

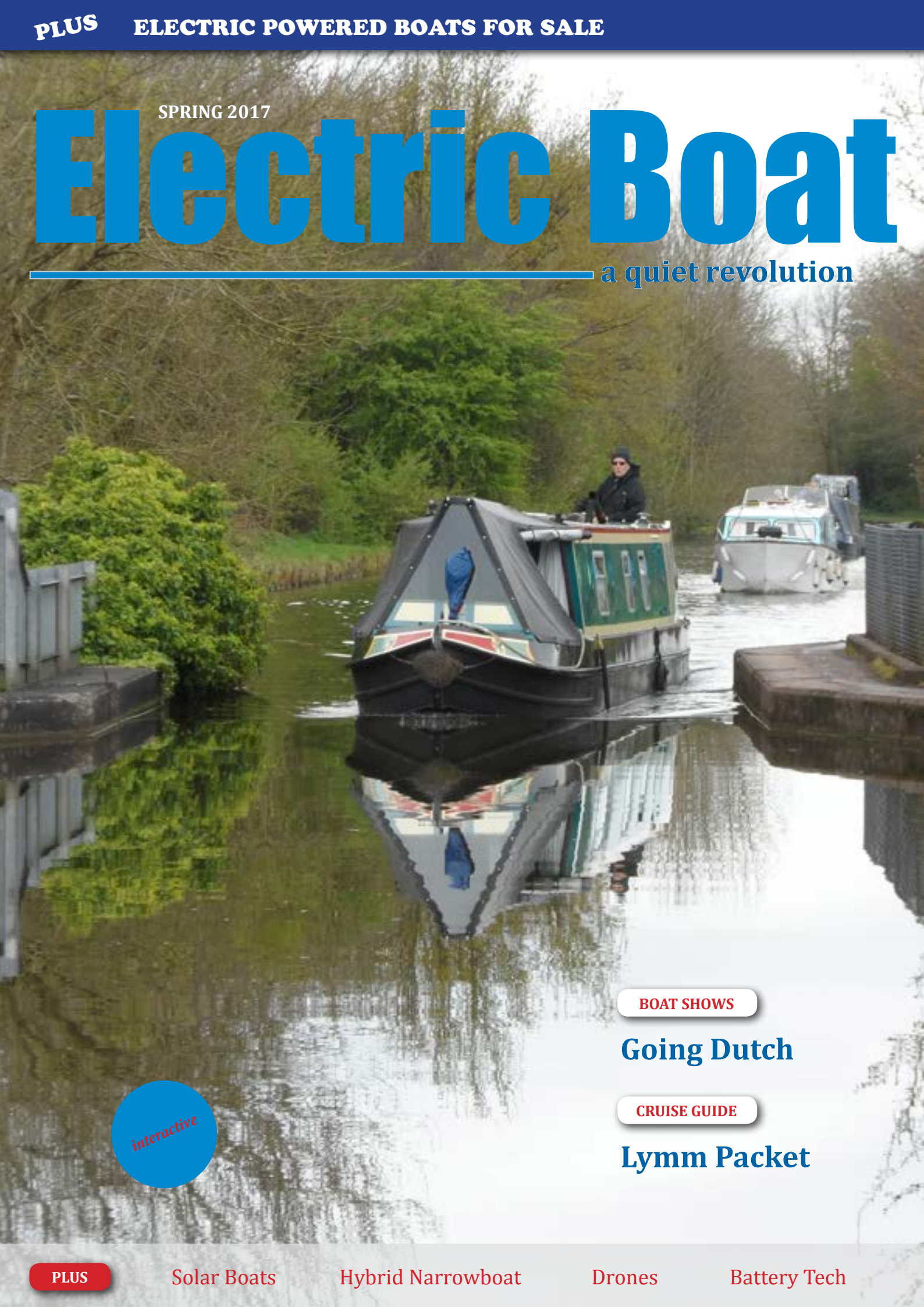
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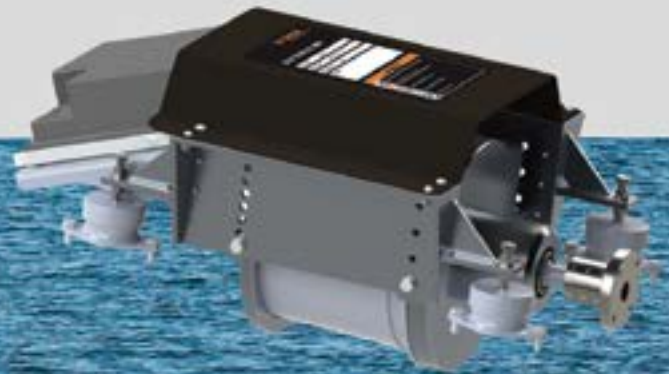
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Electric Boat

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Contributions from members and readers are welcome although we cannot be held responsible for any damage or loss which may occur to material provided. Items of interest include letters, reports of rallies, events, cruises, articles and advice on building and running electric boats and on items of equipment. We also welcome manufacturers' reports on new equipment and boats.

Copy Deadlines

Material to be considered for inclusion in Electric Boat should be sent to the editor (preferably by email) by the following dates:

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Electric Boat

Volume 30
 Number 1
 Spring 2017



Old Packet House to Lymm

P19

Moving on



The start of another boating year, and the year Barbara Penniall steps down as Secretary of the EBA. On page 10 she tells of her involvement with the Association over the past 21 years. Without Barbara's input it is very doubtful that the EBA would have survived this length of time in its present form, and she will certainly be missed. It is also the end of an era at Beale Park with the death of Richard Howard. The Beale Park Boat Show was a must go for Barbara and the EBA in the early days and she has fond memories of the Show. She pays tribute to Richard on page 6. The magazine is also moving on, into the new interactive era. If you have a wifi connection and are reading this using the latest edition of the Adobe Acrobat Reader app (which is a free download from all app stores) and you see a [link](#) in the text and click on it it will take you to another place. The same thing if you see the cursor turn into a finger pointer when it is over picture or illustration. Try clicking on my mugshot at the top of the page. I have only made a few interactive links in this edition, from the simplest linking the Contents page thumbnails to their page numbers, to the linking of Kevin's book on his International Page (I just know he will be so pleased) to my favourite which is the video

linked to the picture of the electric rudder drive on page 25. Clever stuff. But compare this with the experiments of Michael Faraday working almost 200 years ago see page 27. He may not have a car company named after him, like another electrical pioneer Nikola Tesla, but without the work of both these giants in the science of electro-magnetism there would not be an Electric Boat Association and I wouldn't be messing about with dynamic linking to the internet. The EBA will be at Crick again for the third year, on the waterfront as before, and will have EBA members Trevor and Pam Thorne's Nb *Sunflower* on the finger pontoon opposite our stand. *Sunflower* is a 45ft canal boat powered by a Lynch 200 48v motor. People are already asking to book a viewing but all they need to do is turn up at the EBA stand. Crick runs for three days 27-29 May. The growing interest in electric propulsion has been very apparent over the last two years of the show and it looks to be increasing. Things move on.

Don Wright

Cover: At Dunham viaduct on the Bridgewater canal

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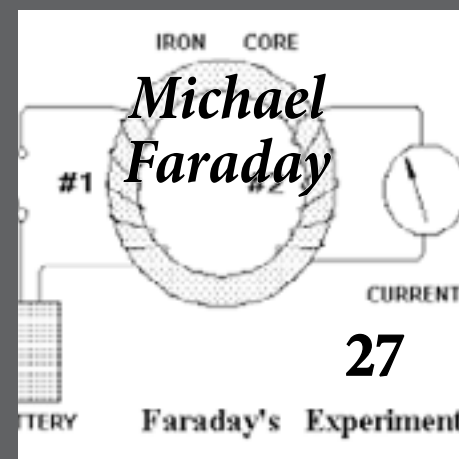


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In Brief

Canoe Trail

Nearly 2,000 young volunteers (15-25 years-old) are helping to create the UK's first ever coast-to-coast canoe trail. The Desmond Family Canoe Trail will stretch 162 miles to connect Liverpool to Goole along the Canal & River Trust's Leeds & Liverpool Canal and Aire & Calder Navigation, travelling through Wigan, Blackburn, Burnley, Leeds, Skipton and onto Goole. The trail is named after newspaper proprietor Richard Desmond, who donated £1.3m to the project and has the support of British Canoeing and Canoe England. The volunteers are also helping to design the trail, organise and run a year-round programme of activities for their local community, as well as improving the environment along the trail, by planting new community gardens and habitat.

