

Spring 2023

ELECTRIC BOATS

INTERACTIVE



FEATURE BOAT

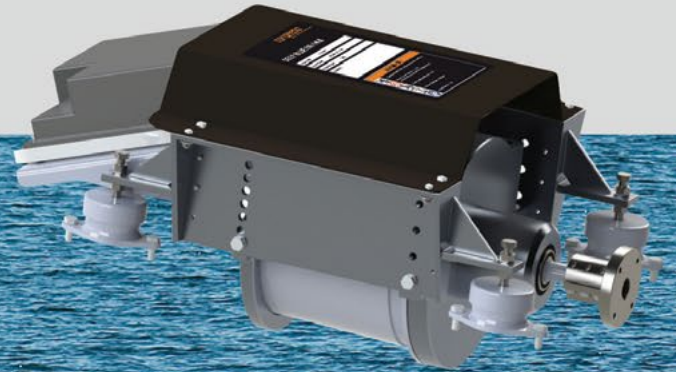
eMogi Aluki

CRUISE GUIDE

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Contributions from 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 Boats interactive** should be sent to the editor (preferably by email) by the following dates:

Spring 31 January
Summer 31 July

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History is King

Spring 2023 sees the Coronation of Charles 3. Our Spring 2023 cruise guide (p17) takes us into Chester following the old Chester Canal and by Rowton Moor. In 1645, long before the canal was built, the Parliamentarians routed the Royalists in one of the last major battles of the English Civil War. The Royalist forces retreated to Chester, some possibly along the line of the much later canal cut. It is said that Charles 3's predecessor Charles 1 watched the battle from Chester's City Walls before fleeing himself from the city. The King Charles Tower on the Walls has a plaque which records the legend that on the 24th of September 1645, during the Civil War, King Charles I stood on the tower and watched his army defeated in the battle of Rowton Moor. However Rowton is not actually visible from the tower but the Tower is certainly high enough to be seen from anybody cruising the canal. The British canals are a linear network of the Industrial Revolution's history and heritage. Both the Inland Waterways Association (p12) and the Canal and River Trust (p13) are guardians of this heritage but sometimes it takes one of them to point out to the other the importance of treading carefully. And if you want to get more involved the Canal and

River Trust has launched an appeal for thousands of volunteers to work along the Trust to protect and preserve the 2,000 mile canal network (p13).

If you just want to explore this heritage from the water up, an electric kayak (p6) is a great entry level boat (and it can be carried around locks) As ever there is nothing new in electric canoes. The Ray Motor Company was building them in 1920 after the First World War (p35).

Electric RIBs will also be highlighted by the Round Britain eRIB challenge as part of the marine industry's transition to electric propulsion for leisure and small commercial craft (p13)

The Olympics, which is always a showcase for the latest urban mobility systems, return to Paris in 2024 and it will be interesting to see whether electric boats will be used to ferry people on the Seine. Or possibly accomodate them in floating solar hotels (p23).

Fuel cell technology continues to develop at a fast pace and the Vendee Globe Race next year will have a hydrogen powered International Monohull Open Class (p30)

Don Wright

Cover: eMogi Aluki

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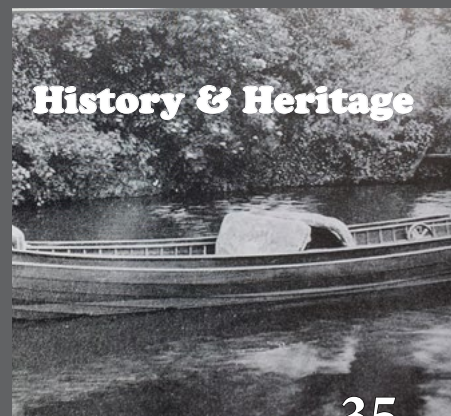
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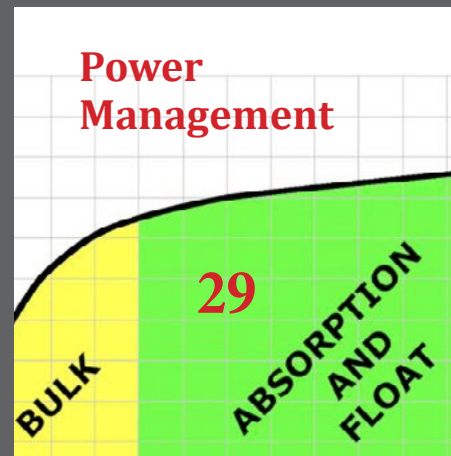
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eMogi electric kayak

The eMogi kayak company is a new start up based in the city of Olomouc in the north east of the Czech Republic. The city borders the Morava River at its confluence with the Bystřice River. The Morava is a tributary of the Rhine and the river system at Olomouc is a great location for kayaking. With more than three years of development the eMogi Electric Kayak was created to enable river navigation against the current, so that having cruised down a slow moving river it is possible to get back to the launching site upstream and avoid needing two pick up points, giving kayakers much more independence.

Like an electric bike, an electric kayak offers powered assistance if and when needed.

The boat made its debut in Summer 2021 on a promotional tour of northern Europe. The eMogi kayak was then featured in the November 2022 Prague expo 'E-salon a clean mobility exhibition'.

The eMogi is next looking to exhibit at Demark's largest boat show at the end of February 2023. The show is biennial but has not been held since 2109 as a result of the pandemic and it is expected to attract a very high number of visitors and exhibitors.



Morava River Olomouc





eMogi Aluki

There are two versions of the eMogi electric kayak; the Aluki and a higher spec Aluki R.

It is possible to attach electric motors to conventional kayaks but eMogi have developed a kayak as an integrated high-tech product with a patented electric drive and wireless controller on the paddle. The system is fully integrated and is operated by controls fitted to a normal kayak paddle which allows assisted paddling if needed in a strong river current or if travelling greater distances. It is the only motorized kayak that can be comfortably carried with a weight of around 22kg. The eMogi kayaks are hand built with custom colours using vacuum technology and top grade carbon materials combined with quality epoxy resin, sandwich materials (Aeroglass, Coremat, Honeycomb) which makes the eMogi electric kayak light and easy to carry and handle. The kayaks are very stable with a vessel stability level 5 and include safety device which cuts off the motor should the kayaker fall off the boat. eMogi provides an authorized warranty and post-warranty repairs and service.



Technical specifications

	Aluki	Aluki R
Length :	3.23 m	3.23m
Width :	.70m	.70m
Weight from :	25kg inc battery	22kg inc battery
Construction :	aeroglass	aeroglass, carbon-coremat
Motor:	1kW	1kW
Voltage :	22V	22V
Batteries from :	20 Amp.	40 Amp
Charger :	24V/5A	24V 12A
Maximum speed :	10 Km/h	20 Km/h
Range :	7h	11h



Propulsion: Motor and Propeller

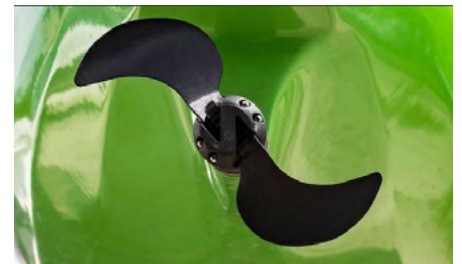
The Aluki electric kayak is powered by a 1kW 22.2 volt pod motor. The power/maximum speed of the engine is set during the manufacture and gear ratios configured according to the customer's preferences as to greater range or higher speed for the higher specification Aluki R model.

Speed and range data are only indicative, as they are influenced by several factors – especially passenger weight, water surface, temperature and current, wind intensity, and paddling, etc. The maximum speed can be set to match the purpose and use of the kayak. If the kayak is for rescue or for example river police, the power can be configured up to 20 km/ hour and provided with higher capacity batteries so the time and range increases. If the kayak is for rental, the power can be set from 2-10 km/ hour. The speed can also be varied manually with the

voltage controller but not more than 10 km/hour.

The electric Aluki has an in house custom designed foldable propeller for efficiency, simplicity and easy replacement. The centre of the propeller is made of durable nylon, not 3D print, so unlike solid propellers any damage only requires the replacement of the blades, not the whole propeller, and the replacement blades can be 3D printed from a file provided by eMogi

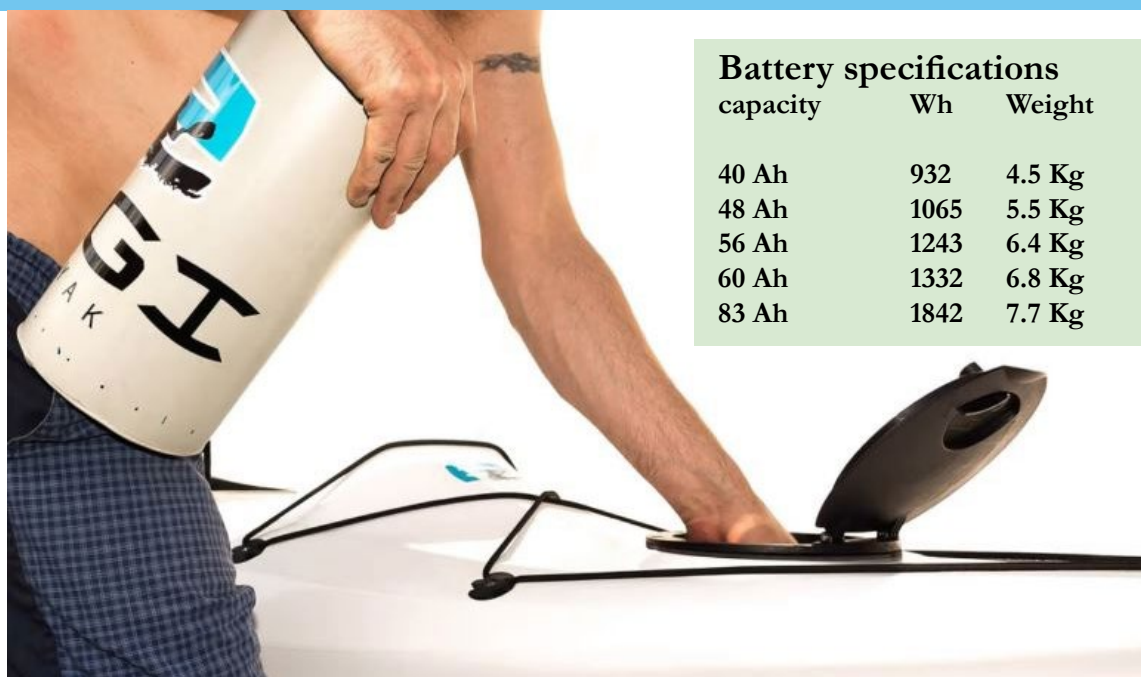
eMogi can also supply a solid three blade propeller that doesn't have the efficiency of the foldable prop but will endure harsh conditions. The three blade propeller will cause drag in the water when the motor is not running and the foldable prop allows normal kayak paddling without any motor propulsion. The foldable propeller is also a benefit when paddling in weedy waters because when the motor is stopped the propeller folds and any weed picked up or any other fouling items fall off



eMogi POD Motor Technical specifications

Power: 1.0kW

Voltage: 22 volts direct current



Battery specifications

capacity	Wh	Weight	Running Time
40 Ah	932	4.5 Kg	1.2 - 11 Hrs
48 Ah	1065	5.5 Kg	1.5 -13 Hrs
56 Ah	1243	6.4 Kg	1.7 - 16 Hrs
60 Ah	1332	6.8 Kg	1.9 - 18 Hrs
83 Ah	1842	7.7 Kg	2.6 - 23 Hrs

