

# FUELING THE FUTURE



**Case histories and successes around the world from the IWI Alternative Fuels Committee**



**Inland Waterways International**  
campaigning for inland waterways worldwide since 1995

# FUELING THE FUTURE

**Case histories and successes around the world from the IWI Alternative Fuels Committee**

There are hundreds of fleets, boat manufacturers, and owners, governments, commercial enterprises and private citizens that are making the move to reducing fossil fuel consumption for their marine needs.

This portfolio of successful case histories has been assembled by Inland Waterways International to demonstrate the scope of solutions and possibilities in service now and underway for the future in different applications around the world.



**Inland Waterways International**

*campaigning for inland waterways worldwide since 1995*

# **Amsterdam 2013 - 2025 Electrification of all canal traffic**



**2013** In the Fall of 2013 a Zero emission status was declared by the City of Amsterdam requiring all private and smaller sighting boats to go electric by 2020, and the larger 20 meter (65ft.) ones to be emission free by 2025 at the latest.

**2015** More than 150 exhibitors were on display at the Electric & Hybrid Marine World Expo 23-25 June 2015 at Amsterdam RAI. Each showcased the very latest ideas, concepts, technologies and components for electric and hybrid marine applications.

This resulted in the City of Amsterdam deciding to ban 2-stroke engines on private boats from 2017 and for commercial vessels operating in the city (530 canal boats yearly transporting some 3 million passengers for sightseeing) achieve "zero emission" target on its 60 miles of canals by 2020.

# Amsterdam • 2013 - 2025 • Electrification of all canal traffic

## Private Boats • Commercial Boats • Ferries



*Skoon floating battery terminal to charge electric boats in Amsterdam canals*

The City License will not be renewed unless the boat is electric.

This included retro-fitting historic vessels. To help push along the move to electricity among smaller boat owners, the city is also working with contractors to install 100 boat charging stations by the end of 2021.

Concerning the regulations and cost for Amsterdam (pleasure craft) for mooring in the canals, a 'Groen Vignet' (green license) is about 0.3 times the cost of a red license. Green is for pleasure craft with an electric motor, or no motor. Red is for petrol or diesel engines.

They calculate length x width to get to m<sup>2</sup>. The average cost is about 60 euro per m<sup>2</sup> per year for a red license so for a launch of 7 x 2.5 m = 17.5 m<sup>2</sup>, the license fee is 1050 euro per year, while electric boats of the same size pay only 315 euro per year, or in other words a 67% discount.

**2020** Corvus Energy announced that it had been selected by Holland Ship Electric to supply lithium-ion battery-based energy storage systems (ESS) for five new all-electric ferries being built by the shipyard group for Amsterdam's municipal public transport provider, GVB.

The first, 41 m LOA by 13.9 meters Beam and able to carry 20 cars, four trucks and 400 passengers, will enter service by 2021. It will feature a superstructure and aluminium railings instead of steel to reduce maintenance.

This and its sisters will operate on three of the North Sea Canal routes, replacing the current fleet built in the 1930s. The routes in the North Sea

# Amsterdam • 2013 - 2025 • Electrification of all canal traffic

## Private Boats • Commercial Boats • Ferries



*Battery electric ferries by Damen*

Canal are among the busiest routes, transporting more than 350,000 cars each year.

**2021** The replacement of the ferries is in line with the sustainability goals set by GVB and the Municipality of Amsterdam to provide zero-emission public transportation in the Municipality of Amsterdam and surroundings. The aim of GVB's extensive new building and retrofit program is that the entire fleet will be hybrid or fully electric by 2025.

# Norway 2014 - 2026 National ferry regulations

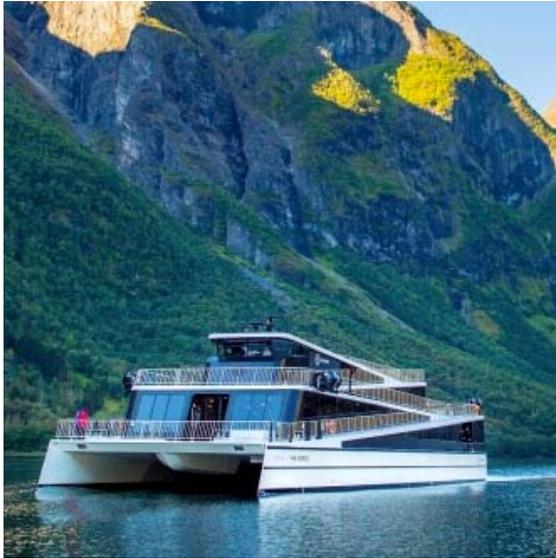


**2014** As atonement for the oil industry that made Norway into a very rich country, since 2014 this Scandinavian nation has been aiming for a fossil-free transport system. Based on operational data, Siemens concluded in a life cycle analysis that 61 of Norway's 112 diesel ferry routes could be replaced by electric ferries with a payback time of 5 years. The analysis included auxiliary costs such as chargers, grid, and so on.

