft. Less well known is the yard's interest in electric auxiliary engines, something they have been involved in for more than 10 years.

Their first project, the refit of a Contessa 32 called *Calypso*, was an experiment to see what was possible. '*Calypso* was a test bed in the technology's infancy,' explains Kit Rogers. 'Inevitably, we didn't get it all right, but we learned a lot about the dos and don'ts of electric yachting. The end result was a hybrid. The more we did, the more interesting the project became. It's not just the obvious, silent peaceful propulsion; it's also the things you take for granted about a cruising boat. For example, no gas; we didn't need it because we had electric power. In fact, we went further and installed an instant hot water tap – both big safety improvements.'

The yard's current project is an electric folkboat conversion for a foreign customer. At first glance, she's as traditional as it gets. A very small throttle leaver and electronic status panel in the cockpit is the first giveaway of something different hiding below the companionway steps, whilst traditional brass rowlocks hint at the kind of customer they are working on the project for. 'The client, first and foremost, loves to sail. He sees the electric as an auxiliary option, along with the rowing, and is excited to own a boat that's quietly different. He's looking for a more connected experience and the electric engine helps him achieve it. When you've been motoring in and out of marinas under chugging diesel engines for years, the electric motor is something of a revelation. When we had some teething problems after the initial installation, the client just rowed out of the harbour and went for a weekend's sailing in the Solent.

'The end result is a folkboat re-invented, which, for the kind of sailing he does, is perfect. Utilising an Ocean Volt electric motor,connected to a conventional prop shaft, the yacht has enough range for a couple of hours motoring on full charge. For trips further offshore a compact portable Honda generator plugs in to make the boat a simple hybrid,' adds Kit.

Jeremy and Kit worked together on their first electric yacht experiment 10 years ago

The Ocean Volt installed with wiring

Due to the serious battery capacity and inverter on board it was possible to fit an instant boiling water tank and induction hob, making *Calypso* gas-free

Power management is achieved via a more-sophisticated-than-usual monitor

Currently in build, the Spirit 111 is a bold hybrid yacht project promising 30 miles motoring under electric power alone

Spirit of the age

Like Formula One racing, it's the cutting edge of electric yachting that trickles down into mainstream production in no time at all. For Spirit Yachts, a builder defined by a unique blend of traditional and state-of-the-art, electric yachting has been driven by demanding clients that want their yachts to be at the cutting edge.

Their latest project, the 111, has all the hallmarks of a superyacht project and the team is earning their keep delivering to brief. Managing director Nigel Stuart explained how it works:

'The 111 combines several dynamic technologies to deliver something that's never really been done before. A lithium-ion powered electric drive system can be charged by hydrogenation and two high-wattage diesel generators. Each generator is 22kW, meaning they can pack a lot of power into the system in a short period of time. They don't need to run for long to fully recharge. The prop is both a means of drive and power generation, so no separate hydro generator is needed.

'At the helm the system can be switched between propulsion, stopped and hydro-generation modes. She will be capable of motoring under electric alone for more than 30 miles and, under sail, starts charging the batteries once she's going through the water at over 3-knots. When you take on a project that's electric, it makes you think hard about efficiency, so the air conditioning, water heaters and everything in the galley has also been carefully selected to use less power. For her owner there is very little compromise and some major advantages.'

Whilst it's a long way from the average cruising yacht, the trickle down effect of projects like this can't be underestimated.

The Ocean Volt system mounted in place of the folkboat's original diesel

Lithium Ion batteries are far more resilient than their old-fashioned counterparts, dealing much better with the heavy loads demanded of them on an all-electric yacht

With very few moving parts, an electric motor takes up far less room, though batteries tend to make the overall weight about the same