Energy supply and storage



The lithium ion battery is housed in a lockable storage compartment which opens fully for ease of access and a spare battery can be carried in the forward watertight compartment. The eMogi Li-on batteries are available in different capacity sizes



eMogi electric kayaks battery charger
Output: 25.2 V / 12 A
Input: 100 – 240 V ac / 1.5 A

Kayak control and monitoring

The eMogi electric kayak has a wireless thrust controller integrated into the kayak paddle. This enables the user to hold a paddle as normal in a standard kayak and steer in the same way by dipping it in the water to act as the rudder.

The control buttons are at hand positions on the left and right side of

the paddle stem.

The green button activates the electric propulsion with 3 gear speeds and red button switches the motor off. This gives full control of the kayak while using the paddle compared to kayaks with a separate outboard propulsion system in addition to a paddle.

After testing several rudder types

eMogi decided that using the paddle always proved to be the best way to secure full control over the electric kayak both moving forward and navigating in any situation.

A small screen in front of the kayak cockpit monitors the motor engagement and the remaining battery capacity





Electric tandem in development

When developing an electric kayak eMogi first choose a kayak model, which is suitable for integrating the electrical equipment. They then customise the kayak by cutting and making spaces and adding necessary parts - a form for the shaft, a form for the display, waterproof chambers, battery space etc..

Once the model has been created to their satisfaction it is used as a GRP mould for layup and vacuum manufacture.

The eMogi team have been given the shell of a half-made tandem kayak for testing on the water and are now working on the shell to integrate a

motor and electrical system.

eMogi think this electric tandem will be great leisure kayak for pairs and families.

The standard seat in the Aluki single kayak can be replaced at the manufacturing stage with a seat developed for disabled athletes available in four sizes with adjustable foot rests and straps

eMogi also thinks this tandem kayak will be great for people with all kinds of disability and they plan to integrate the electric controls into the back seat for the leader of the boat and the front cockpit can include a seat suitable for disabled users.



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In Brief

Canalscape heritage

The IWA's Heritage Advisory Panel supported the North and East London Branch in objecting to a proposal from Canal and River Trust to dispose of the strip of land alongside Commercial Road Lock between two historic bridges, twin arches of the Commercial Road Bridge and the fine single arch of the docks railway, now DLR. This canalscape is very important to the character of the designated Regent's Canal Conservation Area and the IWA considered that anything built on the site would inevitably damage these views. Additionally they believed that it is inappropriate to dispose of any land that forms part of the operational environment for a canal lock.

The Canal and River Trust responded to the objections saying that they "accept that that the sale of this land on a freehold basis is not in the best interests of the Trust and we will not be progressing it."

Listed building consent

IWA North Staffordshire & South Cheshire Branch submitted an objection to a Canal & River Trust planning application for Listed Building Consent for alterations at Hazelhurst Top Lock (Lock 10). IWA objected strongly on heritage and health and safety grounds to one aspect of the application, which was the proposal for a fabricated "restrictor" on the end of the balance beams. The IWA was concerned that this would have had a detrimental impact on the heritage setting of the listed lock (which is also part of a conservation area), and would have introduced a new unexpected hazard to boaters operating the lock, who would no longer be able to pass around the end of the balance beam in an emergency. The Canal & River Trust have now removed the part of the application referring to the balance beam "restrictors".



Electric Cheetah

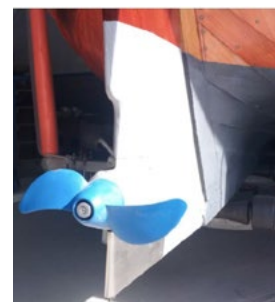
The all-new Cheetah Adventure 720 family catamaran is the first boat in the joint venture between the Isle of Wight companies Cheetah Marine and the RS marine group of businesses RS Sailing and RS ElectricBoats. The collaborating companies have created a spacious family style catamaran as a low maintenance, all purpose, a workhorse. The Cheetah Adventure is being developed with an EV future capability and over the course of

2023, an EV model will be available as improved technologies become production ready. Cheetah Marine has been producing bespoke commercial and leisure catamarans for fishermen, police, hydrographic survey, charter and others for thirty years. The new collaboration looks to modify some of Cheetah's existing commercial workboat products for EV markets and then to increase its range of leisure catamarans.

Electric Skiff runs like a dream

Scottish boatbuilder, A & R Way has embedded an ePropulsion Spirit 1 EvoRemote system into a rudder on a new-build Oban Skiff. Adam Way says the boat runs like a dream, and no one sailing by could tell that the 1880s design skiff has an electric secret. The propeller is at the bottom of the rudder, the controller is under the seat, and the LCD screen is inside the boat. The battery clips into the boat's centre.

Having the propulsion system in the rudder doesn't appear to have affected steering at all. Way found that with ePropulsion Spirit models there's less drag on the propeller compared to some of their competitors. 'Because it's direct drive, there is no gearbox, which means it's very smooth turning,' Way says, 'a lot of electric motors are made to emulate petrol outboards but once taken apart LCD screen, battery etc can go anywhere in the boat'.





Wheelchair electric boat

The new Coulam V17 Wheelyboat, the first fully electric wheelchair-accessible hire boat has been launched on the River Avon in Warwickshire. by Avon Boating. The boat is designed for local disabled people, their friends and families, and the many disabled tourists who visit each year, enabling wheelchair users of all ages and abilities to independently access and enjoy the waterway that runs through the heart of Stratford-upon-Avon. Funding support comes from Stratford District Council and national charity The Wheelyboat Trust. The V17 is said to be The Wheelyboat Trust's most versatile Wheelyboat yet. They are suitable for use on inshore waters such as lakes, rivers and canals, and are perfect for pleasure boating.

The boat's Torqeedo Cruise2 outboard runs very quietly, and is capable of a full day's boating without needing to charge. Every Wheelyboat has roll-on, roll-off access, an open and level cockpit, and their drive-from-wheelchair helms enable anyone in a wheelchair not only to board easily and move around safely but drive it too. Gerard Walmsley, director at Avon Boating, said, "For a long time, we've wanted to be able to accommodate wheelchair users, or anyone with more complex mobility issues, on our hire fleet. With the purchase of the Coulam V17 Wheelyboat, we can finally offer this service'. All Wheelyboats are handmade and fitted out to order by Jim Coulam of Coulam Boatbuilder in Lincolnshire.

In Brief

Dead Dog Bridge

The The Grade II Listed Interchange Basin Towpath Bridge on the Regent's Canal in Camden, the busiest canal footbridge in the country with over one million walking and cycling visits per year, is set for a £533,000 ten-week repair project by the charity Canal & River Trust. Built in 1846, the historic bridge known locally as Dead Dog Bridge carries the Regent's Canal towpath across the canal basin beneath the Camden Interchange Warehouse, nicknamed 'DeadDog Tunnel'. Built by the London & North Western Railway, the massive Grade II Listed red brick Interchange Warehouse was designed to bring together canal, rail and road transport in one covered building, with three layers of storage. The entrance to the Interchange Dock became known as 'Dead Dog Tunnel' because, historically, debris, including dead animals, accumulated here at the end of the 26-mile lock-free stretch of the canal flowing into central London. The bridge repairs have been enabled by an award from Postcode EarthTrust thanks to funds raised by players of People's Postcode Lottery. To date, over £16 million has been raised by People's Postcode Lottery players to support the conservation work of the CRT

Volunteer appeal

The Canal and River Trust has launched an appeal for thousands of volunteers to work alongside work with the Canal & River Trust charity in its growing mission to protect and preserve the nation's 2,000-mile historic canal network across England and Wales. The Trust is appealing for its largest ever range of volunteer roles and activities, from lock keeper, through to numerous community, administrative and professional support, wildlife and heritage conservation opportunities

Electric RIB around UK

The Round Britain eRIB challenge

is a not-for-profit event which aims to support the marine industry's transition to electric propulsion for leisure and small commercial craft. Setting off from Lyme Regis in Dorset, using a combination of shoreside infrastructure and on-water charging, Harry Besley, a 17 year old skipper from Taunton, will attempt to drive an electric boat around Britain in Summer 2023. The electric RIB being built specifically for the Challenge will be used to showcase the capabilities of electric propulsion in UK coastal waters. The Clean Maritime Plan 2050 has targeted all new vessels in UK waters to be designed with zero emission propulsion capability.



Introducing the Virtual Club House. A members only place where members can chat about all things electric boating.



by Tim Knox EBA Secretary

It's a great pleasure to welcome you all to the Virtual Club House. This is a safe members only space where we can all pop in for a chat.

Its not easy to get together as we have members over the world. Pandemic or no pandemic.

The Club House has three main sections.

1. The Newsfeed - this is a chat room and a place where you can spread some good news or a funny story or nice pic of your boat.
2. The Forums - These are specific topics of conversation eg. 48V batteries or charging points on canals or lack of.
3. Boating areas - This is to help you to get together with people in your area, either on the water or at your local watering hole.