**2013** Norled, one of the country's major ferry companies launched the Ampere, the world's first fully electric battery powered car ferry which in its first two years sailed a distance equivalent to 4 times around the Equator, racking it up 6 km at a time by shuttling back and forth between two little ports called Lavik and Oppedal.

# Norway • 2014 - 2026 • National ferry regulations

## Ferries



*Vision of the Fjords*

A 400-passenger electric carbon-fibre catamaran Future of the Fjords began cruising the waters of the country's famously majestic fjords. The Norwegian Parliament accept a resolution which would see emissions banned on the world heritage fjords "as soon as technically possible and no later than 2026."

**2020** In response to this, ferry operator Fjord 1, which runs one of the largest regional transport networks in Norway has been electrifying its entire fleet. It signed an agreement with the Havyard Group for the construction of another seven battery-electric ferries. Five of them will be built in the company-owned shipyard in Leirvík, and two more will be built in the Turkish Cemre shipyard.

Their names are Vision of The Fjords, Legacy of the Fjords etc. The battery specialists who have been focusing on making this possible include PBES Energy Storage and Siemens. On the Oslofjord, at the northern end of which lies the Norwegian capital Oslo, these ferries will be put into operation by 2022 – the first of these as early as 2021.

The transport authority Ruter has awarded the contract to operate the electric ferries to the Norwegian provider Boreal Sjø. So far it is clear that the ferries, each 35 metres long and eight metres wide, can carry 350 passengers.

**2020** In addition, in June 2020, Wärtsilä was commissioned to design and equip two battery-powered ferries for Norwegian operator Boreal Sjø at Holland Shipyards in the Netherlands. The following month in New Delhi, India, Cochin Shipyard Ltd (CSL) also received a commission to construct and supply of two autonomous electric ferries to Norway-based ASKO Maritime, with an option to build two more identical vessels.



*Schottel SRE 340 EcoPeller*

The 67 meter-long vessels will initially be delivered as a full-electric transport ferry, powered by 1,846 kWh capacity battery. After commissioning autonomous equipment and field trials in Norway, it will operate as a fully autonomous ferry of ASKO that can transport 16 fully loaded Standard EU trailers in one go across the fjords.

In August 2020, propulsion specialist Schottel announced that Festøya, the first of four hybrid ferries for Norwegian ferry operator Norled equipped with its electric drive systems, had recently entered operation. According to the company, each of the four double-ended ro-pax ferries, built at the Remontowa shipyard in Poland, feature two of its SRE 340 EcoPellers, powered by a diesel-electric hybrid system and operated by battery power during transit.

**2021** Another Turkish boat builder, Sefine Shipyard, has won a prestigious order to supply Norwegian operator Boreal with five electric ferries – each supported by two Volvo Penta D13 MG IMO III generator sets (gensets). The ferries will operate to-and-from the islands in the inner Oslo fjord and run scheduled services throughout the day. The Multi Maritime-designed vessels will each have a length of 35 metres, a beam of eight metres, and two passenger decks capable of accommodating up to 350 passengers.

# USA - California 1970 - 2021 World's best selling electric boat



**1970** Since 1970, The Duffy Boat Company of Newport Beach, Orange County, California, USA, has built and sold more than 30,000 of luxuriously appointed 16 – 22 ft electric dayboats, of which more than 3,500 locally, but exported to customers around the world. In 2000 alone, Duffy delivered over 15,000 boats. For a number of years they organised “The Great Electric Boat Race” around Newport Harbour.

Duffys are primarily for harbours, bays, rivers and small lakes, so their boats are very capable of handling winds up to 40 mph in protected waters. While not designed for use in heavy seas, the Duffy 22 completed a 100 mile trip in southern California seas around Catalina Island on April 19, 2013 in 25 knot winds. Their sales brochure states “A Duffy is not just a boat, it's a lifestyle.. Once you experience your first Duffy cruise you'll understand exactly what that really means. Our motto - Unplug, Untie and Unwind...it's that simple.”