Dredging Works

The Canal & River Trust has awarded its national dredging contract to carry out essential dredging works on its 200-year-old waterway network in England and Wales to Land & Water Services Ltd following a competitive tender process. Dredging is vital to keep the waterways open for navigation, as well as ensuring the canals are safe, combatting unruly vegetation and improving wildlife habitats. In 2015/16 the Trust spent over £7 million on dredging the 2,000 miles of waterways in its care.

Simon Bamford, asset delivery director at Canal & River Trust, said, 'This contract is the result of 18 months of hard work, care and attention as we've reviewed how we manage our overall dredging programme and looked at how we can improve things.' The contract will be for a period of 10 years and will start on 1 July 2017 and will expand the previous work to include: mainline, spot and hydrodynamic dredging; vegetation works; professional services; ancillary construction and civil engineering works; construction of fixed and floating moorings.



On Her Majesty's Service

Torqueedo has provided the auxiliary propulsion system for the Queen's rowbarge *Gloriana*. Torqueedo Deep Blue 40 Saildrive motors, along with two pairs of battery packs for the vessel have now been installed in time to meet *Gloriana's* spring programme of events. Christoph Ballin, CEO and cofounder

of Torqueedo said, 'We are absolutely delighted to have been chosen by The *Gloriana* Trust to equip HM Rowbarge *Gloriana* with Torqueedo's Deep Blue 40 Saildrive motors which offer the vessel steady, powerful and reliable performance, as well as protecting the environment through the use of clean technology.'

HSC Silver Anniversary

EBA member Henley Sales and Charter, which is celebrating 25 years of selling and hiring boats, has launched a new day hire website for electric boats on the Thames at Wallingford under the brand "Pure Boating". A selection of trusty Frolics as well as new boats from HSC French and Canadian sales partners are now available for hire.

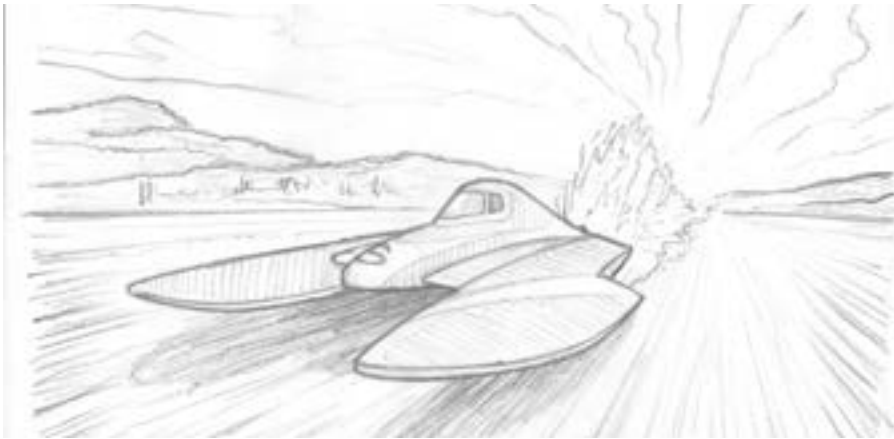
HSC MD Gillian Nahum has been a champion of the electric boat movement since the late nineteen eighties and she was chair of the EBA

for a couple of years. 'Thanks to the massive investment by companies like Tesla, boaters are waking up to electric boating as a mainstream option,' Gillian said, 'And after twenty five years of selling boats I am delighted to find that the general public is now very much on side.'



Barbara Penniall pays tribute to Richard Howard, 1936-2017, Chairman and Trustee of Beale Park

We were very sorry to learn of the recent death of Richard Howard who was a member of the Electric Boat Association and trustee of Beale Park. For many years Richard was well known to us as a keen supporter of the work of the EBA and owned his own electric launch. Richard was at the Beale Park Boat Show every year encouraging exhibitors and checking that arrangements were in place to everyone's satisfaction. He was a familiar sight strolling around the Show – in later years more leisurely in an electric golf cart – and Beale Park exhibitors will sorely miss his cheery banter and quiet efficiency. Our sincere sympathies go to his widow, Sally, their children and grandchildren.



Electric Water Speed Record

A new challenge is currently underway to break the World Electric Water Speed Record of 98.806 mph (159.013 kph) established by British pilot Mike Bontoft in his US hydroplane Bridget's *Watt Knot* in 2008. The 16ft British challenger, *The Bluebird eHydroplane*, will be piloted by Gina Campbell, daughter of legendary Land and Water Speed Record King, Donald Campbell. Coordinated by the boat's owner Mussett engineer of Lodden, Norfolk the boat, modified to calculations by naval architect Lorne Campbell, Mussett are considering twin McClaren electric motors or a prototype single motor from an un-disclosed British manufacturer. Deriving its energy from xx li-po batteries with an energy density of kW/h. Among those in negotiations to jointly sponsor the boat are a work-clothing manufacturer, an electricity

supplier and a Swiss watchmaker. Following 80 mph shakedown trials in the UK, the *Bluebird eHydroplane* will be shipped over to Stockholm for an Electric Powerboat Speed Regatta planned for September this year. There the boat will set its first record of 110 mph, although it has been designed for a top speed of 125 mph (200 kph). In November 1989 Fiona Countess of Arran piloted her *An Stradag* e-hydroplane to 50.825 mph (81.80 kph) at Holme Pierrepont, Nottingham. Electric Boat International Editor Kevin Desmond said 'With the new electric aero-engines linked to fuel cells currently powering one-off motorcycles and light aircraft to speeds of over 200 mph, it may not be long before we are looking approaching similar speeds on the water!' *The artist's impression is by motorsport artist Arthur Benjamins.*

Mini drone cleans up

EBA member Grove Boats has successfully tested its mini SeaCleaner drone for collecting floating waste in



a port environment or enclosed water surface, and they are now planning to pilot the drone in start-up situations. In addition, Grove Boats are also working with the Swiss company Avalgo Sarl, which has developed the AspiRobot, a catamaran for collecting and processing lake weed and algae.



In Brief

Ancient Paths

At the beginning of May the long-awaited path following the ancient route from St Benet's Abbey to How Hill National Nature Reserve via Ludham Bridge was officially opened as part of the 2017 Broads Outdoors Festival. The news means that Broad's visitors can now walk all the way from 11th century St Benet's Abbey to How Hill along the picturesque riverside, just as the monks of the abbey once did. A previous footpath existed some years ago but flood defence work meant the original route had changed. For years the only direct route between the Abbey and How Hill had been by boat, but now visitors can moor at either location and explore on foot the landscape and heritage. The Broads Authority worked hard to get the permissions needed for the path which was identified as a key link in the Authority's Integrated Access Strategy.

IWA objects to HS2

The IWA has responded to HS2's consultation on design refinements to the Secretary of State for Transport's preferred route for the HS2 Phase 2b route and has objected to a number of the proposed changes to the previous (2013) route.

The IWA has serious concerns over the impact on inland waterways as HS2 is developed in the west from Crewe to Manchester and the West Coast Main Line, and in the east from near Curdworth to Leeds and the East Coast Main Line.

The IWA has also recorded reservations about a number of other proposals which could affect canals and rivers in Leicestershire, Derbyshire and West Yorkshire, including on the Ashby Canal near Measham, and the Chesterfield Canal at Staveley and Norwood.

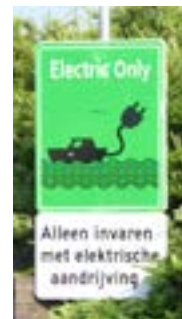
The IWA's full response to the consultations, which closed on 9th March 2017, can be found through this: [link](#)

Boat Shows



The attendance at this year's BOOT Holland was 35,400, a 5% drop on last year, but then it did snow on the Sunday. The number of electric boats on show was also reduced compared with previous years, but as featured below, an electric boat with 75 square metre surface area was probably the largest ever exhibited at any BOOT Holland

The Netherlands has two major boat shows at the start of every year and, as befitting a country that has established a complete electric only waterway route in Friesland, electric boats and boating feature prominently. The shows are comprehensively reviewed by Anton Schiere the editor of the Dutch online magazine *ElektrischVaren* who has kindly allowed Electric Boat to use copy and pictures from his Boat Show Special reports. On this page we cover Boot Holland and on page 9 we take a look around the HISWA Amsterdam Boat Show



Krautler importer Reinout Snoeck has just received an order for the next batch of 32 POD 4 kW motors for the Friesland "Happy Whale" electric boat rental project. The Krautler POD could be seen on the e-Sensation electric boat, the brand of Friesland boat builder Albert Hendriks.