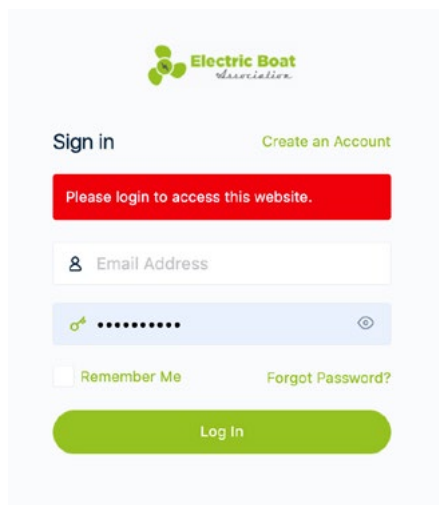
Information and Privacy

You need to sign in to get access to the Club House and you'll need to update your profile. This has great benefits. We need your up to date

details to effectively run this organisation. Previously this has been on spreadsheets that needed to be updated manually, a laborious and time consuming task. Now all information is held on 1 secure database. It means that you can access the Club House and we can easily send you updates via email and post out the EBA magazine. (this magazine has been sent using the old spreadsheet because there are still a few members who have not signed up to the Club House). Whist the administrator can see all the information you choose what information is seen by other members. You have the choice of Only You, Your Connections (those people you have agreed to share info with) or All Members. It is entirely your choice.

How to sign in for the first time

From www.electricboatassociation.org click 'Club House' in the top nav

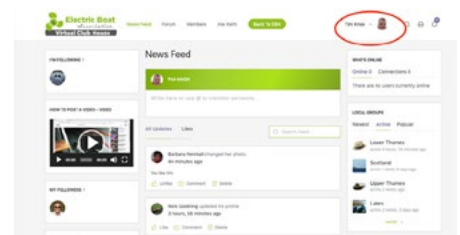


Use the email address we have for

you and click forgot password. You'll be directed on how to get a new one. (There are still some members for whom we don't have email addresses. If that is the case please email me at secretary@electricboatassociation.org and I will make a link to give you access)

Updating your profile

Having gained access to the Club House please update your profile.



This is done by clicking on your name, found to the right of the top nav. Be sure to answer all of the required fields and choose the level of privacy you are happy with. And save!

Boating Area

If you want to find members in your local area for an impromptu meet. Go to the members section (top nav) and search for your boating area eg. Upper Thames. You will need to 'connect' with them in the first instance.

I sincerely hope you enjoy the Clubhouse, there will be teething problems but over time we will improve its functionality and scope. I'm sure it will prove a powerful tool to aid the EBA in to the future.

Clubs and Associations

As Edward Hawthorne's book (serialised on page 35) reveals boats powered by electric motors were on canals and rivers long before the internal combustion engine took over propulsion and the resurgent interest in electric boats is reflected in the clubs and associations that can be found all over the world.



The Electric Boat Association of America was formed in 1992 with the objective of being inter alia: an educational arm and information source for electric powered boating issues, and a representative of electric boaters in matters of environmental protections and regulations; a planning and organizing agency for meetings, exhibitions and competitions. The Wye Island Challenge was established in 2001 to demonstrate the viability of electric powered boats and to advance their performance development.



The Electric Boat Association of Greece is a non profit organisation founded in 2016 to promote the development of Electric Boating and to serve the needs of all who have an interest in electric boating. The Association has a regular news blog and a latest report features the Artemis Technologies launch of the world's first commercially viable fully electric, high-speed foiling workboat range. Developed and built in Belfast, the zero-emission vessels are the greenest workboats on the planet and represent a £12 million investment in research and development.



The Electric Boat Association of Canada is a not for profit Canadian corporation and was formed by a group of boating enthusiasts concerned about the use of fossil fuels for transportation and excited about the possibilities of boats and ships powered by electricity. Their website has a news feed from Plugboats.com and a latest post features Mercury one of the world's largest fossil fuel outboard manufacturers going electric. The concept Mercury Avator electric outboard is designed to showcase the new line.



The Frisian Electric & Hybrid Boating Association (SEFF) was founded to promote electric and hybrid boating in the Netherlands Frisian province.

In latest news SEFFF supported a dinghy race during Sneekweek in August. The race was held from the theatre to the Schaapmarktplaats for everything that could be inflated to float. More than 100 dinghies and boats which could only be propelled by hand took part and for support and safety, SEFF provided two electrically powered sloops.



The French Electric Boat Association was created in 1994 in Bordeaux by partners from different professional backgrounds - academics, researchers, engineers and industrialists - to develop the image and market of the electric boat in France as well as abroad. Their news section reports that The Calanques National Park has launched a new call for projects aimed at all operators/shipowners in the territory. Hybrid or electric/hydrogen, it covers both retrofit operations and the acquisition of new boats.



Founded in 2018 the Norwegian Association for Electric Boats is a not for profit organisation for all stakeholders in the electric boat value chain. The Association focus is on building network and communicating the needs and business requirements of their members to regulatory bodies and the government, promoting technology change in leisure boats, participating in fairs being a hearing body for the authorities regarding boating laws and statutes and working for the development of charging facilities..



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Cruise Guide

Waverton to Chester

Cruise Guide

Our Spring cruise is along the last five miles of the Shropshire Union Canal to Chester. The Shropshire Union was created in 1845 when three canals companies the Chester Canal, the Ellesmere Canal and the Birmingham & Liverpool Junction Canal merged to become the Shropshire Union Railways and Canal Company. Our cruise is along a section of the oldest canal, the Chester Canal which opened in 1779 and was originally intended to link the River Dee to the Trent and Mersey Canal at Middlewich and improve Chester as a port in competition from Liverpool. But there were engineering and financial difficulties and when it opened the canal had only reached Nantwich. Problems with the Dee River company also delayed the building of the connection to the river. The canal was completely uneconomic and went out of business in 1787 before being revived a few years later when it joined with the Ellesmere Canal Company.

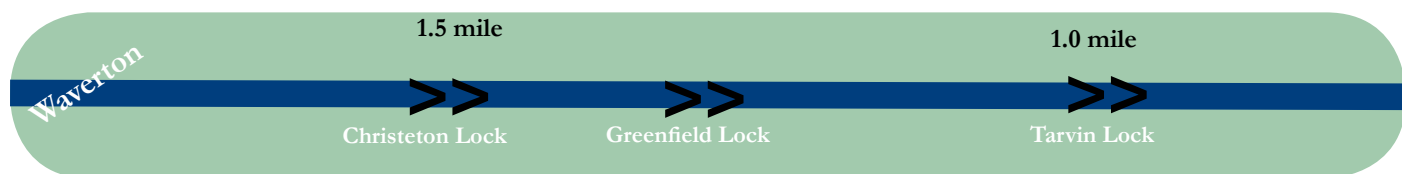
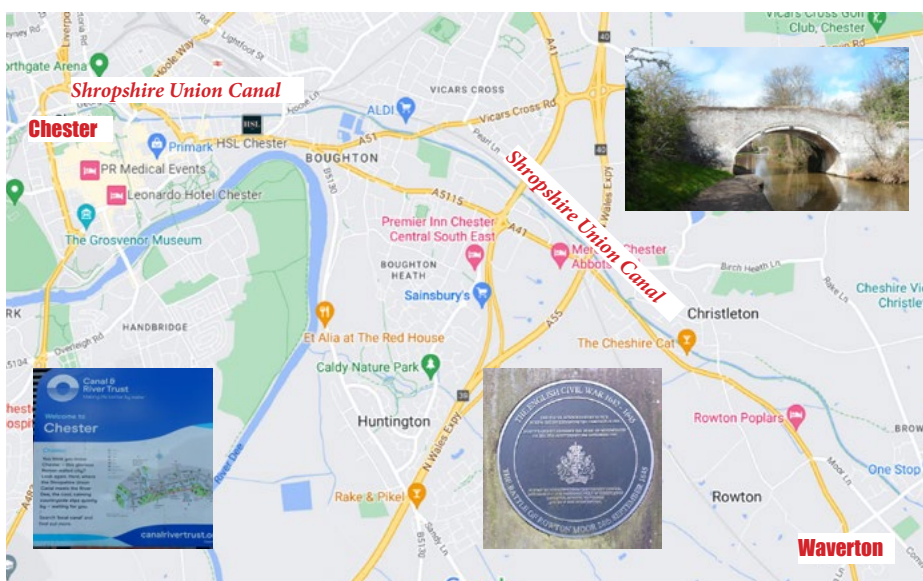
Waverton to Chester

Our cruise starts at bridge number 119, Egg Bridge in Waverton, a village on the outskirts of Chester originally a small settlement named Wavertone in the Domesday Book. The sixty six mile Shropshire Union Canal is almost entirely rural often passing through remote countryside but Waverton is the first sign of urban development as the canal approaches Chester, and Egg Bridge is a modern construction unlike the following humpback bridges which are very typical for eighteenth century canals. The next bridge number 120 is Rowton Bridge and the nearby Rowton Moor three miles from Chester is where one of the last major battles of the 1645 Civil War took place. The Royalists were defeated and

retreated to Chester where it is said King Charles 1 watched the retreat from the Chester Walls. Our cruise then goes past the next village, Christleton, where the first of five locks signals the steep descent to Chester and where the towers and chimneys of the city come into view. With only a few moorhens moving on the water it is easy to forget that the canals were once an essential part of, and facilitators to, the Industrial Revolution and the old Chester Canal was no exception. Today Chester is famous for its Roman and Medieval history but as we continue towards Chester evidence of former waterside industry is to be seen in the guise of old mills converted for other use, and



Cruise Location



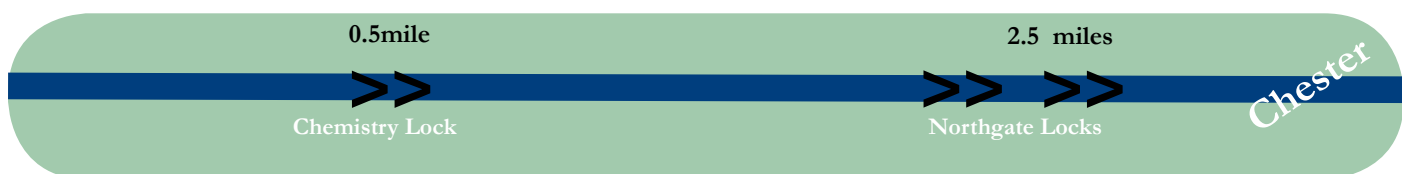


each of the locks is overlooked by very recognisable period lock keeper's cottages although no longer housing



lockkeepers. Signs of Chester's industrial past increase as we approach the city. Chemistry Lock is named after the nearby chemical works with an acid distillery, naphtha and lead production buildings. Water for Chester has been extracted from the River Dee since Roman times. The old pumping house on the river has gone but the Water Tower and Engine House by the canal remain and are listed buildings. As is the Shot Tower a little further on which was used to make lead shot for the Napoleonic Wars. After Cow Lane Bridge number 123 the canal passes through a deep rocky cutting with the ancient city walls high above topped by King Charles' Tower. Next comes the three Northgate staircase locks followed by a sharp turn into the Tower Wharf canal basin where Telford's canal warehouse has been converted into a pub restaurant. A plaque in commemoration of Tom

Rolf, the inland waterways pioneer who was born in Chester, can be found attached to the bridge crossing the canal as it exits the basin at the far end on its way to Ellesmere Port. The canal arm to the River Dee also starts here but locking into the river is still in the process being restored.