# USA - California • 1970 - 2021 • World's best selling electric boat Recreational Boats



*Duffy boat interior*

**2008** In 2008, the Duffy 22 Cuddy was launched, Over 9 feet wide, the boat has the largest interior of any previous Duffy by 50%, so designed to give more space to the elegantly upholstered seats and tables for “sunset meals” afloat.

In 2014 he was elected the City's Mayor and implanted 20 new EV charging stations alongside the existing infrastructure for marinas of hundreds of Duffy boats. More recently he has invented fiberglass SafeHuts for the homeless sleeping on the local piers. In 2020,

**2020** Duffy celebrated its 50th Anniversary. Marshall Duffield's contribution to Newport Beach has gone further than just boat production. Alongside Torqeedo electric outboards (100,000 sold since 2006), the Duffy Case History exemplifies the great potential of inland waterways fleet transition.

# USA - California 2019 - 2021 Battery and hydrogen ferries



**2019** Some 425 miles northwards along the Californian coastline, at San Francisco, one boards the Enhydra, (a tribute to the California sea otter), a 128-foot-long hybrid ferry operated by Red & White Fleet, a tour guide company that's one of San Francisco Bay Area's oldest businesses.

The boat can shuttle up to 600 passengers for over an hour using lithium-ion batteries developed by Corvus Energy, a company that makes energy storage solutions for the maritime industry. BAE Systems integrated some of the technology, which also includes gear from Cummins Red & White Fleet plans to have a 4-strong zero-emissions fleet by 2025. the first aluminum hulled, lithium-Ion battery plug-in hybrid vessel built from the keel up under US Coast Guard regulations.

## USA - California • 2019 - 2021 • Battery and hydrogen ferries

### Commuter Ferries



*'Water-Go-Round' Golden Gate Zero Emission Marine ferry*

The Enhydra can cruise in all electric-mode at 7 knots for 2+ hours, consuming less than 8 gallons per hour. With near silent operation, the Enhydra comes equipped with elegant interior finishes, clear handrails for maximum viewing capacity, a state-of-the art sound system and personal audio headsets for audio tours in 16 languages. In 2021 R&W are planning their first hydrogen fuel cell powered vessel.

The 84-passenger e-ferry was under construction at the All American Marine shipyard in Bellingham, WA using private funding from SWITCH and a \$3 million grant from the California Air Resources Board (CARB).

While Hornblower Group's Vessel Construction Management Team was overseeing and ensuring the successful construction of this innovative vessel, the project was leveraging technology from partners including Golden Gate Zero Emission Marine, BAE Systems, and Hydrogenics. Scaling this zero-emission technology will only be possible with significant investment in new fueling infrastructure.

SWITCH is partnering with Clean Marine Energy (CME) to develop electric charging and hydrogen fueling infrastructure onshore. Backed by the same founders, CME plans to make clean fueling infrastructure available in multiple ports across the US.

# **Norway 2019 - 2021 Electric inboard & outboard motors**



**2018** Norway also has its own smaller sized electric engine builders: EVOY in Norway make drivetrains for boat systems at 74-671 kW, 100-900hp, for new and used fast planing boats from 20 to 30ft (6 to 9 m.). In July 2019, Evoy I, a 28ft (8.6 m.) Polarcircle 860 workboat, was timed at a speed of 50 knots across Ranafjorden.

**2020** In 2020, Evoy teamed up with two other Norwegian marine companies, Frydenbo and Hurtigruten to make a 150hp electric outboard – which will be the world’s most powerful to-date.

In August of 2020 Evoy worked with the with the world’s first electric boat shared ownership service – Kruser – to expand its fleet to include planing boats with Evoy's 150 (hp) electric outboard.

# India 2018 - 2021 Public Private Partnership



**2020** AltFuels Committee President Hartmut Ginnow-Merkert from Berlin, Germany, and supervised by Dr Frue Cheng of Taiwan, focussed on envisioning the use of solar power in the area of eco-tourism, by means of designing solar-powered houseboats for three different countries, one of which was based on the traditional Kerala rice boat.