MG Energy Systems were at the stand of the Furiaone Solar boat team with their championship winning boat *Furia III*. MG are a world wide leader in lithium power packs and their High Energy 5 kWh lithium line introduced in 2016 has proved to be very successful as a result of its competitive price



Green Line had on show their latest 36 foot hybrid boat which now has a 10 kW electric motor with a 20 Nm e-range at 5.5 knots and an e-top speed of 6.5 knots. .

Torqueado were ever present at the show and their range of electric motors featured on a variety of exhibitor stands



The Sailing Watervilla is the second such boat to be built by Lieuwe Koonstra and has 65 square meters of living space. With 40 kWh of MG Energy Lithium batteries, a Fischer Panda 18kW DC genset and 20kW Fischer Panda PODs at the bow and stern, the boat is steered with a gear stick. Sophisticated autopilot technology ensures that the wind catching vessel can be manoeuvred by both PODs simultaneously. The solar panels on the roof also make this high tech boat virtually self sufficient in energy.

Boat shows



Visitor numbers at this year's HISWA Amsterdam Boat Show were reported as being 35,000, a 14% decrease on last year. Electric boats only play a small part in the show but e-propulsion featured prominently on many stands.



In addition to its wide range in outboards and POD motors, **ARKA Electronics** was exhibiting its 5 kW a-synchronous drive, which is also available up to 100 kW.



NIMAG were showing their latest product the Haswing 3kW outboard with a brushless permanent magnet POD synchronous motor.



FOXES Nautical Engineering were showing their lightweight e-sloop 650 design with 4mm aluminum hull and a 5 kW ARKA steerable POD.



Reinout Snoeck is a distributor for Kräutler motors and was showing an impressive video of all their boat installations, one of the latest being the futuristic *Staets* canal boats in Amsterdam which have remote steering and 40kW Kräutler sail drives.



The **DutchCat 12** on show is a parallel hybrid powered with two 10kW Kräütlers.

Combi Outboards, one of the oldest manufacturers of electric drives for boats, were showing 6m Prince Sports boat tender, with a water cooled 10kW inboard and Curtis controller.



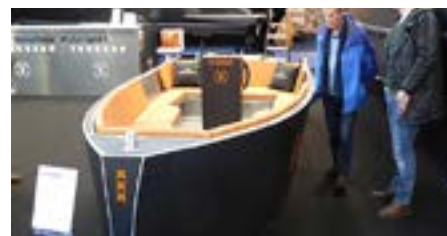
The *Belle van Zuylen* is an Amsterdam canal boat that has an efficient hull design enabling the boat to achieve the minimum required speed limit of 12km/h with a 15 kW Bell Marine drive



Clouds International is a distributor for **Ocean Volt** and were exhibiting the Finish company's electric saildrives which are suitable for seagoing ships. The 8kW or 15kW saildrives have a liquid-cooled permanent magnet motor with the heat exchanger in the tail of the saildrive leg.



Verschuur Watersport were showing an eye catching boat designed by Michiel van Vossen and clearly intended for the canals in Amsterdam. The inboard 2 kW Torqeedo motor is powered by four 160 Ah AGM batteries





Happy Boating... Barbara Pennial looks back on 21 years

I have had the pleasure of being Secretary of the Electric Boat Association for the past 21 years and this will be my last Electric Boat magazine contribution as Secretary. I am handing the baton over (or should that be a charging lead?) to my successor Rob Kay.

My involvement with the EBA followed the unexpected death of my predecessor John Gardner, in January 1996 when the then Chairman Phil Horsley asked me to take over the secretarial duties. I remember being very reluctant at the time as I had two small children and a house to run, but Phil was very persuasive, handing me a file of 18 months' work, saying it averaged 4 letters a month and unless I took it on, the Association would fold. And, as they say, the rest is history. The idea for an Association had been conceived in 1981 during a seminar on electric boating when twenty-three interested parties from the electric vehicle and boating industries came together at Westminster to discuss electric boat potential and the need for an Association.

In July 1983 Admiral Gick's 32ft *Patricia* cruised from Emsworth across a calm Solent to Cowes (22 miles in 5 hours). This was the first electric boat to cruise offshore since 1886 and in 1984, the EBA first appeared on a stand at the London Boat Show. July 1988 saw the first issue of "Electric Boat News" and in November the same year, Lady Arran piloted her 15ft electric hydroplane *An*

Stradag to a new two-way world record averaging 50.825 mph. Cedric Lynch had designed and built the motors that revolutionised electric boating and with media coverage in 88 outlets and prime position on the Pool at the Earls Court Boat Show, the EBA was becoming recognised in the boating world.

I wanted to expand on those early achievements so in 1997 the EBA took part for the first time in an outdoor boat show at Henley. That summer Malcolm Moss crossed the English Channel in his solar boat *Collinda* in a remarkable 6 hours 15 minutes under cloudy skies and in August, *Wagtail V* (29ft) travelled 116 statute miles in 24 hours without re-charging her batteries. The digital revolution had arrived so time was spent setting up a comprehensive website with links to our business members and their products, details of achievements and news of forthcoming and past social events. We organised weekend cruises for private members, attended boat shows all over the country, handing out material on behalf of our business members and giving help and advice when ever was appropriate. Having taken on a data base of 78 private and 16 business members, we were soon over 400 – and counting. In 2005, following developments with hydrogen fuel cells, the EBA took possession of a skiff which had been used as a test bed for a potential future propulsion system and this was taken to various shows as an example of future boating. The Association has always been a champion for promoting hybrid propulsion systems and in 2009 was awarded the Mansura Medal by the Royal Thames Yacht Club. This prestigious award was given to the EBA in recognition of the Association

that is deemed to have done most for the promotion of hybrid power. From the early days of people viewing electric boats as 'unusual', although there have been electric boats on the water in the UK since the 1840s, they are now accepted as readily as are electric vehicles. Many narrowboat owners are members of the EBA, with craft ranging from 23ft to 68 ft, some solely electric, some hybrid with diesel electric and many now solar powered. The Electric Boat Association is recognised as a leading authority on all aspects of electric boating and as the only active English speaking Association, deals with enquiries daily from all over the globe. We have helped to set up similar Associations worldwide and work closely with our counterparts in Europe. The demise of electric boating was partly brought about by the development of the internal combustion engine at the turn of the 20th century and after the First World War, electric boating became more of a specialist recreation. The increased interest in our preferred form of cruising came with the realisation that the earth's resources are rapidly diminishing. That fact is widely recognised, so a great deal of money and resources is now being invested in the development of electric propulsion for vehicles, which would appear to be the way forward in the 21st century and of course we benefit from these developments. How ironic is that!

Thank you, EBA. I have made so many good friends along the way, have enjoyed cruises, dinners, brilliant weekends in excellent company and have thoroughly enjoyed my time with you.

I look forward to keeping in touch and wish my successor the very best of luck and happy boating.



The sun didn't always shine (Ed.)

Battery Tech

Batteries continue to increase in energy density.

MG Electronics have a new line of batteries using NCA chemistry (Lithium Nickel Cobalt Aluminum Oxide (LiNiCoAlO₂)) for 2.5 and 5 kWh capacity batteries weighing 15 and 27 kg. Their energy densities are 6 kg/kWh and for the double capacity, therefore more weight efficient. A battery no more than 5.4 kg/kWh. Torqeedo's Power 2.7 kWh battery, weighing 24.2kg has an energy density of 9kg/kWh. In 2016, Torqeedo unveiled their prismatic-cell BMWi3 33 kWh with its 7.8 kg/kWh weight (as used in the 100 mile range electric automobile of that name) for used with the 40-80hp Deep Blue system. Until now the industry standard weight (except for MG, their special Solar Challenge lithium packs always were super light at round 4.5 kg/kWh) was between 7.4 - 11 kg/kWh, so these new products are real breakthroughs..