Info

Launching

Craneage and slipway facilities on the UK canals are few and far between.

There are slipway facilities at: Taylors Boatyard, Upper Cambrian Rd, Chester CH1 4FB
Tel: 01244 379922
www.taylorsboatyard.co.uk

Licences

Short term licences can be obtained from the Canal and River Trust Boat Licensing Team. There is a 25% discount for electric propulsion.

T: 0303 040 4040

Mon to Fri, 8am to 6pm.

Email: customer.services@canalrivertrust.org.uk

canalrivertrust.org.uk

www.canalrivertrust.org.uk/licensing

Pubs

Pied Bull

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Chester

CH1 2HQ

Tel: 01244 325829

www.piedbull.co.uk

Accommodation

Real ales

Garden

Wifi

Old Harkers Arms

1 Russell Street

Chester

CH3 5AL

Tel: 01244 344525

Real ales

Canal Terrace

Lunchtime and evening meals

Wifi

Liverpool Arms

79 Northgate Street

Chester

CH1 2HQ

Tel: 01244 310232

Real ales

Tourist Information

www.visitchester.com



Chester Canal Port

Chester's Canal Port is situated at a late eighteenth century canal junction where the Chester Canal met the Wirral line of the Ellesmere Canal. Telford's Warehouse was built for the Ellesmere Canal Company by Thomas Telford in 1790. The building also housed the canal company offices and a tavern that was used by passengers waiting for the packet boats to Ellesmere Port where they transferred to a ferry across the Mersey to Liverpool. The graving lock and dock is a transport heritage site and was constructed in the 1850's to build boats for the Shropshire Union Railway and Canal Company. The yard was taken over in 1921 by the River Dee boatbuilder, J H Taylor. The Chester Canal originally connected directly to the River Dee by a staircase of five locks. When the Wirral line North to the Mersey was built two of the locks were replaced by ones on a new line going West to the river and the remaining three staircase locks at Northgate lift the canal 33 feet to the cutting running below the city walls. The development of the streets around the canal basin was linked to the development of the canal with many of the houses occupied by shipwrights and other workers from the local canal yards.

Pied Bull

On the site of an eleventh century coaching house the sixteenth century Pied Bull on Northgate is the oldest continuously licensed premises in Chester and home to the only micro-brewery within the walls of Chester, producing their own CAMRA award winning cask beers. The on site micro-brewery is located in the cellar right underneath the bar and tours can be booked.

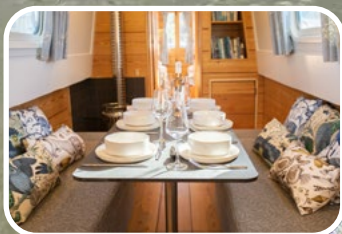


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World's largest electric ferry

Australia

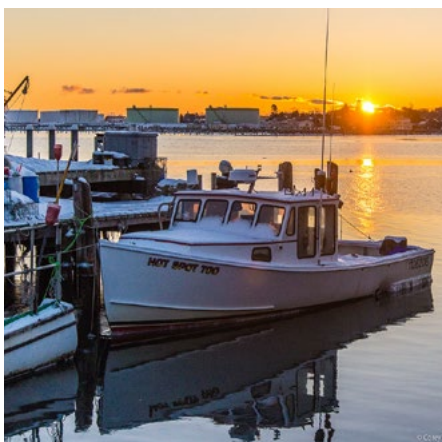
The world's largest battery electric passenger ferry has been ordered by Argentina-based operator Buquebus. The 130-meter-long electric ferry is being built by Incat the Tasmanian builder of high-speed catamaran ferries. Designed as two aluminum hulls connected to a bridging section, it will have passenger and crew capacity of 2,100 and room for 226 cars. Originally it was to have four dual-fuel engines powered by LNG

with a top speed of around 37.5 knots. But Buquebus is now looking to replace the LNG powerplant with batteries and electric motors. and Incat is confident that they can deliver this ground-breaking ship. The new ferry design will include multi-fuel generators as an interim measure until shore-based charging solutions are in place, at which time the fuel container/generator modules will be removed and the vessel will operate as

electric only.

Retractable charging cables will be installed port and starboard, which are expected to support 30-to-40-minute fast charging as well as overnight top-ups.

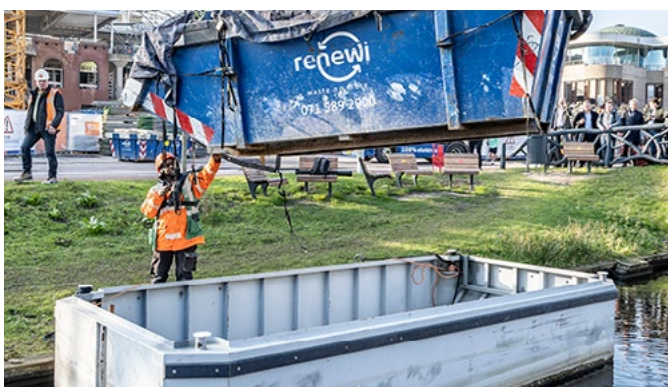
The battery banks and motors are reported to be in development with Incat's suppliers, and if all goes to plan Buquebus can expect delivery of the world's largest zero emissions ferry some time in 2025.



Servicing electric boats

USA

The non profit Island Institute has partnered with Maine Electric Boat, the Maine community college system, and the Mid-Coast School of Technology to develop a three-part training course for boat mechanics to enable them to service electric boats. The intention is to create stable, sustainable career opportunities for Maine residents while boosting the confidence of would-be electric boat buyers. Maine's working waterfront is a major part of its economy and culture and with 3,400 miles of coastline the state is home to a lobster industry valued at more than \$1 billion annually, a robust commercial fishing business, and a growing aquaculture sector. This activity is mostly undertaken by fossil fuel-powered boats so as Maine pursues its target of reducing greenhouse gas emissions getting cleaner vessels on the water will be essential.



Electric removal

Netherlands

Leiden University is planning to use electric boats for all its future renovation or construction projects in the city centre. The university thinks that it is important to gain experience with electric transport by water as soon as possible, not only because of municipal requirements but also to reduce its environmental footprint and the inconvenience to the city's residents. It has been calculated that the project will save 14,000 van trips in the city centre. The waste containers are lifted by an electric crane into the hold of an electric boat.



Amphibious electric car

USA

Poseidon Amphibworks is prototyping the Trident LS-1 an electric three wheel car that is road legal and doubles as a boat. The Florida based startup hopes to launch an entire family of such amphibious EVs, designed and specced to fit a variety of purposes. The flagship LS-1, the LS-2, which is the luxury sport model, the search and rescue design LS-3, the limo shuttle LS-4, and the LS-lite, which is a stripped-down, more basic version of the LS-1. The company has road registered the vehicle as a three-wheel motorcycle in order to keep costs and regulatory issues to a minimum. The Land Sea LS-1 runs a simple, non tilting reverse trike chassis with electric motors on all three wheels. These will

Zeabuz autonomy

Norway

Zeabuz is a spin-off from the leading research community on autonomous vessels at the Norwegian University of Science and Technology (NTNU) in Trondheim and has developed one of the most complete technology packages for autonomous urban ferries in the world. Zeabuz believes that creating shortcuts across waterways with small ferries is probably the safest and simplest mobility operation to convert to autonomous operation. Regulatory organizations also like the idea because of its simplicity and intrinsically safe operational design. Zeabuz recently showcased the ferry to VNF (Voies Navigables de France) the French navigation authority and the Paris Olympic organisation at an event in Trondheim where the milliAmpere 2 prototype was taken back and forth across the canal in Trondheim.

Zeabuz thinks that there is a very good chance that their autonomous ferries will be used in the Paris Olympics and they are preparing to form a consortium with manufacturers and operators to provide a turnkey solution.

Zeabuz are seeing an increasing interest in autonomous urban ferries and have been receiving inquiries from all over the world.

Pelasgus electric argonaut

Greece

In an adventure reminiscent of ancient Greek marine mythology Andreas Apostolopoulos, electrical engineer and founder of the Greek Electric Boat Association, has undertaken the herculean task of building an 11 metre timber boat in his own back garden in Aigio on the Peloponnese, equipping it with batteries and electric motor. In this he has been helped by an Egyptian-born craftsman called Eisam, using regional woods such as black pine from the island of Pythagoras, Samos, but also from the ancient forest of ancient Epirus motherland of Alexander the Great, and finally eucalyptus from Odysseus's island, Ithaca. Once completed, the *Pelasgus* will cruise from Athens up the Adriatic to Venice.