**2013** Sandith Thandassery, a naval architect who graduated from IIT-Madras founded NavAlt Solar & Electric Boats Pvt. Ltd headquartered at Kochi, (also known as Cochin), a city in southwest India's coastal Kerala state. His vision was to transform marine transport more efficient by drastically reducing the energy for its operation. Having built a 20-seater solar boat for a tourism operator in Bhatinda in Punjab, Thandasherry collaborated with Alternative Energies of La Rochelle, France to make a 40 kW, 75-pax solar ferry for Kerala



*The Aditya carries 110,000 passengers per year with a fuel cost of \$2.50/ day*

State Water Transport Department (KSWTD) for operation on Lake Vembanad between Vaikom and Thavanakdavu.

In November 2013, after attending the trial run of the *Aditya*, India's Transport Minister A.K Saseendrank said the Government was planning to operate at least one solar-powered boat each in every district, eventually a fleet of up to **50** vessels. *Aditya*, used in the singular means the Sun God, Surya.

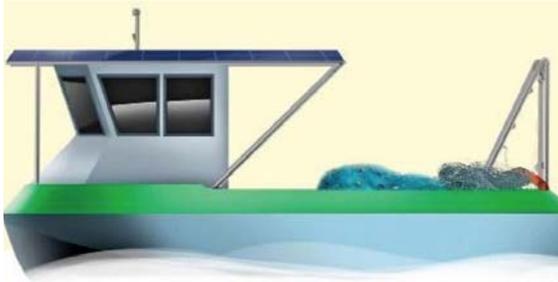
**2020** By 2020, *Aditya* had transported over 110,000 passengers and a totted up a distance of 70,000 km (22 daily trips, carrying a maximum of 75 passenger per trip), without relying on a single drop of fossil fuel. It thus saved KSWTD over 100,000 litres of diesel, worth approximately ₹75 lakh. *Aditya* uses a meagre ₹180 per day as energy cost, as opposed to approximately ₹8,000 that would be required for a diesel-run ferry of similar size.

Thus encouraged, Kochi Metro Rail Limited (KMRL), the Government of Kerala, and German funding agency KfW signed an agreement with the Cochin Shipyard to build **twenty-three** 100 pax hybrid-electric ferries and the remaining fifty-five ferries to have 50 seats, several of them double-deckers.

The vessels will run for up to one hour on fully electric mode courtesy of a propulsion system equipped with a lithium titanium oxide battery, which can be fully recharged in as little as 15 minutes' time.

The project will cover 16 routes in the Greater Kochi area, connecting 38 terminals across 10 island communities, across a 78-km channel length. The

## India • 2018 - • Public Private Partnership Commuter Ferries • Solar Ferries • Solar Workboats



*NavAlt is now building fishing and patrol boats*

first batch of ferries are slated to operate on Vyttila-Kakkanad route from 2021. *Aditya* was a game changer in Kerala's water transport sector, so much so that ambassadors and officials of over 40 countries flew down to check it out.

One delegation from the Andaman and Nicobar Islands in the Bay of Bengal has commissioned two 1,200 pax electric ferries to operate between mainland India and the islands. The 1,200-passenger ferries is part of a four-vessel order that also includes two 500-passenger ferries. When, in July 2020, *Aditaya* won a Gustave Trouvé medal in the Plugboats.com online voting contest, its success was published across the Indian Media and read about by over 5.5 million readers across the India Continent.

**2020** Kerala is also an example of how an AltFuel marine success can have a knock-on effect: Steps are also being taken to increase the number of electric vehicles in the State to bring down pollution. Efforts are being made to roll out 6,000 electric buses by 2025. E-autos too will be introduced on a larger scale (a dozen of them operate in Kochi now). In the wake of the threat posed by COVID-19 where studies showed that air and water became cleaner following the lockdown, steps are being taken to encourage planting of fruit trees and afforestation. A total of 1,000 acres under local bodies were converted into green zones by July 2020.

# Copenhagen 2018 - 2020 Five electric ferries



**2018** In July 2018, Damen Shipyards Group signed a contract with leading multinational public transport company Arriva Danmark for seven fully-electric ferries for use in Copenhagen Harbour.

Arriva would operate these ferries for its client, Danish public transport agency Movia. One crucial requirement was that the new vessels be able to fit into the existing framework – including use of current timetables and infrastructure, as well as capacity to carry at least 60 passengers.