More life in Gel Tubular

Leoch, one of the world's largest multi range battery manufacturer has introduced the GTP-12110 the latest addition to the Powerbloc GTP Series. The GTP-12110 is the first gel tubular battery to be produced in a Group 31 case, the most popular leisure battery box size on the market. Its arrival introduces this premium lead-acid technology to a much larger audience and challenges lithium-ion as a fit and forget option at a quarter of the cost. EBA member DBS Energy is a distributor for the battery and expects the GTP-12110 to be particularly popular for the liveaboard and extensive cruising leisure market due to its endurance and deep discharge capabilities. Henry James, MD of DBSE said, 'The GTP series uses the ultimate deep cycling lead-acid technology and until now gel tubular technology has only been widely available for the industrial market but the introduction of the GTP-12110 means that the domestic and hobby market can finally take full advantage of longer lasting battery power.' The battery is totally maintenance-free and can be fitted in any orientation due to the immobilised electrolyte. It also has dual terminals allowing for cleaner connections in series and has a five year warranty

Batteries will keep going for five thousand years

Scientists at the University of Bristol have figured out how to use nuclear waste as an energy source, converting radioactive gas into artificial diamonds that could be used as batteries. These diamonds are able to generate their own electrical current and could potentially provide a power source for thousands of years, due to the long-standing half-life of the radioactive substances. The first generation of Magnox nuclear reactors in the UK used graphite blocks to help sustain the nuclear reactions. During the process, the graphite blocks themselves become radioactive, generating an unstable carbon isotope, carbon-14. The last of these Magnox reactors was retired in 2015, but after decades of nuclear power generation, almost 95,000 tonnes of these graphite blocks need

to be safely stored and monitored while they remain radioactive. And that could be a pretty long time, given that carbon-14 has a half-life of about 5,730 years. While that means carbon-14 has to be stored for an extremely long time, it also means the material could make for some very long-lasting batteries. 'Carbon-14 was chosen as a source material because it emits a short-range radiation, which is quickly absorbed by any solid material,' said Professor Tom Scott, 'This would make it dangerous to ingest or touch with your naked skin, but safely held within diamond, no short-range radiation can escape.' According to the researchers, carbon-14 batteries would only be good for low-power applications – but their endurance would be on a whole different scale. An alkaline AA

battery weighs about 20 grams, has an energy density storage rating of 700 Joules/gram, and uses up this energy if operated continuously for about 24 hours. A diamond beta-battery containing 1 gram of C14 will deliver 15 Joules per day, and will continue to produce this level of output for 5,730 years. That level of output could make the diamond batteries useful in situations where it is not feasible to charge or replace conventional batteries - low-power electrical devices where long life of the energy source is needed, such as pacemakers, satellites, high-altitude drones or even spacecraft. 'It's early days yet, but what's exciting about this research is that it could provide a useful purpose for a huge amount of radioactive waste, in addition to giving such amazing battery life,' Scott said.

Ampere in Ireland

In the last issue of the magazine Ampere, the all electric 58ft narrowboat owned by EBA members Malcolm and Barbara Bridge, had just arrived on the Grand Canal 20 miles west of Dublin and we continue their electric cruise on the Irish waterways

The Irish waterways are shaped roughly like the 'Legs of Man', with the Grand and Royal canals radiating out from Dublin and the middle Shannon linking them to complete the triangular core. The 'legs' then head north, south-west and south-east. Of these, that to the north, which includes the Shannon-Erne Waterway and the two Loughs Erne, is much the biggest. The critical factor when planning a round trip is that a very low railway lift bridge, properly known as the Newcomen Street Bridge though more widely as the "Effin' Bridge", crosses the Royal Canal in Dublin and is only lifted about six times a year. We timed our cruise to catch the lift on 1st May. The journey into Dublin offers an interesting insight into Irish arithmetic. The first lock is No 15 but, as the Irish only count staircases as one lock, by the time you emerge from No 1 you have actually worked 19. Then the Joker is played. When the canal was extended to the Liffey from its original terminus near the Guinness brewery they didn't re-number, just started again at 7. Consequently, Lock 15 to Grand Canal Dock is actually 26 locks. Waterways Ireland insist on boats being accompanied by their staff anywhere within the 12th Lock on either canal for security reasons so we had the assistance of a couple of great guys and made very good time. Grand Canal Dock is an excellent base for visiting Dublin, having locked gates, water and power while being only ten minutes walk from the city centre. Power, by the way, is obtained from bollards by inserting one of WI's ubiquitous Smart Cards which operate almost everything. Card units cost the equivalent of about 50p and give 2 kWh of electricity. The cards also give access to toilets (free), showers, pump-outs and Elsan disposal (2 units each), or laundries (4 units each) and work the locks on the Shannon-Erne Waterway (1 unit each). It is, perhaps,

worth mentioning that the power bollards are tripped at 10A, giving rise to some initial concern on our part as the lowest input we can set on our Quattro is 11A. However, I am pleased to report that, so far, we have yet to trip one.

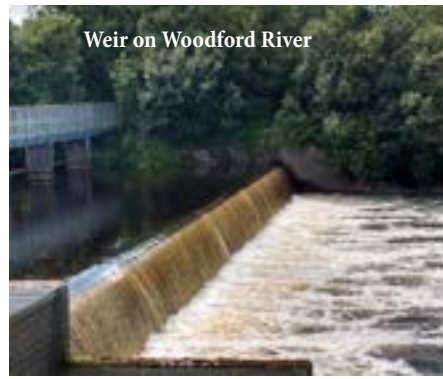
Going from the Grand Canal to the Royal involves crossing the Liffey barely ¼ mile from Dublin docks. However, the river is quite sheltered and was like the proverbial mill pond when we crossed, passing under the aforementioned "Effin Bridge" shortly afterwards. We and the other boat crossing with us were then whistled out of Dublin by no fewer than eight WI guys. The inner suburbs near the impressive Croke Park stadium look pretty rough but there are some nice areas further out. The Royal Canal, re-opened in 2010 after 30 years of campaigning, is a lovely canal with varied scenery and has been well restored, if somewhat lacking in boating facilities. At 90 miles in length there is too much even to try to describe in detail but crossing the M50 (Dublin's equivalent of the M25) on an aqueduct was an experience, as was getting stuck in a narrow cutting behind a broken-down dredger soon afterwards. It was a lovely evening so, after notifying WI of our plight, we tied the bow to the dredger, the stern to an overhanging tree, and sat on the front deck with a glass of wine watching the trains on the line 20 feet above us. The following day, somewhat late as the man who was to move the dredger "first thing" didn't arrive until 10:30, we met up with a road tanker and took on 400 litres of diesel. There followed a series of interesting places, including Kilcock, where the first volunteer restoration took place, the University town of Maynooth, where we caught the end of term celebrations and had drunks on our roof at 02:00, Mullingar, the largest town on the Royal with a harbour



directly opposite the Cathedral, the clock of which chimes every ¼ hour, day and night, and Coolnahay, where a largely original lock cottage operates as a most delightful tea room. Unusually, it doesn't charge, just asks for donations. Quite the most unusual place, however was the Corlea Bog Road Centre, essentially a shed containing about 100' of bog road, cross-laid tree trunks dating from 148 BC discovered during peat digging and preserved by the Mary Rose facility in Portsmouth. Well worth the mile walk from the canal. In rural Ireland the smell of peat fires is ever present. We chanced upon its being dug one evening. The hoppers of large extrusion machines are loaded by excavators and it is then extruded in long strips and left to dry, being cut and turned by hand as it does. The Royal ends at Richmond Harbour where it locks down into the Camlin River and thence into the mighty Shannon. A couple of days upstream then takes one to Carrick-on-Shannon, the boating centre of Ireland, where there are two huge hire fleets and moorings for many private boats. Unlike many towns outside the Dublin area, Carrick is well maintained and quite lively. From there it is only a cock-stride to Leitrim, the southern end of the Shannon-Erne Waterway, another example of tasteful but well engineered restoration, though this is high tech, all the locks being hydraulically operated after inserting the aforementioned Smart Card into



Crossing the Liffey



Weir on Woodford River

a control panel. The name ‘Shannon-erne Waterway’ is more appropriate than the original ‘Ballinamore and Ballyconnell Canal’ as only a couple of miles and three locks are truly canal, the rest being lake and canalised river. The Woodford River, flowing north into Upper Lough Erne, is actually quite large and has some impressive weirs alongside the locks. The border between Northern Ireland and the Republic follows the river for some miles and of particular note are the remains of the old bridge at Aghalane, blown up during the troubles, and the nearby Senator George Mitchell Peace Bridge which replaced it.