Kevin Desmond



have enough power to accelerate from 0-60 mph in around five seconds. It'll seat one driver, front and center, with a two rear seats. It can be driven straight down a boat ramp into the water, where in shallower areas it will operate as an electric boat using two electric thrusters mounted on retractable struts at the rear. Once the water's deep enough, the front hydrofoil, complete with a second pair of electric thrusters, will swing down, and the rear struts will push downward. At a certain speed, the hull will rise out of the water and a "flight control" system will take over as the car hydrofoils along at speeds up to 35 mph. The hydrofoil system will make it an exceptionally smooth ride through choppy waters, and on land it will double as little electric runabout



Solar Boats and Boating



Freepower electric excellence

The crowdfunded solar boat *Freepower* from the Norwegian Bjurtech company is the winner of The 2022 Gussies Electric Boat Awards for Excellence for electric boats up to 8m/26ft in development (page 33). Bjurtech's goal was to create an autonomous boat with the freedom to go whenever and wherever without fuel stops. The boat is built of recycled aluminum, and is 6.2m long

and weighs 700kg, including the hardtop canopy and solar panels. Power and propulsion are provided by a 3kW ePropulsion electric outboard motor and 9kWh integrated battery system which gives about 3 hours and 30 km of range at full speed of (7 knots) and about 6 hours and 60 km at a 5.5 knot cruising speed. A twin battery option can double the range. *Freepower* has an Ecobalance system

controlling every aspect of the boat's operation from solar panels down to propeller pitch. The Ecobalance system has been included to minimize energy use when driving the boat and balance it with the solar input. Bjurtech says you can run all day as long as the sun is up, even at Norway's latitude.

The boat can also be recharged with shore power if needed.



Mahi solar solo

The *Mahi 2* is an autonomous boat powered only by solar energy and is the first boat of its kind to complete an Atlantic crossing. It left A Coruña, Spain in September 2021, and despite losing satellite connection in January, the small vessel continued its journey independently until it reached the island of Martinique in the Caribbean. The mono hull boat measures 4 x 1 x 0.5m and communicates by exchanging data through an onboard modem, GPS and automatic identification system.



BIG electric speedboat

Blue Innovations Group (BIG) is planning to launch a high performance electric speedboat. BIG was founded by John Vo, Tesla's former head of global manufacturing and hopes to achieve mass production volume for the volume 30-foot electric cabin cruiser by utilizing automotive manufacturing techniques, making the hull aluminum as well as using a battery that is structurally integrated as part of the boat's frame. Extendable solar panels fold out from the main canopy to provide up to 2.7 kW of solar power for recharging the boat's massive liquid-cooled lithium iron phosphate 221 kWh battery.



Solar Boats and Boating

Solar Tech

Fabric solar cells

Massachusetts Institute of Technology engineers have developed ultralight fabric solar cells that can quickly and easily turn any surface into a power source. These durable, flexible solar cells, which are much thinner than a human hair, are glued to a strong, lightweight fabric, making them easy to install on a fixed surface. They are one-hundredth the weight of conventional solar panels, generate 18 times more power-per-kilogram, and are made from semiconducting inks using printing processes that can be scaled in the future to large-area manufacturing. Because they are so thin and lightweight, these solar cells can be laminated onto many different surfaces. For instance, they could be integrated onto the sails of a boat to provide power while at sea, adhered onto tents and tarps that are deployed in disaster recovery operations, or applied onto the wings of drones to extend their flying range. MIT use nanomaterials that are in the form of a printable electronic inks to produce the solar cells in a nano clean room. The solar cell structure is coated using a slot-die coater, which deposits layers of the electronic materials onto a prepared, releasable substrate that is only 3 microns thick.,

Bifacial thin film

Although bifacial solar cells based on silicon wafers are already on the market, thin film solar cells have so far lagged behind in part, due to the low efficiency of bifacial thin film solar cells. For any bifacial solar cell to be able to collect reflected sunlight at the rear side, an optically transparent electrical contact is required. In a new process developed by National Tsing Hua University in Taiwan, the thin film cell yielded values of 19.8% for front illumination and 10.9% for rear illumination that has been independently certified by the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg/Germany.



Folkloric Explorer eBoat

Built in Mauritius, the 7.3 tonne, 35-passenger electric pontoon Folkloric Explorer eBoat boat is 10m long by 5m wide and has a draft of just 33 cm and was designed to be completely solar-charged when cruising in remote areas. Forty-eight flexible marine-grade 110-watt solar panels on the roof charge the boat's six 48-volt lithium batteries, which in turn power the two Torqeedo Cruise 10.0 TS electric outboard motors. At its cruising speed of 3 mph, the boat can run for approximately 15.5 miles on one charge and the flat-bottomed hulls allow it to cruise in shallow water and make beach landings. The Folkloric Explorer will be used for tourist cruises in Mauritius' Grand Port to showcase the region's history and the importance of protecting its ecology.

Floating solar hotel



The *Anthénea* is a floating, solar-powered hotel suite equipped with electric motors and the ability to adapt to any environment, from Arctic to tropical. Designed by French veteran designers, engineers, and naval architects the *Anthénea* has five south-facing solar panels, two electric propulsion pods and stabilising ballasting

ZEN50 solar cat funding



Zero Emission Nautic the Barcelona-based solar electric catamaran manufacturer has raised €5.5m to continue construction of the first hulls of its ZEN50 solar electric catamaran. The catamaran will also have an The Oceanswings wing sail making the ZEN boat the first series production leisure craft to feature this fully-automated wing sail technology. The rooftop of solar panels offer a peak power of 16kW.

Boat Shows



Boot as it is known for short, is spread out over the 16 halls of the Messe Düsseldorf with more than 75 exhibitors dedicated to electric boats, motors and accessories. The actual number is probably closer to 90 because some companies shared booths with distributors or other companies and hadn't been listed separately in the show's online directory.

The very first thing a visitor saw on entering Hall 1 of Düsseldorf was an electric boat – the brand new all-electric Delphia 10 Lounge. Aqua is installing a global network



of high speed marine charging stations, and for Düsseldorf they installed a 'virtual network' of demo, non-working chargers. There was one prominently displayed at the bow of the Delphia 10 Lounge and installations were also at the stalls of many of the companies Aqua



After being closed for the last two years Boot Düsseldorf opened again at the start of this year.

Plugboats editor Jeff Butler spent three days there going around the many electric boats and motors exhibitors. For the full tour with links go to plugboats.com

partners with – Axopar, Delphia, Evoy, RS Electric Boats, Vita Yachts and X Shore. Directly across the aisle from Delphia was another electric/hybrid boat manufacturer Greenline Yachts which had four of their models on display. In some ways the two companies being at the entrance



acted as bookends to the electric boat industry. Greenline is one of sustainable boating's pioneers, having launched their first hybrid in 2008, while Delphia started manufacturing their first electric models in May of last year and have pledged to be all-electric by 2025. A bit further along a set up from German-Turkish manufacturer Caracat was attracting a lot of attention. The Caracat is a word combining 'caravan' and 'catamaran'



The Caracat can be towed behind your car on wheels as a caravan or launched with pontoons and a Torqeedo outboard as a houseboat. Walking in to Hall 4 gave the impression that it was completely electric boat manufacturers. Gathered by the entrance were: Ruban Bleu of France, Vita and RS Electric

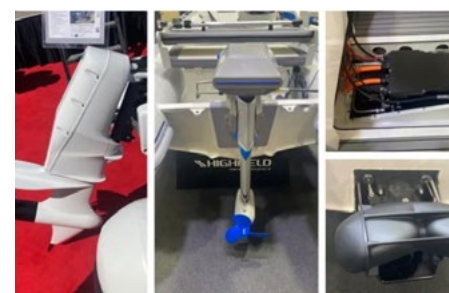


Boats from the UK, and Garda Solar from Italy. Moving towards the central portion of the hall were Magonis, Candela, X Shore and Axopar, who were showing their Axopar 25 with an Evoy Storm outboard. Moving on to Hall 5 Frauscher had the electric version of the 740 Mirage Air on display and



Rand exhibited their entire range, including the Source 222 unveiled at Cannes last September and brand new Breeze 20, making its world premiere at Düsseldorf.

The other hall that had a huge electric presence was Hall 10 with dozens of electric motor manufacturers anchored by the exhibits of ePropulsion, Torqeedo and the stage of the Blue Innovation Dock (BID). The BID was sponsored by Groupe Beneteau, Brunswick, ePropulsion, Greenline, SILENT-YACHTS, Sunreef and Torqeedo, among others..



Boat Shows



METS MARINE
TRADE EQUIPMENT
SHOW TRADE
SHOW

The industry's largest trade exhibition of leisure marine equipment, METSTRADE featured a total of 1,400 exhibitors from 49 countries across 10 halls at Amsterdam RAI covering every facet of marine equipment, systems and materials. The busy show saw 26,480 visits registered by 17,417 unique visitors spanning 126 nationalities, accompanied by 6,175 exhibitor personnel.

Electric propulsion specialist eD-TEC showcased its new eD-QDrive propulsion system for the first time.

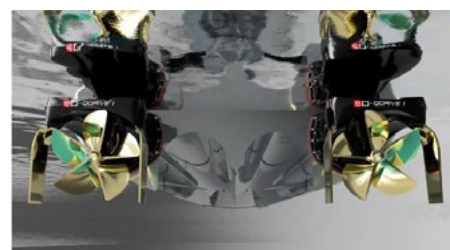
RYA Dinghy and Watersports

Featuring dinghy sailing, windsurfing, wingsurfing and foiling as well as paddleboarding, the long-standing Royal Yachting Association Dinghy and Watersports Show at Farnborough International Exhibition Centre brings together participants, clubs, training centres, Class Associations, equipment manufacturers and retailers from right across the small boat sailing and board sports community, all sharing their water-based passions and helping more people spend more time afloat. This year the Show welcomed 8,500 visitors, 160 exhibitors, and hundreds of boats and boards with some 74 expert talks and presentations also taking place across the weekend. Visitors came from all over the UK as well as Ireland, Spain, Portugal, Singapore, Hong Kong and USA. ePropulsion UK made its debut at the Show together with eSolent, the Hayling Island based dealer for ePropulsion and eco marine solutions.

eSolent has launched a new e-Safety Boat package specifically aimed at RYA Affiliated Clubs, training and watersports centres to help clubs and watersports providers move away from burning hydrocarbons.

The e-Safety Boat Package makes switching to electric propulsion easy and comprises a Rigiflex 360 safety boat and Extreme Trailer fitted with an ePropulsion long-range Navy 3.0 electric outboard and E80 battery. It includes full fit-out with cabling, controls, charging and a bespoke bow locker for the battery.