Propulsion was a major factor in the design of the vessels. Movia requested a cleaner, greener use of energy from its ferry service, and Damen had a number of options available. Engineers considered biodiesel engines, hybrid vessels with generators on board, and full electric solutions, ultimately deciding full

## Copenhagen • 2018 - 2020 • Five electric ferries and shore chargers

### Commuter Ferries • Rapid Charging



*This is the fast charger from the ferry in Copenhagen.*

electric was the optimal choice for the twelve year operation of the ferries, based on several factors.

This zero emissions, fully electric solution is quiet in operation and is much more maintenance-friendly than a diesel option. Combustion engines contain a lot more mechanical parts that can fail, and the oil used for lubrication of these moving parts makes the system very dirty in comparison with an electric motor.

The next decision to make was how often the vessels could charge their power supply – how could the ferries operate all day on a minimal battery pack and recharge without disrupting their schedule?

To answer this question, Damen Civil – another branch of Damen’s complete service provision – investigated full civil solutions such as accessibility to the local grid, the regulations surrounding civil power supply, and the practical limitations of the jetties as potential charging points. The ferry route takes one hour to complete, and at each end there is a small window in which to prepare for the beginning of another route. Damen saw this as a window of opportunity to take advantage of a fast-charging system.

To fulfil this, Echandia Marine of Stockholm (with its DNV-GL certified LTO battery systems), Eekels, Heliox and Staubli, together with Damen developed their 23.3 meter x 5.6 meter, *E-Ferry 2306* design with a capacity for 50 passengers, tailored so that the vessels can auto-dock – bow first – at the existing jetties and fast recharge in only seven minutes.

# Copenhagen • 2018 - 2020 • Five electric ferries and shore chargers

## Commuter Ferries • Rapid Charging



*Existing floating jetties?*

The first 5 yellow ferries were delivered in July 2020 in the presence of Copenhagen's Lord Mayor Frank Jensen. The remaining 2 followed in the autumn.

According to Damen, the ferries reduce Copenhagen's public transport NOX emissions by 2.5%, CO2 emissions by 10% and particulate emissions by 66%. As well as a positive environmental impact, there will be a noticeable improvement in efficiency and experience. The ferries are silent, making for a beautiful ride - and need to be charged for just 7-minutes after each journey - negating the need for longer charging periods which take the ferries out of service.

Given the demands of its operation, each ferry carries two drivetrains to provide a good level of redundancy should any unexpected problems occur.

The ferries cover passenger routes in the central metropolitan area of Copenhagen as well as to the port area and serve as a blueprint for future sustainability projects in cities around the world.

# Denmark 1995 - 2020 World's largest electric ferry



E-ferry Ellen is a project co-funded by the EC under the H2020 Research and Innovation programme involving the design, building and demonstration of a fully electric powered ferry which can sail without polluting and CO2 emissions.

**1995** The project was initiated on June 1, 2015 with a budget of 21,3 M€ with EU funding of 15 M€ and the cooperation of 9 partners. From Denmark: Aeroe Kommune, Sofartsstyrelsen, Dansk Brand-OG Sikringsteknisk-Institut, Radgivende Skibsingeniører Jen Kristensen APS, Soby Vaerft A/S, Tuco Yacht Vaerft and Danfoss Mobile Electrification of Finland, Hellenic INstitute of Transport of Greece, and LeCLanche GmbH of Germany and Switzerland.

## Denmark • 1995 - 2020 • World's largest electric ferry

### Ferries



Charging arm of E-Ferry Ellen

**1995** In its first year of operation on a 22 nautical mile route, E-ferry *Ellen* has notched up some noteworthy milestones. Operating between the Danish islands of Ærø and Fynshav, the vessel was designed by Jens Kristensen Consulting Naval Architects and built by the Søby Værft shipyard. Just under 60 meters long and with a breadth of approximately 13 meters, the ferry travels at speeds of 12-12.5 knots, and is capable of carrying 198 passengers in summer months, with this capacity dropping to 147 during winter.

It can also carry 31 cars or five trucks on its open deck. With a 4.3 MWh capacity battery pack, the largest currently installed for maritime use, it is the first electric ferry to have no emergency back-up generator on board.

Compared to a similar modern diesel-powered ferry, making some 1,800 trips, *Ellen* annually saves around 2,520 tons of CO<sub>2</sub>, 14.3 tons of NO<sub>x</sub>, 1.5 tons of SO<sub>2</sub>, 1.8 tons of CO and half a ton of particulate matter. The E-ferry is charged from the local grid on the island of Ærø, whose electricity demand is entirely powered by wind. Even if *Ellen* were to use electricity from the usual Danish grid mix, it would still save around 2,010 tons of CO<sub>2</sub> annually.