The two Loughs Erne could hardly be more different. The Upper Lough comprises a mass of islands separated by reedy channels so there is rarely any feeling of being on a lake at all; the Lower Lough has islands but is mostly one large expanse of water. Both have numerous sites of natural

and historical interest and the Lower Lough, in particular, has plenty of mooring jetties, though few have facilities beyond the occasional water tap. Between the two lies Enniskillen, a pleasant, if somewhat grey, town with two harbours, one conveniently close to ASDA and Tesco, the other in a park on the other side of the river, with an excellent shopping centre between. It also has Headhunter’s, the most unusual railway museum I have ever seen. It’s in a barber’s shop, though taking up much more space than the working area. Well worth finding (which isn’t easy even though it is on the main street). It’s opposite the pink church! Being in Northern Ireland prices are lower than in the Republic (about 20% pre-Brexit, 30% now) and we re-stocked the fridge, freezer and wine cupboard before leaving. Also worthy of note is that deionised water, difficult to obtain in the Republic, is readily available. Returning over the Shannon-erne we were blessed with a week of blazing sunshine and the barbecue had its first outing of the year. We then left the boat in the very safe and hospitable Carrick Boat Club while we paid a flying visit home. It is perhaps a little late to make the point, though better late than never, that the Irish, their boaters in particular, have been wonderfully friendly and helpful. While in Carrick BC we wanted to shop at Tesco, about a mile away at the other end of town. A lady member insisted on giving us a lift and, when we emerged with our shopping, another lady, whom we hadn’t previously met, came scurrying across the car park. “Are you Malcolm and Barbara by any chance?”. When we admitted to it she introduced herself and offered us a lift back to the Club if we would wait a few minutes while



Refuge tower Devenish Island

she bought something from another shop on site. Wonderful! Our low free-board has led many people to warn us not to go on the big lakes as we would surely sink (we didn’t) and almost as many have enquired whether we were sinking (we weren’t). The most amusing example of the latter was one occasion when we left the generator running while we went shopping, returning to find a couple of very concerned gentlemen trying to work out how to prevent this. Occasional bubbles of gas find their out of the below-water, water outlet from the exhaust water separator and these had firmly convinced them that tragedy was imminent. A final story of this ilk. Before leaving Carrick on our way down the Shannon we moored for a couple of days near the town centre. These are finger moorings and we were moored stern-in with our back doors open, though without sight of the walkway behind us, when we heard the patter of small feet and a small voice piped up, ‘Mummy, is that a submarine?’ Nuff said.



15th century cross
Devenish Island



M50 motorway from Royal Canal aqueduct

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Solar Boats and Boating



Saving the world's oceans

Today 80% of global trade is carried by sea and the oceans suffer due to massive pollution, mainly due to the type of fuel used by the large container ships vessels. If nothing is done, the International Maritime Organisation estimates that by 2020 the maritime sector's CO₂ emission will increase by 30% to reach 1,475 million tons per year, directly impacting life and marine resources with the acidification of the oceans, the bleaching of coral reefs or the disruption of the biomass equilibrium.

After a first successful voyage around the world using only solar energy (as *Planet Solar*), *Race for Water* left its home port of Lorient in April on a five year expedition. As the ambassador for the

Swiss Foundation that gave its name to the boat, *Race for Water's* core mission is to preserve the oceans and the expedition has four major objectives: to promote innovative solutions to transform plastic waste into energy; to accelerate energy transition through the development of hybrid solar hydrogen propulsion; to host international research, and to raise awareness of the urgency of ocean conservation.

The boat will be totally self sustainable with the first hybrid engine coupling solar energy with hydrogen produced using seawater electrolysis.

In addition to the sun and the sea *Race for Water* will also use the trade winds with a high-altitude towing kite.



Solar News

50% Efficiency

A new solar cell design could raise the energy conversion efficiency to over 50% by absorbing the spectral components of longer wavelengths that are usually lost during transmission through the cell. This research was carried out by a team led by Professor Kita Takashi and Project Assistant Professor Asahi Shigeo at the Kobe University Graduate School of Engineering. In theory, 30% energy-conversion efficiency is the upper limit for traditional single-junction solar cells, as most of the solar energy that strikes the cell passes through without being absorbed, or becomes heat energy instead. In order to reduce these large energy losses and raise efficiency, Kita's research team used two small photons from the energy transmitted through a single-junction solar cell containing a hetero-interface formed from semiconductors with different bandgaps. The reduction in energy loss demonstrated by this experiment is over 100 times more effective compared to previous methods..

SINTEF

In January 2017, SINTEF (Solar Fueled Electric Maritime Mobility), an independent non-profit research institute based in Norway was awarded the \$1 million 2016 Energy Grant from the United Nations Department of Economic and Social Affairs (UN-DESA), in partnership with the China Energy Fund Committee to demonstrate the feasibility and the social, economic and environmental benefits of solar electric ferryboat transport in Tunisia. Ban Ki-moon the out-going UN Secretary-General said at the awards ceremony. 'The transport sector is responsible for nearly a quarter of energy-related greenhouse gas emissions. It also has significant public health impacts. The answer is not less transport – it is sustainable transport.'



Solar Boats and Boating



Solar electric narrowboat

Australian Mothership Marine were at Crick last year introducing their range of solar electric and hybrid boats for inland waterways

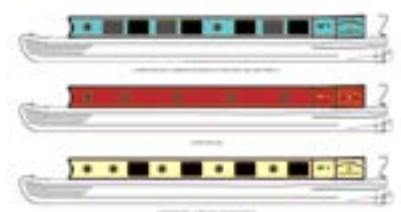
The Mothership Solar Electric narrowboat is a purpose built solar powered boat with a 20kW electric motor and back-up generator. Her steel hull offers the strength and toughness needed for life on canals. But the superstructure is a lightweight super-strong composite that has been moulded to house recessed solar panels. It is an elegant and practical solution that offers many benefits. The exterior finish can be kept classically traditional with a paint finish that would blend into the fleet at a narrowboat rally. Alternatively a low maintenance gelcoat finish simply requires a polish every now and then.



A stunning feature of the Mothership narrowboat is that the sides and roof actually lift up, just like the doors on a gull winged car. With up to 6 gull wing modules the lifting feature also allows for greater efficiency of the solar panels as well as making the interior of the boat light and airy.

The Mothership narrowboat carries nearly 2 kW of solar panels, more than many houses. Interestingly, a high proportion of the energy generated comes from the near vertical panels on the side of the superstructure by way of reflection from the water. There are 4 panels on each side. They have been specially constructed to match the adjacent 4 rectangle hopper windows. Having the solar panels recessed within the roof panel is very practical and helps protect the panels from damage. Unable to find a standard solar panel that was tough, high performance and of a size and style sympathetic to their boats, Mothership commissioned their own panels from a highly specialised company used to making panels for harsh environments like mid ocean monitoring stations and deep space. It also means that

Mothership are able to configure the arrangement of individual solar cells to maximise charging performance. Mothership have incorporated the nineteenth century interior design principles of William Morris in the cabin fit out to bring a sense of authenticity to the build. Morris was a true innovator and they hope that he would approve of the innovations found on the Mothership narrowboat. The 57 foot boat has a semi trad stern, galley, bedroom suite and bathroom. There is no real necessity to have solar panels along the vertical side of the boat. It just helps realise more power from the sun. If the preference is for a boat that has portholes all along the side of the cabin, or various combinations of panels and windows, there is no restriction to doing this in the design and build. It is simply a question of personal choice





Solar Boats and Boating



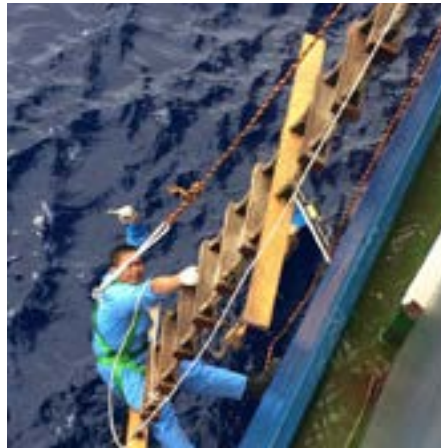
Half Moon Bay to Hawaii

Last year Damon McMillan and a team launched *SeaCharger*, an 8ft (2.3 m) 60 lb. (27 kg) autonomous underwater pod monohull decked by two 100-watt solar panels into the Pacific Ocean from Half Moon Bay, California. Forty one days later they stood in a harbour on the Big Island, Hawaii as *SeaCharger* came to shore, completing a journey of 2,413 miles.

SeaCharger used off-the-shelf electronics as much as possible. The brains of the boat were an Arduino Mega, an Adafruit GPS, a satellite modem from Rock Seven, a compass from Devantech, and a battery protection/charging circuit from AA Portable Power Corp. Information was sent back to the team every two days. In July, McMillan then re-programmed the boat and sent it on its way to Aotearoa, New Zealand, a distance of

4,400 miles.