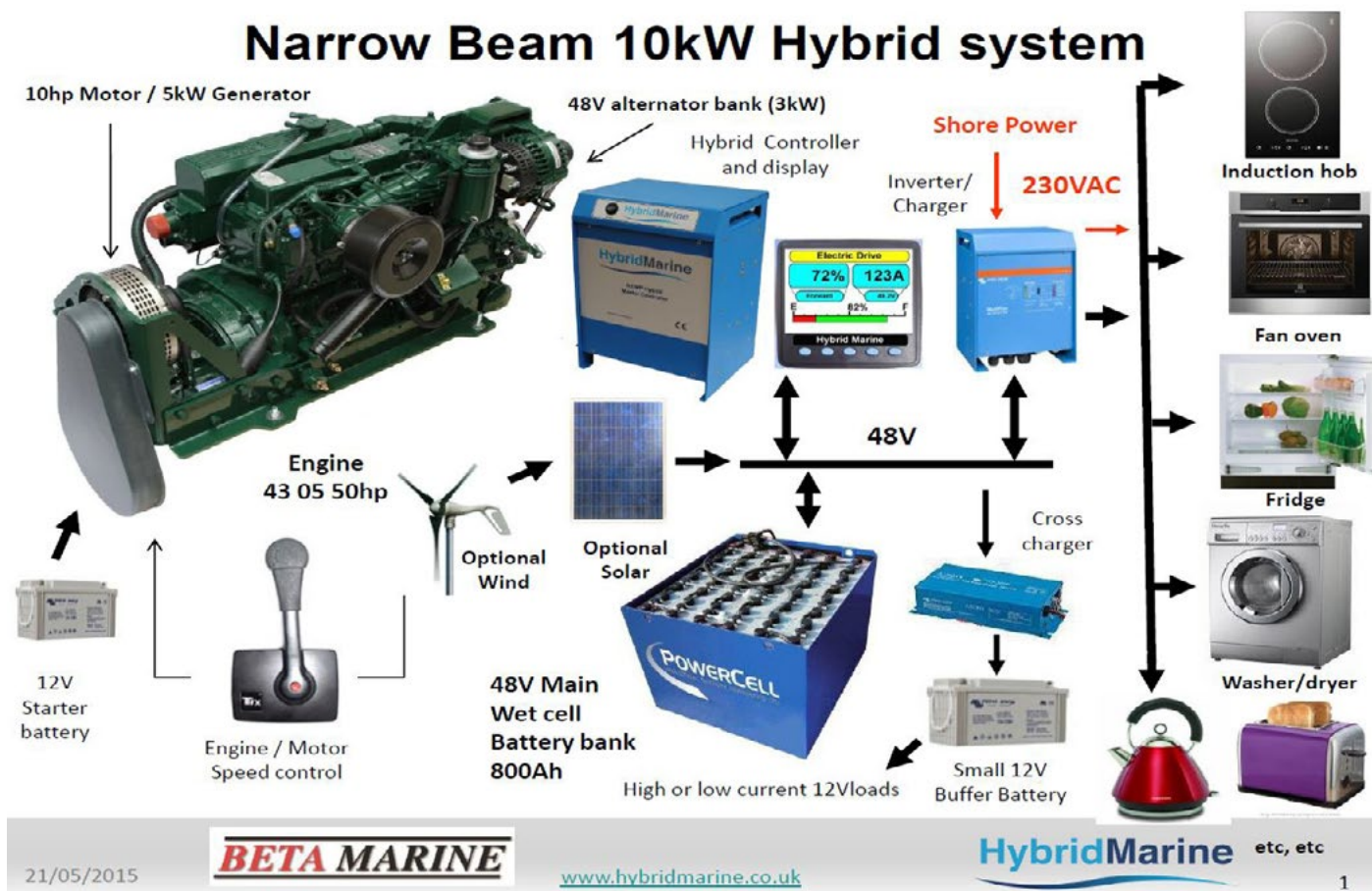
The Navy 3.0 and 6.0 long-range electric motors were featured at the show as well as the highly portable Spirit outboard. The Navy 3.0 outboard will comfortably power a 2.5 ton boat between 300W and 3000W of power and between low speed and full throttle, with run times of 80 minutes at full speed and up to 13 hours at low speed..



The eD-QDrive is an electric drive train comprising a complete system from surface drive unit mounted through the transom to the battery system, AI controller and helm interface. The system, designed in-house by the team at eD-TEC, offers an electric drive solution for small yacht dayboats and tenders to performance cruisers up to 30 metres in length. eD-TEC says the drivetrain achieves this thanks to the modular and scalable design of the eD-QDrive units themselves and the high-C-rate battery bank, which allows for up to quad eD-QDrive installations giving a power range from 50kW to 2,400kW, and a modular battery bank that offers power from 80kWh to 320kWh.



Narrow Beam 10kW Hybrid system



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Power Management



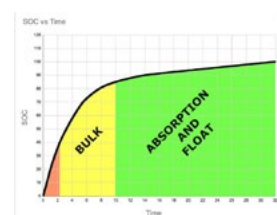
After continually cruising for a number of months Paul Sumpner from narrowboat Old Nick looks at the boat's power management

After continuously cruising now for a few month we have have settled into a regular routine. We are very comfortable with the way the Vetus E-Line engine is performing and have got used to the slightly different method of energy management that an electric serial hybrid, with Lead Carbon batteries, requires. We have been truly amazed at the number of positive comments and questions that we have received from other boaters and gongoozlers but also disappointed at the level of misunderstanding and the amount of misinformation that exists about boat technology. The two biggest misconceptions are that the technology is not there yet and that we can only cruise for a few hours. *Old Nick* allows us to cruise every day on canals and rivers, with absolutely no concerns about running power. Although we are not regularly doing the 8+ hour days of cruising that we used to do when we were younger, we can cruise for 8+ hours on an overcast day and have plenty of power left to do whatever we want to that evening. It did take us a while to get our heads around not having to regularly re-charge the batteries back up to 100% State of Charge (SOC) that is the recommended norm for conventional Lead Acid batteries. We typically run our Lead Carbons, within a range of 60%-90% SOC and apart from when we are on electric hook-up in a marina or on one of the Electric Boat Charging Points we have found on the Thames, we never fully recharge them to 100%. Above is a diagram showing the amount of usable power that Old Nick's batteries

provide. At 100% SOC the batteries store a whopping 38.4KWh of power and we can regularly discharge them (3000 cycles) down to 40% without reducing the life of the batteries. Even the occasional discharge to 20% SOC in extreme conditions, is apparently OK, but we will hopefully not be putting this to the test. So if we set out with a fully charged set of batteries, we have approximately 23KWh of power or 480Ah at 48v before the batteries reach the critical 40% SOC, even with zero solar power, which is never the case. To put this in to cruising hours, at our preferred 800 RPM cruising speed we consume 30A, so we could cruise for 16 hours continuously. In reality, unless we are cruising at night, there will always be some measure of solar power available and we are typically seeing between 5 and 10KWh per day during July. In fact, when the sun is strong, we often achieve what we like to call "State of Nirvana" when the engine is powered 100% by solar and taking no power at all out of the batteries.

As I am writing this article this evening, our batteries are around 75% SOC and tomorrow we will do a few hours cruising on the Thames and probably end up with SOC in the upper 60s. Then with an afternoon of solar we should see the SOC come back up in to the lower 70s. As we will both be showering tomorrow, we will run the generator for an hour, get a tank full of hot water and bring the SOC up by another 8-10%. This pattern will continue all through the summer with us trying to get the maximum amount of

solar whilst running the generator as little as possible. When we do run the generator, we will try and time it for when we need hot water, as the immersion heater does take a lot of battery power. We also never run the generator when the batteries are at 85% SOC or higher. as this is just not efficient, due to the typical charging pattern of lead carbon batteries (see below). It is much more efficient to run the generator at full load and bulk charge the batteries until they reach 80-85% and then when the Victron Quattro switches to absorption, knock the generator off and let any afternoon solar do the rest. The graph below shows the typical charging times for Lead Carbon batteries. We only run the generator



in the yellow "bulk" area and try to let the solar take care of the green "absorption and float" area. In our experience, we are seeing slightly quicker charge times than shown and expect to take 1 to 1.5hrs to increase the SOC by 10%, when running the generator. In an ideal world, we would never have to run the generator, but as continuous cruisers, we have to be realistic and I now accept that it is part of our routine. But it is very quiet (running at 1500 RPM), is more efficient than running a conventional diesel engine and alternator and can be run while under way

Fuel Cells



OceansLab fuel cell

British yachtsman Phil Sharp has revealed details of a new zero-emission hydrogen-powered International Monohull Open Class Association (IMOCA), ahead of the 2024 Vendée Globe race. This new IMOCA is managed by OceansLab, a sustainable sports management company, and will see a unique and innovative ocean-racing campaign with the aim of demonstrating scalable clean technologies within the maritime sector. OceansLab says its new IMOCA will also be the first to exclusively use hydrogen fuel cell technology, thanks to a 'Hydrogen PowerModule', created and developed by the team at Genevos, where Sharp who has a passion for renewable energy innovation, is a co-founder. This new monohull, designed by French sailboat design office Manuard, is currently under construction at Black Pepper Yachts in Nantes. The shipyard says the build uses existing moulds that have been recycled and reworked.



New World of solid hydrogen

Next Generation Shipyards of the Netherlands is building an executive tender for the Port of Amsterdam that will be fuelled by a solid form hydrogen, a technology said to make it possible to store H₂ under normal atmospheric conditions. The propulsion technology uses sodium borohydride, a powder that is a hydrogen carrier. It is a technology developed by the Dutch H₂Fuel start-up that says hydrogen, when bonded in the NaBH₄ powder, cannot explode so that it can be safely stored anywhere. Called *Neo Orbis*, (New World) the tender will be 65ft long, similar to the sightseeing boats on the canals of Amsterdam. The ship is expected to make trial runs in 2023.



Loop Energy the Vancouver-based manufacturer of hydrogen fuel cells for commercial mobility, has developed a 120 kW fuel cell system that reportedly provides an additional efficiency gain of 20% when it generates

electricity. The S1200 is designed to deliver up to 60% in net system efficiency, which Loop says enables an electric vehicle powered by a Loop Energy fuel cell to deliver up to 54% fuel to wheel efficiency compared to the typical fuel to wheel efficiency delivered by a diesel engine powered vehicle of 20-25%.