**2027** In December 2020, it was announced that a Danish-Norwegian project aimed at building what will be the world's largest and most powerful hydrogen-fuelled ferry had applied for EU funding. The plan is to start operating a Copenhagen-Oslo service by 2027. Several shipping and energy firms have banded together to build a ferry capable of transporting 1,800 passengers between the two Scandinavian capitals. The vessel, which will be named *Europa Seaways*, will be powered by zero-emission hydrogen fuel cells

## Denmark • 1995 - 2020 • World's largest electric ferry

### Ferries



*Europa Seaways*

The hydrogen will be produced in Denmark using offshore wind power, meaning it will be 'green hydrogen' rather than grey or blue, which involves using fossil fuels in the production process. According to the project's initial calculations, the ferry would avoid 64,000 tonnes of CO<sub>2</sub> emissions every year, the same as taking more than 13,000 passenger cars off the road.

*Europa Seaways* will also be able to carry vehicles, either 380 cars or 120 trucks, on the roughly 48 hour-long roundtrip. To achieve this feat it will be powered by a 23-megawatt fuel cell, which will dwarf all existing propulsion systems.

# France

## 2009 - 2021

### Battery, hybrid and solar vessels



The French Electric Boat Association has an important corpus of 50 active and professional members. With pioneer companies such as Ruban Bleu of Nantes, by 2020 the total number of small pleasure boats, privately owned or for rental, has grown to 9,000.

Meanwhile Alternative Energies of La Rochelle, founded in 1996 by Philippe Palu de la Barrière, starting with a 35PAX solar-powered ferry, have progressed to 15 such boats for various cities in France (Paris, Bordeaux, Marseille, Rouen, Strasbourg, Ajaccio, Calais, la Rochelle, Lorient, Nantes and Toulon).

**2009** In 2009 ODC marine introduced the first passenger ferry powered by lithium batteries and in 2012 first hybrid passenger vessel. These are part of a 70-strong nationwide fleet of hydrogen fuel and all-electric passenger boats,

# France • 2009 - 2021 • Battery, hybrid and solar vessels

## Commuter Ferries • Battery Ferries • Solar Ferries



<https://www.odcmarine.com/odcmarine-project-2/>

built by other shipyards such as the Chantier Naval Franco Suisse, Transfluid, Torqeedo, Fisher Panda and Naviwatt, Mayday, ABB, ODC Marine with capacities from 12 to 200 passengers.

**2009** In 2017 AE developed a fuel-cell sea ferry called Galilee. They also worked with NavAlt in India to create their first solar-electric ferry Aditaya (see Kochi Case History below).

AFBE, led by their President Xavier de Montgros, are also the interlocutors of professional organizations and public authorities, asked to participate in various working groups, such as the ISO standard on electric propulsion through AFNOR or the PAMI (Modernization and Innovation Assistance Plan) system of VNF for a cleaner river fleet.

AFBE is also part of the Federation of Nautical Industries, the EcoNav network and the Groupement des Industries de Construction et Activités Navales (GICAN) and the Maritime Cluster.

While those wishing to build or retrofit electric boats in France can obtain financial aid, recent legislation passed by the French Government requires any harbour with more than 200 berths to set aside 1% for electricity complete with recharging points. This will create 2000 berths by the end of 2021.

# Sweden

## 2014 - 2030

### The evolution of alt fuel ferries



**2014** In 2014, the Swedish companies Echandia and Green City Ferries launched the retrofitted all-electric passenger ferry Movitz. With a 200-kWh battery and a diesel engine for back-up, Movitz could operate as a commuter in Stockholm for 1 ½ hours and recharge in 15 minutes.

Two years later, Green City Ferries launched the BB Green prototype, a 20 m high-speed carbon-fibre all-electric vessel using ASV (Air Supported Vessel) technique. With a 200-kWh battery the vessel operates for 15 minutes at a speed of 30 knots.

**2020** Four years later, the Transport Authority is still not interested. Green City Ferries along with former Minister of Finance, Allan Larsson, then took the initiative to develop a plan for the transition to an emission-free archipelago fleet. Of today's 60 vessels 30 of them should be retrofitted with

# Sweden • 2014 - 2030 • The evolution of alt fuel ferries

## Hybrid Ferries • Bio Diesel Ferries • Battery Ferries

batteries or fuel cells, 30 of should be discontinued and 30 new vessels should be invested in.