Disappointingly, in January 2017, after 155 days at sea, during its journey from Lae, Papua New Guinea, *SeaCharger's* rudder failed - just 482km from its final destination. It was rescued by the crew of Liberian freighter *Sofrana Tourville*.



- A: Electronics Enclosure
- B: Devantech CMPS-11 tilt-compensated compass
- C: Sseeduino Mega
- D: Pololu Servo MUX Board
- E: R/C Receiver
- F: Adafruit GPS
- G: Breadboard
- H: Servo
- I: Rudder control arm (connects to servo)
- J: Rudder
- K: Solar Cells
- L: Boat deck
- M: Hull
- N: Carbon fiber shafts with embedded electronics wiring
- O: Voltage Regulator
- P: Battery controller and D/C regulator
- Q: Data logger
- R: Batteries
- S: Balancing Board
- T: R/C airplane brushless motor
- U: 4:1 belt drive reduction using GT2 timing belt
- V: Thruster
- W: Propeller
- X: Prop screw
- Y: Keel enclosure
- Z: Black delrin thruster pod endcap



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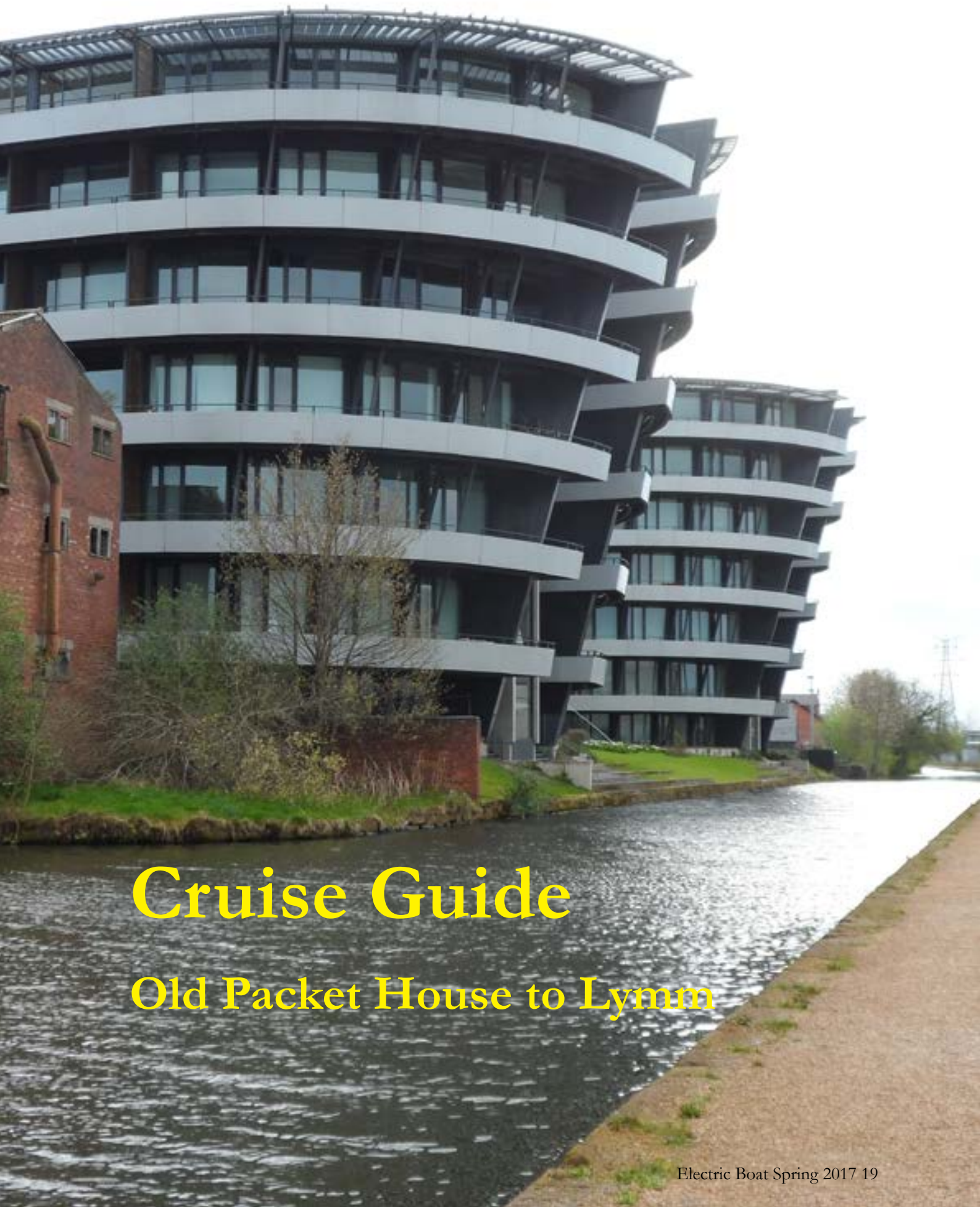
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Cruise Guide

Old Packet House to Lymm

Cruise Guide

Our opening cruise for the season is a short trip along the Bridgewater Canal arguably the first true canal in the UK. Our trip is along the western section to Liverpool which was finally opened in 1776. Once clear of Manchester's environs this section has retained much of its rural character, but as befitting a canal that carried the coal that fuelled the Industrial Revolution there are remnants of industrial archaeology all along the route, the most obvious being the listed 18th century hump back bridges. The Bridgewater is a wide gauge contour canal, keeping to a line 25.2 metres above sea level, which means that not only are there no locks but that also the waterway meanders pleasantly through the Cheshire countryside.



Old Packet House to Lymm

The Bridgewater Canal continued to carry commercial traffic until 1974. Passenger traffic to Liverpool in lighter constructed faster "packet" boats started almost as soon as the canal was completed. These boats picked up travellers and mail at designated stops and the Old Packet House pub was originally a small cottage and one such collect and drop off point. The pub is behind the oldest surviving canal side

warehouse in the UK. Although it has lost an upper storey, and is now used as a hire shop, its canal side shows very clearly the distinctive features of a Duke of Bridgewater warehouse, with boats being able to enter the warehouse under an arch (now bricked up) for loading and unloading.



This is the start of our cruise, as it was for travellers almost 250 years ago. We are no sooner under Altrincham Bridge, first built in 1765, when we pass an even better (although later) example of a Duke of Bridgewater canal warehouse, now disused and in a worse state of repair. We are passing through the edge of Broadheath which



Cruise Location





Lymm canalside

was a significant early 20th century light engineering area, attracting bombing raids during the second world war (one of which took the roof off the first warehouse). Towering over the second warehouse and overlooking the canal like the prows of cruise liners is the Budenburg Haus Project, a Norman Foster design of flats, and one of the first Urban Splash regenerative developments in Manchester. Before its buildings and site fell into disuse



Budenburg Gauges made instruments for submarines. The adjacent old Linotype works come quickly into view and again the listed old buildings are part of a conservation area and being integrated in a huge new build residential project. The canal now moves away from the 19th century factory wharves that once received raw materials and distributed finished product and we soon reach Oldfield Quays which is a feature of the last modern suburban housing development before reaching the open countryside.

The canal now reverts to its 18th century form as it passes through a rural landscape and under all the Grade 2 listed brick built hump back bridges which are one of the features of the canal. We cross over the rebuilt River Bollin aquaduct which was the site of a major breach in 1971 which closed the canal for two years. We pass along a large embankment at the edge of the National Trust's Dunham Massey estate which gives excellent

views of the rolling Cheshire fields as they fall away into the valley of the River Bollin. As we reach Agden we pass the modern boatyards of Lymm Marina and then Hesford Marine.



Then in a reminder of how boats were serviced in the past we reach the disused building that used to be the Old Canal Horse Hospital.

Our approach to Lymm is signalled when we pass the Lymm Cruising Club Headquarters which has its own slipway. Going under Lymm Bridge, the last old humpback bridge on this cruise, we pass the outdoor canalside terrace of the Golden Fleece pub before reaching the visitor moorings at the bottom of Bridgewater Street.



1.5 mile

2.0 mile

Agden

Lymm

Info

Launching

Hesford Marine, Warrington Lane, Lymm, WA13 0SW, has craneage and slipway facilities.

Tel: 01925 754639

Licences

All craft using the Bridgewater Canal must have a Bridgewater Canal Licence. The Bridgewater Canal is privately owned by Peel Holdings and they have recently changed the reciprocal licensing arrangements for CRT licence holders. The Bridgewater Canal Co now charge £40 for boats staying on the canal for more than seven days or returning within 28 days.