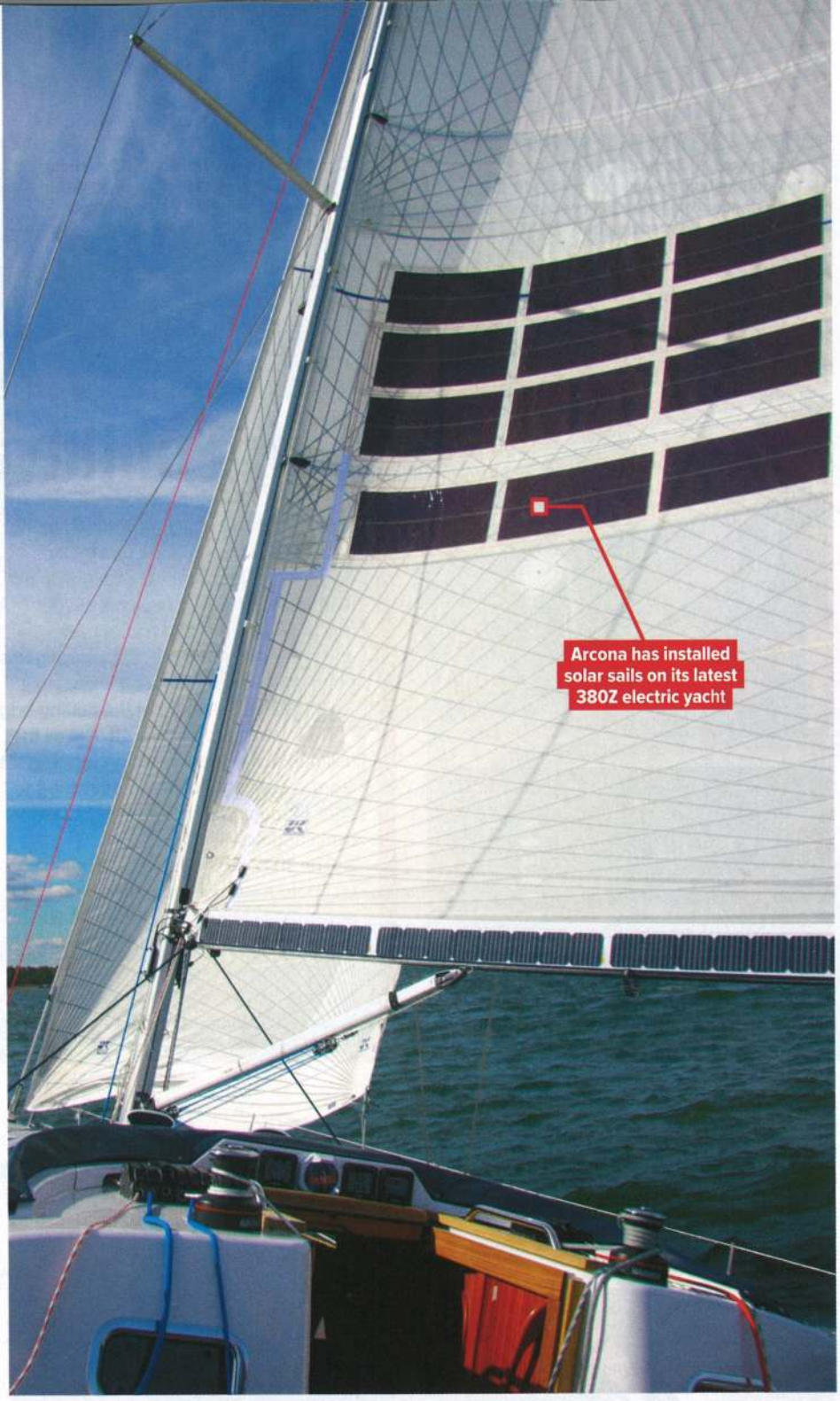
Off the shelf electric

Perhaps the biggest indication of the future of electric is the willingness of production and semi-production builders to put their flags to the mast and embrace it. One of the first was Hanse, who developed a version of their 315 utilising a Torqeedo electric pod system. Providing around the same amount of power as a 10 horsepower diesel, a 4.4kWh lithium ion battery pack powers the system. Depending on how much you want to spend, motoring range can be extended with more batteries. A generator takes the place of the engine to charge the system and extend range if necessary.