The plan for the fleet has until now been to change from fossil diesel to biodiesel which is claimed to be carbon-neutral, which is questioned. Furthermore, any diesel emits nitrogen-oxides and particulate matter which are harmful to people and waters.

**2030** There is also a European initiative called Viable cities in which the mayors of nine Swedish cities (among them the three largest - Stockholm, Göteborg and Malmö – officially signed a climate contract where they made a commitment to have their cities climate neutral by 2030.

# **UK 1980s - 2020 Boats for residents and visitors**



In the early 1980s, following the setting up of the world's first Electric Boat Association, a key player was Rupert Latham of the Steam and Electric Launch Company which built, sold and exported some 200 Frolic and Mystic dayboats.

A close second was Emrhys Barrell of the Thames Electric Launch Company who sold new boats and developed and installed electric and hybrid systems into existing boats. Their electric systems enabled two 29 foot cruisers to break records by covering more than 100 miles in 24 hours on one single battery charge.

Encouraged by a special rate licensing fee from the local navigation authority, during mid-1980s there was a boom in the popularity of Thameside electric dayboats, either in private ownership or as rental fleets. To this were added two

## UK • 1980s - 2020 • Noats for residents and visitors Canalboats/Narrowboats • Tourist Ferries



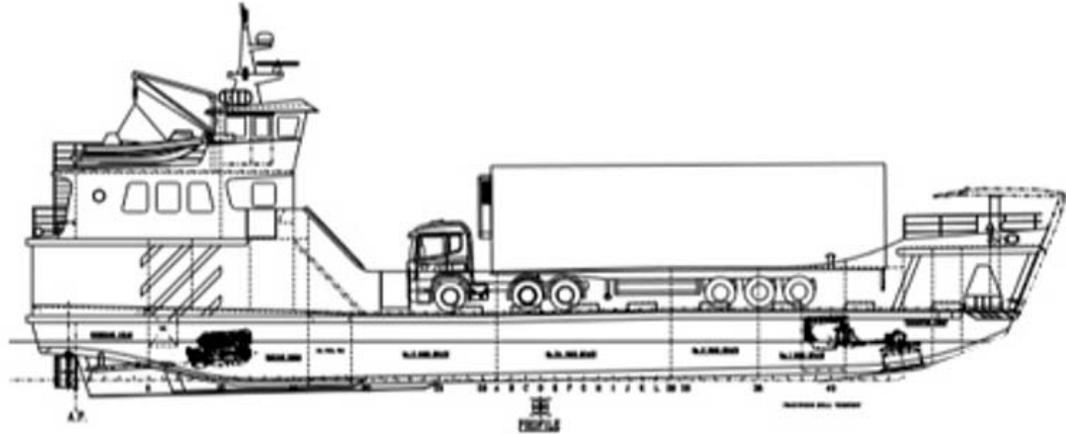
*E-Voyager is a refit of an old diesel ferry and uses 2nd life batteries*

electric river patrol boats for the then National Rivers Authority which were hybrid models, keeping their diesels but able to cruise range permitting on electric.

The cruising, ferry and fishing company Plymouth Boat Trips (PBT), the boatbuilder Voyager Marine in partnership with the University of Plymouth, the University of Exeter, the manufacturer Teignbridge Propellers and the engineering technology company EV Parts have developed an electric ferry called the e-Voyager.

It uses repurposed, Nissan Leaf batteries and an advanced electric motor, which replaces the traditional diesel engine. The green ferry will undergo rigorous running trials, before carrying passengers on ferry routes from April 2021. Partners note the e-Voyager will be the first vessel to be recognised by both the Maritime and Coastguard Agency and a Classification Society. The partnership will now aim to convert larger passenger vessels.

# Orkney Islands 2020 Consortium of partners



MV Shapinsay, the first hydrogen fuel cell ferryboat in the world obtaining its energy from renewables such as wind and tidal power is undergoing trials between the Orkney Islands in Scotland.

The HyDIME project is made up of a consortium of partners being led by Ferguson Marine. Partners include Ballard, ULEMCo, Lloyd's Register, HSSMI and Orkney Islands Council and is funded by the EU project HySeas III. The ferry has initially been trialled using hydrogen to fuel its auxiliary power while docked before undergoing sea tests.