Licence application forms and fees are available on request by contacting:

bridgewatercanal@peel.co.uk

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Broadheath

WA14 1LW

Tel: 0161 929 1331

Real ales

Lunchtime meals

Accommodation

Tourist Information

www.visitcheshire.com/places/lymm-p34871



Lymm

Lymm is a completely unique place name, thought to be Celtic in origin, meaning place of running water.

Although the Bridgewater Canal is our cruise guide focus the Celts were referring to Slitten Brook and Lymm village is at the bottom of a steep ravine created by this tributary of the River Mersey. Now only an exploration on foot up the Dingle to Lymm Dam gives a sense of the ancient settlement topography.

Lymm Dam was created in 1854 by building a turnpike road across the head the ravine which saved the stagecoach a steep descent into Lymm and an even greater climb out of the village after turning sharply at Lymm Cross, a listed market cross dating to the mid 17th century. The lake created by the dam now has a Recreational Park Green Flag award for excellence. When the canal reached Lymm in the mid 18th century the village became a manufacturing centre for fustian cloth. But before then Slitten Brook had powered an even earlier industry producing slit iron for nails, spikes and coopers' barrel bands. Lymm Slitting Mill fell into disuse in 1825 and was excavated by local historians in the 1970's revealing the foundation walls, the mill keeper's cottage and the remains of the waterwheel pit.

Charging points

The Bridgewater Canal has a number of cruising clubs and although the EBA is no longer a member of the Association of Waterways Cruising Clubs and it may be worth contacting the local AWCC representative to ask whether mooring and charging facilities are available.



Brewery Tap

The Lymm Brewing Company is a small micro brewery located in what used to be the old post office building on Bridgewater Street in Lymm.

Future cruises

Where next?

Have you got a favourite waterway to recommend for a day's cruise?

Has it got things to see, places to go?

Can you take a good digital picture?

Contact: editor@eboat.org.uk

The Brewery Tap is directly above the brewery and the canal, which is carried on a viaduct over the street, is visible from the front door of the pub and can be reached by a short cobbled road opposite. As well as brewing their own beer (Bridgewater Blonde highly recommended) the Brewery Tap also sells beers from the associated Dunham Massey micro brewery. Pies and sandwiches are available from the deli next door and hot baguettes can be ordered and delivered direct from the *Butty and Sweet* a cafe boat moored close by on the canal.



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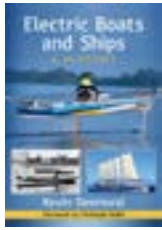


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Kevin Desmond

the founder editor of the Electric Boat magazine reports on electric boats around the world

His book "The History of the Electric Boat and Ships 1835 to the Present Day", is due for publication in 2017.

Kevin's first article about electric boats was published in 1979.

DutchCat 12



Netherlands

Jan van Eck of Wateringen, the Netherlands, has launched his 12.55 m DutchCatTwelve catamaran concept, designed by Vripack naval architects with a beam of 4.90 m and a draft of just 0.8 m, coming in 6 propulsion options: 100% electric from twin 10 kW Krautlers with a 48 kWh WhisperPower gel battery, series or parallel hybrids or twin 30 hp Yanmar diesels. Alongside this, each owner can select the interior layout, cabin or fabric schemes.

DutchCatTwelve was nominated as European and HISWA Powerboat for 2017

Zero- emission

Norway

Norwegian ferry operator Fjord 1 is building two pure battery ferries to meet Norwegian Government requirements for zero-emission technology. From January 2018, Fjord1 will be operating the two new battery ferries on the 2.4 km route between Anda and Lote on the west coast of Norway and this will be the first ferry connection in Norway where the Road Administration requires the use of zero-emission technology. Construction of the new ferries has started at the Tersan Shipyard in Turkey..



Grove Boats takes on Ruban Bleu brand



Switzerland

Two longtime key players in the e-boat movement have joined forces. EBA member Grove Boats of Yverdon-les-Bains have become distributors for Ruban Bleu, based in Nantes, Brittany, the European leader for electric boats used for rental, hotel resorts and for private individuals looking for a smooth and quiet electric leisure boat. Over 1400 boats are operating throughout Europe and Ruban Bleu's products portfolio covers a range of elegant units with a capacity from 4 to 11 passengers. Grove Boats will now be distributors and provide customer service for the Ruban Blue range

Electric Boat International



Ferry electric

Sweden

From 2018, the world's largest emission-free electric ferries, *Tycho Brabbe* and *Aurora*, formerly diesel-powered, will operate completely on battery power between Helsingør (Denmark) and Helsingborg (Sweden), a distance of approximately 4 km carrying more than 7.4 million passengers and 1.9 million vehicles annually. The new battery solution will help lower total emissions across the fleet by more than 50 percent from the current diesel operated vessels. The combined battery power of 8,320 kWh for the two ferries is the equivalent of 10,700 car batteries. ABB will supply the complete power and propulsion systems and in particular, at both ends, the first automated shore-side charging stations using an industrial robot, to optimize the connection time and therefore maximize the charging period.



Russia

Electric Trawling

Max Zhivov of Russia is known for creating boats with green credentials. His previous vessels have included mega-yacht *Black Iceberg*, which has 32 m² of solar panels on the upper surface of the superstructure, and the 47 metre *Sky Ya*, a semi-displacement hybrid superyacht which also uses solar technology

Zhivov has now designed the e-powered Trondheim 40 Trawler. 'The boat has A class power efficiency. This means we have 30% longer range with the same fuel storage as other 40 feet trawlers,' Zhivov said. The Trondheim 40 Trawler is designed to go into shallow and icy waters, like Alaska or the Norwegian fjords. The vessel, which can accommodate up

to six people on board, also has other advantages such as greater storage space because of the small size of the electric motors

'It is designed for extended voyages, where conditions may exceed wind force 8 and significant wave heights of 4 metres and above, but excluding abnormal conditions,' explained Zhivov. It is powered by two Torqeedo Deep Blue i 1400 rpm electric motors and two 64 Kwh large capacity batteries. 'This will allow six hours under electric propulsion in total quiet like on a sailing yacht,' said Zhivov. It has also been designed with two Torqeedo 25 kWh high voltage generators which supply on board electronics for high level heating and air conditioning comfort.

Electric rudder propulsion

Denmark

Torqeedo have teamed up with Hans Yachts of Greifswald, in Germany and Jefa of Copenhagen, Denmark, to produce an e-motion rudder drive, first tested with a Hanse 315. The core of this innovative concept is a specially adapted 4 kW (8 hp) Torqeedo Cruise 4.0 with folding propeller, designed into the rudder blade itself. The streamlined system replaces the combustion inboard or saildrive and removes the need for a separate thruster; The Jefa rudder blade's range of motion is extended to a