One extra benefit was the electric pod's directional control. With no through hull fittings or shaft to worry about, the pod drive on the 315 is mounted directly onto the rudder, meaning it doubles as a directional thruster. As their promotional video shows, the effect in the marina is dramatic, meaning she can easily turn within her own length by combining thrust and maximum leverage.

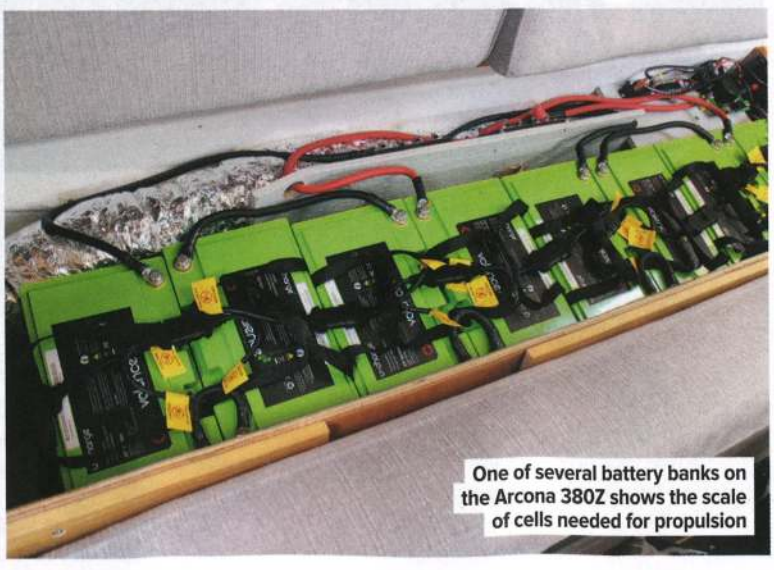
Arcona, Dufour, Elan and Delphia also have electric models and are each taking their own direction on entering the market.

Arcona's 380Z (the 'Z' stands for 'zero emission') fully electric yacht has solar panel covered sails, capitalising on the large surface area to top up batteries under sail. In the multihull market, there is even more scope for solar, wind and hydrogenation due to the much larger horizontal surface area available for solar charging.



Arcona has installed solar sails on its latest 380Z electric yacht

An electric throttle does not have a mechanical link to the motor so can be located wherever it is convenient



One of several battery banks on the Arcona 380Z shows the scale of cells needed for propulsion

Due to its small size, the prop and motor can be attached directly to the rudder, giving unprecedented directional control and making it more like an outboard engine

The Hanse 315 is an all-electric version of a standard production cruiser

OPTION 1
Pure electric

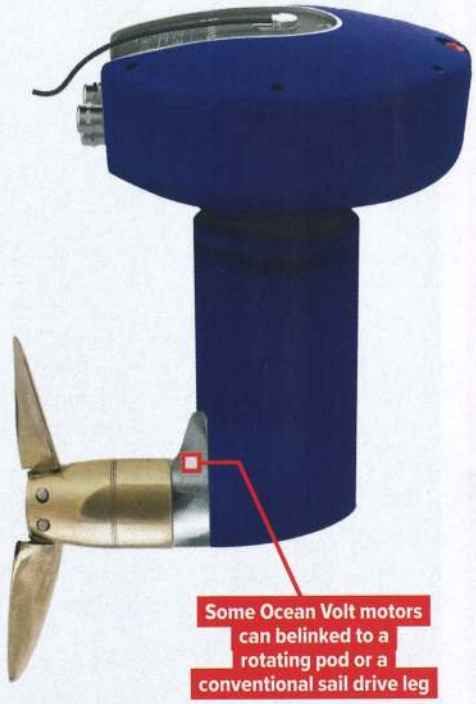
Purely electric systems can be broadly divided into two categories of high and low voltage. The latter is the simplest option in terms of how it works and requires less specialist knowledge to install. Kit Rogers installed a 48v Ocean Volt low-voltage system in his latest project and remarked on the experience, 'The advantage of the low voltage system is its inherent lack of complexity. Whilst we've coupled it with lithium ion battery technology, it can also be wired up to conventional lead acid batteries. There are pros and cons to both. What surprises everyone is the size; it's a tiny motor and is surrounded by lots of space where the engine would normally sit.'