# The Alps

## 1995 - 2020

### Electric passenger boats



The Königssee, a natural lake in the extreme southeast Berchtesgadener Land district of the German state of Bavaria, near the Austrian border, is noted for its clear water and is advertised as the cleanest lake in Germany.

For this reason, only electric-powered passenger boats, rowing, and pedal boats have been permitted on the lake since 1909 – over a century ago. Today's 18-strong fleet is maintained and run by the Bayerische Seenschiffahrt company. Recently two of these boats were re-battered with Hoppecke units.

**1995** In Switzerland, in 1995, at Yverdon-les-Bains beside Lake Lemman,, two 8m50 12 PAX solar-powered passenger boats, Solifleur and Chlorophylle, built by MW-Line were in regular service. When not cruising, their surplus electrical energy was supplied to the town's grid.

# The Alps • 1995 - 2020 • Electric passenger boats

## Solar Ferries • Electric Ferries • Electric Water Limos



*The Riva classic vaporatte gone electric*

**1997** In 1997 MW-Line's Aquarel went into service on the same lake with three boats added to the fleet by 1999.

The 20m 65ft Becassine, also running on Lake Geneva had a range of 90 m 65 mi at 10 knots. In 2019, the fleet received its 5th vessel in the 25 PAX Aquabus Greta, taking visitors to the foot of the city's famous Jet d'Eau fountain using 100% solar power and electric motors.

More recently electric boats have arrived on the Italian Alpine Lakes. Lake Como has been named "The Electric Lake" Along points of interest, 17 charging stations are being fitted around 170 kilometres of the Lake Como.

Taking advantage of these e-vehicle chargers, the Ernesto Riva shipyard of Laglio has produced the 12 PAX 100 kW Vaporina Elettra passenger yacht, The ecovolta lithium-ion batteries used in the Elettra provide a total capacity of 180kWh and enable five hours of autonomous operation at a speed of 13 knots.

Thanks to their high energy density of 480Wh per litre, the batteries offer a high capacity without taking up too much space.

Further along the lake, Nautico Matteri Shipyard and the Econoleggio Como Lake are planning a fleet of zero-emission boats. On neighbouring Lake Maggiore in Cittiglio, Vita Yachts have not only developed a 40 knot electric runabout but also a fast-recharging system.

# Venice 2019 - 2028 Electrification of the canal city



Following the COVID setback, in June 2021 a full international e-regatta (31 boats from 17 nations), electric boat parade and Electric Village and international seminar has been scheduled.

Mayor Brugnarò announced his Municipality's decision to invest €1.5 million into the conversion of the Venice fleet, 300K of which to encourage private boat owners to change their fossil fuel outboards for an electric equivalent.

With 131 million Euros from both the Veneto Region and Azienda Veneziana della Mobilità (AVM)/ACTV, as approved by the City Council, during the next few years, Venice's fleet of vaporetti will be replaced or retro-fitted to diesel-electric serial hybrid propulsion.

According to in-depth researches, the Venice infrastructure is not suitable for pure electric propulsion. Therefore 35 vaporetti will be converted to diesel-

# Venice • 2019 - 2028 • Electrification of the canal city

## Work Boats • Water Taxis • Charging Network



*Charging poles have been installed for boats in 'La Serenissima'*

electric and 28 new ones will be purchased. To this will be added a further investment of 154 million euros.

According to Renato Boraso, Assessore for Mobility and Transport of Venice and Mestre, "In 2 or 3 years all the boats in the Grand Canal will be green." To this will be added the construction of 116 floating pontoons (equipped with gangways) equipped with mooring systems for ferries, while on the land, electric buses and rental electric scooters will circulate in Lido and Pellestrina.

To this may be added a similar conversion for Bureau Veritas workboats. With this transition, the production of pollutants and the acoustic impact of the vehicles decrease considerably.

These contributions derive from specific national funds destined for the Regions in the two-year period 2018-2019 (DM n. 52/2018 and DM n. 397/2019) then attributed to the Municipality of Venice with a resolution of the Regional Council in March 2020.

While the Alilaguna transport company with Vizianallo shipyard of Venice have developed a 16m hydrogen fuel cell passenger ferry Hepic which is still waiting for approval by the Italian Navigation Authorities,

The Italian Government has also decided to invest €30 million into the provision of a fleet of electric boats from the source of the River Tiber to Rome, an application has been made to the EU's Recovery Fund for some €xx millions for the electrification of some 41 ports and retrofitting of a whole fleet of boats.