Fuel Cell Tech

Hydrogen paste

A paste for hydrogen storage has been created by researchers at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials (IFAM) in Dresden.

The researchers claim that their paste has high energy densities and may be used in a variety of vehicles.

The power paste, based on solid magnesium hydride, should allow hydrogen to be chemically held at normal temperature and ambient pressure and released as needed, according to Fraunhofer IFAM. Because the power paste only decomposes at temperatures of over around 250 degrees Celsius, it operates flawlessly even if the paste is left in the sun for hours. The only starting ingredient for the storage paste is magnesium powder, which is a relatively common element. This is reacted with hydrogen to generate magnesium hydride at 350 degrees Celsius and five to six times atmospheric pressure. After that, the power paste is made using ester and metal salt. The Institute claims that this technique is appropriate for hydrogen propulsion in vehicles where installing a pressure tank would be challenging.

The refueling procedure, according to Fraunhofer experts, is simple. Rather than traveling to a gas station, the vehicle driver replaces a cartridge and fills a water tank with tap water. The paste is squeezed out of the cartridge and mixed with a specific amount of water in the vehicle, depending on the desired power. This process generates gaseous hydrogen, which may subsequently be turned into energy for use in an electric motor. Only half of the hydrogen in the reaction comes from the power paste, with the other half coming from the water.

The Fraunhofer experts also claim that with the power paste the vehicle should be able to reach a range comparable to, if not more than, using the same quantity of gasoline.

Batteries



ePropulsion batteries

ePropulsion has announced a new range of E-Series batteries. The E60 and E163 will be an addition to the existing E80 and E175 batteries in the range. The E60's compact form and light, double-layer plastic housing can easily be transported and installed by one person, while the E163 is designed for high reliability with an all-metal housing that is impact resistant and drop proof. The E-Series provides consistent performance and smart operation, says the company, delivering up to 3,000 charging cycles for a reliable user experience. With three times higher and 70% less weight than lead-acid batteries, the E-Series is ideal for smaller vessels with minimal interior storage space. Connectors can be attached with only one hand and no additional tools are required for simple installation. The IP67 waterproof rated E60 is designed for use with the ePropulsion Navy 3.0 Evo (6hp) and the E163 is designed for the Navy 6.0 Evo (9.9hp). Their intelligent battery management system (BMS) features a display that shows state of charge, voltage, current and alarm information for maximum safety. "While capacity is an obvious focus of user-oriented innovation, making batteries easier to use is also vital to promoting adoption of electric propulsion," says ePropulsion CEO Danny Tao, "ePropulsion electric outboard engines, combined with the new batteries are the perfect solution for boaters looking to embrace quiet, clean and environmentally conscious propulsion."

A key innovation of the ePropulsion product line is that all outboards are built on a 48V architecture, allowing for a greater degree of flexibility. ePropulsion E-Series batteries are designed to provide optimal performance for the entire range of ePropulsion electric motors



Aqua superPower says it is leading a consortium which has secured UK government funding to explore the development of bi-directional boat charging. The Virtual Bunkering for Electric Vessels (VB-EV) project brings together Aqua superPower and British bi-directional charging and smart energy technology company Indra, as well as independent, low-emission transport experts Cenex, and the

University of Plymouth. It's being seen as a fantastic opportunity to demonstrate the exciting potential that bi-directional charging could bring to the marine sector, essentially turning ships into mobile battery storage units

Battery Tech

Blue G battery technology

With issues of lithium batteries on superyachts and commercial vessels together with the growing concerns of the marine insurances sector, a new battery technology may offer an alternative. The new non-flammable Blue G battery technology has been verified by the American Bureau of Shipping which has issued a New Technology Qualification (NTQ) for the technology for use at sea.

The Blue G vanadium redox flow battery system has been developed by Singapore's Gennal Engineering who say that the advantages of its system include scalability and a longer lifespan, more than 25 years, which is double that of a typical lithium-ion battery.

Polymer coating

Scientists at Lawrence Berkeley National Laboratory have developed a conductive polymer coating called HOS-PFM that could enable longer lasting, more powerful lithium-ion batteries. The HOS-PFM coating conducts both electrons and ions at the same time. This ensures battery stability and high charge/discharge rates while enhancing battery life. The coating also shows promise as a battery adhesive that could extend the lifetime of a lithium-ion battery from an average of 10 years to about 15 years. To demonstrate HOS-PFM's superior conductive and adhesive properties, The Berkeley Lab team coated aluminum and silicon electrodes with HOS-PFM, and tested their performance in a lithium-ion battery setup. Silicon and aluminum are promising electrode materials for lithium-ion batteries because of their potentially high energy storage capacity and lightweight profiles. But these cheap and abundant materials quickly wear down after multiple charge/discharge cycles. The researchers demonstrated that the HOS-PFM coating significantly prevents silicon and aluminum-based electrodes from degrading during battery cycling.



ePropulsion new I-Series

The I-20 is part of the new I-Series of electric outboards from ePropulsion which also includes the I-10 and I-40. Available in 10KW, 20KW and 40KW input power, the I-Series electric inboard motors are said to be ideal for leisure marine and commercial applications on small and medium size boats.

All products in the I-Series have been designed for ease of use and space-saving. The outboards have a compact design that integrates five functional modules of motor, gearbox, motor controller, system control unit and cooling system into a small space, with ePropulsion claiming they take

up 60 percent less space than a typical combustion engine and said to be 65 percent lighter.

The I-Series also supports the integration of the ePropulsion Connectivity Service, which allows users to access cloud-based connectivity services without the need for additional accessories. Users can check everything from the location of the boat to battery level, speed and charging status, automatically generate sailing logs, authorise guests to power on for easy boat sharing remotely and even turn on the security mode and notify the user should the boat be stolen..

New air cooled Vetus

Vetus has unveiled a new range of air-cooled propulsion systems. Available in three sizes, the EAIR04024, EAIR040, and EAIR060 offer outputs of 4kW at 24 volts, 4kW at 48 volts and 6kW at 48volts respectively, making them ideal for newbuild or repower projects for a variety of hull types up to around 8 metres.



According to Vetus, air-cooled electric propulsion systems can offer certain vessels a range of benefits over water-cooled variants. In areas where cooling water inlet blockages are possible such as weed-infested inland waterways Vetus says that air cooling is a simpler system requiring less maintenance than a water-cooled pump, pipework and strainer, and during cold winter months, air cooling also prevents potentially costly water pump or pipe freezing issues. The Vetus E-Line Air models have a dry weight of just 65kg. The use of existing transmission hardware reduces electrification project costs, and compact dimensions ensure that in repowering situations, the Vetus E-Line Air usually requires less engine space, including an allowance for cooling air circulation, than the unit it is replacing.

EWOL new propeller

Ewol has announced its new patent pending EnergyMatic propeller, which has an automatic return to the feathered variable-pitch mechanism and electric charging. EnergyMatic is a propeller for sailing yachts, specifically to facilitate putting the propeller(blades) in the feathered variable-pitch and is designed to provide minimal resistance under sail on boats with hydraulic or electric propulsion. According to Ewol the EnergyMatic positions itself with minimal resistance even without the need to stop the shaft. This means that it is no longer necessary to switch off the engine and engage reverse gear to significantly increase sailing speed, with a range of 0.5 to 1.5 knots. EnergyMatic's charging' position is designed to turn the propulsion line into a hydro-generator. Ewol says this is an essential feature for boats with 100% electric or hybrid propulsion or with an alternator connected to the shaft; these boats will be able to recharge their batteries simply by sailing in 'recharge' mode, and letting the propeller function as an electric turbine.

The EnergyMatic is a lightweight, high-performance, high-tech propeller that allows the pitch to be altered to increase motor cruising speed and aids manoeuvrability during mooring manoeuvres. Like the other Ewol propellers, it is made entirely of stainless steel to maximise strength, resistance to galvanic corrosion and product reliability over time.



2022 in review



Jeff Butler Editor and publisher of Plugboats reviews the Plugboats 2022 reports and gives an overview of what he thinks are some of the trends in electric boats and boating, and highlight some of the stories that demonstrate those trends (for full review with links go to plugboats.com).



Mercury



Ingenity



Beneteau



Candelay



X Shorey



Fluxy



Pixiiy

The first big show of the year was the Miami International Boat Show where two significant electric boat announcements were made. Mercury showcased a prototype of its new Avator electric outboard and Ingenity launched its second all-electric boat, the Ingenity 23E dayboat. The Ingenity 23E went on to win Boating Magazine's Boat of The Year.

In 2022 more sailboat manufacturers moved toward electrification as the mechanical propulsion for their boats. Beneteau and Torqeedo teamed up for two electric sailboats. Beneteau has pledged that all its boats will be electric by 2024

Sweden's Candela shook up the entire boat market when they introduced the Candela 8 with its double C-Pod engine. Another big launch later in the year, from another Swedish boatbuilder, was the X Shore 1, built in their new 160,000 sq ft facility modelled after automotive assembly plants.

The X Shore facility was built in large part through \$50M funding the company secured in April. Flux Marine in Newport Rhode Island got a \$15.5M investment in their electric outboards and BlueNav, France's first manufacturer of hybrid and electric engines for boats secured funding of a €1.3 million. On the crowdfunding side of things, UK electric boat company Pixii set a goal of £350,000 for their campaign and finished up with £392,000

One of the best indicators of how electric boating is growing is the increased presence of electric exhibitors at traditional boat shows and the emergence of shows dedicated to electric /hybrid boats. Beyond the boat shows, there are also the electric boat competitions. The 'granddaddy' of these is the Monaco Energy Boat Challenge, which started in 2014 and in 2022 hosted 38 university and commercial teams from 21 countries.

As terrific as all of this growth is in electric boats, it can't lead anywhere without similar growth and innovation in energy supply: batteries, charging infrastructure. One of the trends we are seeing on the battery side of things is that both boat manufacturers and motor manufacturers are beginning to get more deeply involved with battery technology and battery companies. In Sweden, Candela teamed up with EV manufacturer Polestar to supply the batteries for the Candela8 as well as their commercial hydrofoiling ferries and watertaxis.