High voltage systems are more advanced, and utilising lithium-ion technology, their capacity is improving year on year. For larger yachts this is generally seen as a better option. A partnership between BMW and Torqeedo has lead to the development of the Deep Blue 315v high-voltage battery. Effectively the same unit as found in the BMW i3 electric cars now often seen on the high street, the system produces a lot of power and is being used on the Spirit 111 project as well as catamarans.

OPTION 2
Diesel generator hybrid

One big barrier to entry exists for most potential electric yacht buyers – range. Even the most advanced set ups are limited to a maximum of a few hours motoring at cruising speed. 'The electric motors excel at two things in particular,' explains Kit Rogers. 'The first is as auxiliary power for getting in and out of marinas. The second is engaged at low power to very efficiently motor-sail in light airs. If you want to do more than that, at present you need to add a way of packing in the charge into the battery quickly whilst at sea; which means a generator.' As with electric cars and as enthusiasm builds for the technology, a hybrid option, pairing a generator with an electric drive system, is already proving popular and is probably the most practical option for those planning to cruise any distance. Using a large generator, charge can be quickly put into the system when needed. Once under sail, the yacht's propeller becomes a hydro generator, meaning that diesel power is not needed day to day. Solar can also be used to add additional charging capacity. 'When a fully integrated electric hybrid system is incorporated into a cruising yacht from the outset, its possibilities really become clear.

Sailing for days on end with no engine noise is entirely possible. There are other less obvious benefits too. Electric drives have no long rotating shaft, so can be used as pod drives as well, meaning the boat is far more maneuverable than even a yacht equipped with bow and stern thrusters,' explains John Arnold, UK manager at Torqeedo.



Some Ocean Volt motors can belinked to a rotating pod or a conventional sail drive leg

Motor, inverter, regulator and wiring can all fit into a fairly small space where a diesel would have been

Using high voltage, the Torqeedo system is well suited to larger yachts

Built to be mounted in place of a traditional diesel inboard, the Oceanvolt AX8 is surprisingly simple to install

The first step towards going fully electric?

Making the case for a full electric conversion is, at present, a big challenge for manufacturers. The cost, for a basic set up, is roughly three times that of conventional inboard diesel propulsion. So, instead of putting their efforts into auxiliary in-boards, several manufacturers are concentrating on proving the concept by converting owners to the advantages of electric through outboard engines.

Nick Nottingham bought a Torqeedo electric outboard in preparation for an Atlantic circuit on his Halberg Rassy 42 *Spellbinder*. 'Weight was a big part of it. With a petrol outboard there's always that precarious exercise of getting the thing off the bracket, down to the waterline and onto the back of the tender. With the electric, it's still relatively heavy altogether, but splits into three easy-to-handle parts: the battery, the drive leg and the throttle. My biggest concern was range. I've come to the conclusion the battery is good for about 10 runs ashore in the average anchorage I end up in, as long as you don't gun it at full throttle! When back on board, it's plugged in and easily charges up over the course of a day when charging the yacht's batteries under engine through the alternator. We tested it quite extensively in the Solent and I'm now more than satisfied it's a great replacement for a conventional outboard.

Easily charged down below, battery packs can be rotated to increase capacity

But what does it cost?

The technology exists, but anyone seriously considering going electric will want to crunch the numbers. In the case of taking out a traditional inboard diesel and replacing it with an electric system, it's relatively easy to work this out. However, unless you include an auxiliary generator, you will be limited to battery range alone. For this reason, we've done a like-for-like comparison for a 35ft yacht engine refit, including the cost of a generator to make the system a practical hybrid. Unsurprisingly, at the moment, there's a big difference in cost, but at between three to six times the cost, it is gradually coming into the realms of possibility, and prices should continue to drop as technology develops and evolves.

Ocean Volt SD10 motor system, including batteries, charger and 6kW generator
£30,825

Beta Marine Beta 20
20hp marine diesel
£4,100