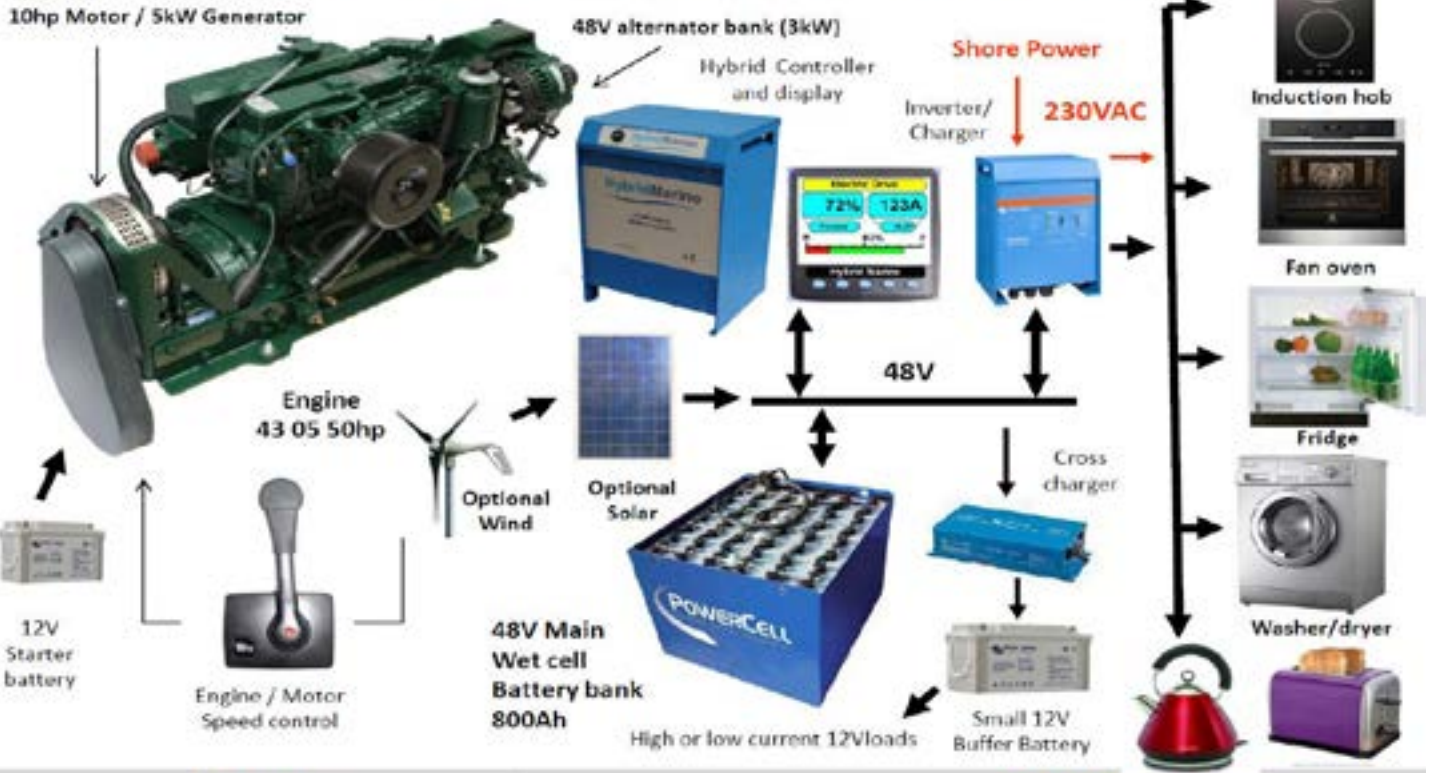


total of 100 degrees. While docking, the stern can easily be maneuvered into the proper position. This is highly useful in windy conditions or in narrow slips.

All pre-docking procedures are based on 3D laser scanning and wireless communication between ship and shore. During the last 400 mm of the ferry's approach the robot will reach out and pull the shore cable from the ship. The cable reel releases the cable and the robot moves the connectors to the corresponding connectors below the robot.

After the connection is made, the robot moves back to the home-position and the roll-up doors closes. The robot will reside inside its own building when not in use.

Narrow Beam 10kW Hybrid system



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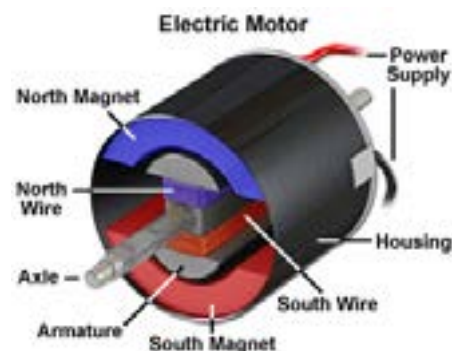
Michael Faraday

Barbara Penniall continues her research into the history of electric boating.

It is possible we would not have an electric boat industry in the 21st century had it not been for a chemist called Michael Faraday. Born over 200 years ago in Surrey on 22nd September 1791, Michael Faraday, was an amazing man. In spite of having received very little formal education and without any knowledge of higher mathematics, Faraday was self taught and eventually became one of the most influential scientists in history with a name known to every schoolchild studying physics.

Born into a poor family, his father James was a blacksmith who came to London in the 1780s from the north of England. The four Faraday children only received the most basic education but Michael had a thirst for knowledge and taught himself to read and write. When he was fourteen he had the opportunity to be apprenticed to a George Riebau, a book binder and bookseller. During the seven years he studied the book binding craft, Faraday had the opportunity to read many volumes including Isaac Watts' *The Improvement of the Mind*. This book sparked a real interest in the young Faraday to study science,

especially electricity. At that time public lessons were being offered in London by the best scientists of the day and Faraday took copious notes which he then showed to the famous chemist Sir Humphrey Davy. Perhaps Davy recognized himself in this young man's thirst for knowledge, and in March 1813, he offered the 21 year old a job as his assistant. That was the opportunity that Faraday craved and he repaid Sir Humphrey's generosity by his diligence in helping him until there came a point he was making new discoveries of his own. In 1821 he married Sarah Barnard and the same year he made the first electric motor by creating a simple electromagnet. By taking a nail and a wire and wrapping about 100 loops of wire around the nail, he connected this to a battery and made a simple electromagnet with a north and south pole. In the middle of the nail he made a hole and put a spindle into the hole so that the nail could rotate. He then placed a horseshoe shaped magnet with the wire wrapped nail in the middle and connected the north pole to the negative pole of the battery and the wire of the south pole to the positive pole. The basic law of magnetism meant that the north end of the electromagnet would repel the north end of the horseshoe shaped magnet and would attract the south pole. The same thing happened on the opposite side which meant that the nail turned and that was the beginning of what would become an electric motor.



The following year he made another demonstration example with a wire suspended in a bowl of mercury with a magnet underneath.

Made a professor in 1833, Michael Faraday was the first person to become a life Fullerian Professor of Chemistry at the Royal Institution of Great Britain and he followed his mentor, Sir Humphrey Davy as the Director of that Institution. The importance of his work was recognized in his own lifetime and the British government gave him a pension for the remainder of his life. Queen Victoria offered him a knighthood but it is known that he 'rejected it gracefully'. He died on 25th August 1867.

Michael Faraday made a huge contribution to the benefits we take for granted in everyday life in this, the twenty first Century. An early pioneer in his field, other scientists built on his work and it is known that Albert Einstein kept a photograph of Faraday in his study beside Isaac Newton and James Clerk Maxwell. Illustrious companions indeed for a poor blacksmith's son.



Faraday's lab at the Royal Institute Museum, and the only original surviving example of his apparatus transforming electrical energy into mechanical energy



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Hybrid Narrowboating

EBA member Rob Tanzer looks at conventional boat fuel consumption compared to a hybrid/electric

Much is talked about electric boats and the benefits of fume free cruising. However, the problem remains that the battery has to be charged at some point. Using a generator simply means that once the battery has discharged, all the energy used for propulsion must be replaced. If the battery is recharged from the mains supply then we can rest assured that the energy comes from a reasonably efficient power station and around 25% of the energy will have come from 'green' sources. However, when charging from a local generator, the boat engine fuel and pollution is simply replaced by the fuel and pollution of a relatively small generator which will be much less energy efficient than the national grid. In addition, in this situation, there is no fuel saving for the user. Hybrid boats have the potential to be significantly more energy efficient than electric boats and are certainly much more efficient than a standard narrowboat.

A standard narrowboat of around 57ft would typically have an engine that would be rated at around 30kW. When pushing a 60ft narrowboat at normal canal speeds it is likely to be using just 3 to 4kW of power. Therefore it will be running at around 10 - 15% load. The best efficiency achieved by a slow revving diesel engine in a boat is likely to be around 30%. However at normal canal speeds the diesel engine will be achieving a much lower efficiency which might be around half or even less than its potential efficiency at a heavier loading. The efficiency could be as low as 10%. When cruising on a canal, the fuel consumption will typically be 2L/hour and the engine will continue to consume approximately 1L/Hour on tickover in locks. In order to compare the fuel consumption of a standard boat compared to a hybrid boat, I have considered a 4 hour day that consists of 3 hours continuous cruising and 1 hour in locks. On this basis the traditionally powered boat would cruise on its engine power for 3 hours and would use use 2 litres of fuel/hour so the total fuel consumed would be 6 litres plus 1 litre for the additional 1 hour in locks. The total is

therefore 7 litres of fuel.

Compare this to a hybrid boat. The hybrid would run on its electric motor using battery power for 2 hours at 4kW per hour which means that it has consumed 8kW/Hr of battery energy. This battery power needs to be replaced and so it then runs for the next 1 hour on the engine. The battery charging capability of a typical hybrid narrowboat is about 8kW which means that with 4kW of propulsion load this amounts to 12kW engine load. The 8kWhr consumed when running on battery can therefore be replaced in approximately one hour and the engine will have consumed 4 litres of fuel. Compare this to the 7 litres of fuel used by the conventionally powered boat. Couple this with the additional kW/Hours that can be provided by a few solar panels and it can be seen that a 50% fuel saving is easily achievable. My own 60ft narrowboat *Watt Now* has 1kW of solar panels which in practical terms means that in the UK, on a reasonably sunny 8 hour day I do get a significant amount of energy put back into my battery.

My thanks to Graeme Hawksley of Hybrid Marine for the basic fuel consumption data.



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