In 2022 hydrogen picked up significantly as a solution for just about everything. In the boat world, Torqeedo has been working with fellow Bavarian company Proton Motor Fuel Cell, to incorporate fuel cell tech into the Deep Blue battery-electric drive systems.

Another big topic in 2022 was the speed of electricboats and the big news was that the Hellkat 32 outfitted with twin Vision Marine E-Motion 180E outboards was the first electric boat to hit a speed of 100mph, smashing the electric boat world speed record

On the smaller side of things, two US companies focussed on new entry level electric boat projects. Epoch Boats is designing a 16-18 foot skiff with a patent-pending retractable hydrofoiling system that deploys at speed offering the average boater a foiling experience. And Elco motors has linked up with Rock Proof Boats (the name explains what they are) to launch an all-electric fishing model.



Blue Nav



Monaco



Polestar



Proton fuel cellr



Hellkat 32



Epoch



Rock Proof



The Gustave Trouvé Awards were started in 2020 by Plugboats to recognize the inventors, designers, manufacturers, entrepreneurs and visionaries who are making advances every day to develop clean, quiet, zero emission technologies and designs to reduce reliance on fossil fuel for marine propulsion. In 2022 more than 100 boats from 21 countries entered. It is the only international boating award that focuses exclusively on electric boats and boating. The awards are named to honour one of the first visionaries of electric boating, French inventor Gustave Trouvé, who in 1881, created the world's first electric outboard boat motor - the world's first outboard boat motor of any technology.

Jeff Butler Editor of Plugboats has kindly allowed **EBi** to reproduce the Gussie awards news and pictures.



Electric Boats Up To 8 metres/26 ft In Production

Faro 5 Faroboats • Portugal

The Faro5 can be combined with its solar-powered docking station, turning it into a fully self-sustainable solution. The battery capacity is enough for 8 to 10 hours. The boat can be delivered with different engine packages,



Electric Boats Up To 8 metres/26 ft In Development

Aurora Sport • Brazil

The Aurora Sport has an ergonomic design with low noise and vibration. It will be constructed with recyclable materials and propelled with a 15kW permanent magnet electric motor and battery system.



Electric Boats Over 8m/26 ft In Production

Candela 8 • Sweden

The C-8 is a long-range, all-electric hydrofoiling craft that travels silently above the water surface, designed to be the most efficient boat ever built. At 20 knots, the energy usage per nautical mile is just 0.8 kWh



Electric Boats Over 8 metres/26 ft In Development

SILENT 120 Explorer • Austria

A 120 foot ocean-going solar electric catamaran from one of the pioneers of electric boating, the SILENT 120 Explorer is more than a yacht – it is a bold expression of electric solar powered yachting.



Electric Sail Boats

Sunreef 80 Eco • Poland

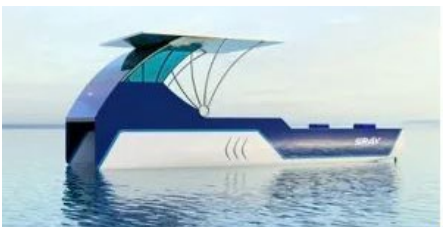
Sunreef's proprietary solar skin power system, covering a total area of 164m² solar panels, can be integrated with various composite structures of the yacht including mast superstructure and hull to generate up to 45.5kWp.



Electric Boats Customised DIY Refit

Elektra • Sweden

Carefully retrofitted with an electric drivetrain designed in-house and machined from aluminum, Elektra is almost 100 years old, designed by C.G. Pettersson, Sweden's most prominent boat designer.



Electric Work Boats

SRAV • India

The new SRAV solar-electric catamaran is designed to revolutionise commercial fishing by minimising operational expenditure. Powered by MAKO 12 kW electric motor, it can achieve a speed of 8 knots



E Commercial Passenger boats in operation

Kochi Metro 1 • India |

Kochi WaterMetro is an integrated water transport solution for the southern city of Kochi in India. The project will be the largest water transport system in the world under a single command



E Commercial Passenger boats in development

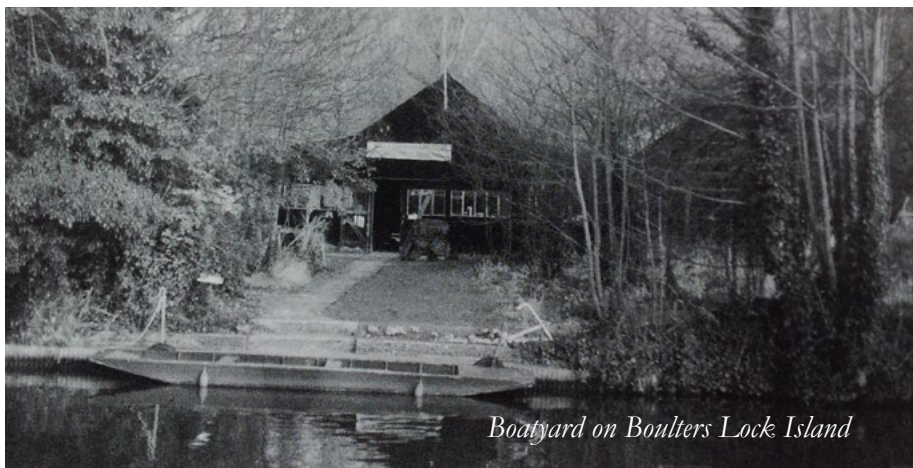
MobyFly 30 • Switzerland

MobyFly hydrofoil boats are fast, transporting 12 to 300 passengers comfortably above the waves at speeds in excess of 70 km/h, with an efficiency requiring up to 70% less energy than current diesel ferries.

History and Heritage

Edward Hawthorne was a mechanical engineer by training and a past chairman of the Electric Boat Association User's Group. His superb and fascinating book is no longer in print and his family have kindly permitted EBi to serialise extracts

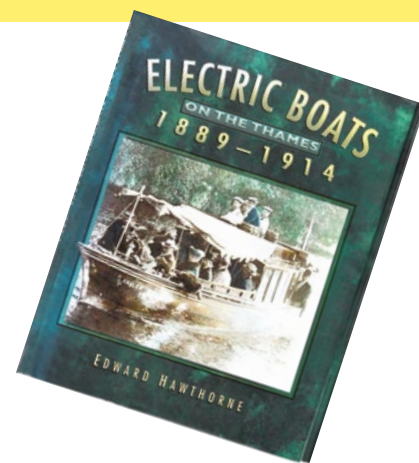
The Ray Motor Company



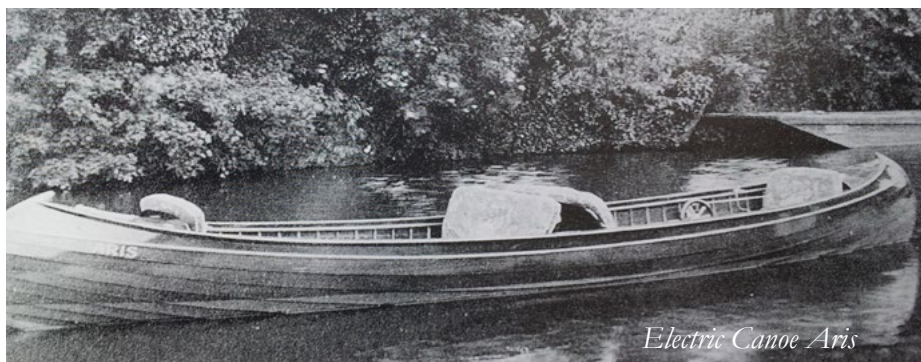
Boatyard on Boulter's Lock Island

Lawrence Carr took over the lease of the Thames Valley Launch (TVL) company premises at Boulter's Lock island in 1904. He put down a new slipway and installed a new and complete plant for charging electric cars and launches. Losing the TVL business probably made life difficult for Carr during the next few years and he seems to have had a very few electric boats in his care. In 1908 Carr took on W Horsham, the son of Horsham the boat builder at Bourne End and a skilful woodworker. He must have been a great asset for he enabled Carr to get into the business of building complete boats. Horsham's first boat to be built at the Ray Motor Company was the motor boat *Ray* and when he finished that in October 1908 he immediately started building a sailing yawl for a Mr Ricardo. During these years other work carried out included maintenance, repair and storage of boats, including the electric launches *Ashore*, *Frou Frou*, *Gollywog*, *Tadpole*, *Mina*, *Esperanza* and *Charlotte*. In 1909 Carr's records indicate that the same electric boats were still in use and being housed and charged at his little boatyard on Boulter's Lock Island. The site at Boulter's Lock had been

rented from Oxford University but in 1909 Carr was able to purchase the freehold. Just before Christmas 1910 the building which Carr used for storing motor boats and contents caught fire and the building and all its contents were destroyed. One of the boats whose furnishings were lost in the fire was the electric launch *Esperanza* which Carr looked after between 1905 and 1913. The owner had to foot a bill of £125 for a new set of curtains, carpets, cushions etc. During the winter of 1911/12 the Thames Conservators authorised the rebuilding of the lock at Boulter's Lock Island and its size was increased to 200' in length and 22' 4" in width. In 1913 Carr and Horsham were becoming interested in the possibilities of building electric canoes, and Carr worked out the specifications for a



25' canoe. However there is no record that the canoe was actually built and the project was shelved until after the war. During the First World War Carr tendered to build 20-27' whalers and gigs for the Admiralty but his yard seems mainly to have been used to build dinghies for the Army. Following the war there was little interest in new electric launches or cars but Carr's enthusiasm for electric canoes was revived, and in May 1920 he and Horsham built *Aris* for Mr Anagos for £460. They continued to build some beautiful electric canoes, one of which *Gena*, is still in use at the time of writing this history. In 1925 Carr may have supplied the electric canoe *Liddesdale* to Lord Astor at Cliveden. The canoe was restored and again the time of writing is now once more at Cliveden in the ownership of the hotel. The Second World War nearly finished off the business but thanks to the efforts of Carr and Horsham, combined with their location at one of the main centres of boating on the Thames during the Edwardian period the little yard tucked away on Boulter's Lock Island was one of the few which kept alive the experience of electric boating for nearly half a century.



Electric Canoe Aris

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