

Case study: Ika Rere, 19 m fully electric passenger ferry for East by West Ferries, Wellington

The first fully electric high speed passenger ferry in the Southern Hemisphere is in service in Wellington. Ika Rere transports commuters across the capital's harbour at 20 knots, a zero emission solution to maritime public transport, powered by 100% renewable energy. It is expected the 19m catamaran will save up to 14,500 tonnes of CO2 emissions over its lifetime compared with an equivalent aluminium/diesel vessel, with an approximate 60% saving in propulsion energy costs. Less maintenance will be required than conventional ferries due to Ika Rere's composite construction which offers superior fatigue properties and corrosion resistance, and due to the battery electric system having fewer moving parts than a diesel engine – resulting in less disruption for both the operator and commuters. The new ferry is faster than the operator's diesel vessels and has a 30% higher passenger capacity, increasing overall efficiency of the route; as well as offering a quieter and smoother ride for an improved passenger experience.

East by West Ferries' CEO, Jeremy Ward, knew he had to put a stake in the ground and do things differently when it came to the purchase of a new ferry for his Wellington Harbour route.

"East by West has been running the Queen's Wharf to Days Bay route for over 30 years and when we decided an upgrade was needed, we knew it was time to think outside the square," says Ward. "We had to find a solution that was going to tick all the boxes – not just revenue and performance and customer experience, but also meeting our responsibility to the environment. We knew we had to stop talking about it, be bold and take action."

Ward's requirements meant that this project would be ground-breaking – it had to transport 130 passengers, have a service speed of 20 knots to meet scheduling requirements, and be fully electric, with no back up diesel propulsion.

Taking on such an ambitious project was no mean feat, but in December 2021, WEBBco handed over Ika Rere to East by West Ferries for its official launch. This 19m 20 knot 100% electric catamaran has a passenger capacity of 132 with three crew, an on-board café, two heads (with capacity for three), and inside and outside seating options. It cruises effortlessly and almost silently across Wellington Harbour from Queen's Wharf to Days Bay seven times a day, providing customers with a comfortable, smooth and enjoyable journey.

This world-leading project was highly collaborative, bringing together several NZ maritime experts to work alongside the East by West and WEBBco teams towards the shared vision. Key design and technology partners were: McKay (electrotechnology specialists), SSC Marine (naval architecture and design consultants), Gurit (composites and lightweighting) and Retyna (EV consultants).

Energy-efficient Hull Design

A slender catamaran hull form was chosen as it minimises displacement and achieves lower resistance. This requires less power to move the vessel through the water, which means less energy to be stored – and therefore a lighter and lower cost onboard energy storage system is required.

Once the principal dimensions and battery specifications were determined, the rest of the vessel could be detailed out, including the construction materials and manufacturing processes.

Low-weight Carbon Composite Construction

Considerations in the selection of construction materials were displacement, energy consumption and longevity, with energy consumption a key factor in the long-term cost of the vessel. The key to reducing energy consumption was reducing weight, so after extensive evaluation, a high-strength low-weight carbon fibre foam sandwich laminate was chosen.

The composite structure not only had to be lightweight and robust, but also provide fire resistance around the energy storage system of the vessel. An A30 (half-hour) fire boundary using light weight insulation was created around the battery space, supported by a fire resistant composite structure featuring an integrated intumescent to protect the structural fibres, combined with a temperature resistant core.

An innovative modular carbon fibre panel system was developed to allow rapid manufacture of the composite shell, reducing labour and tooling costs for the first vessel, and to leap-frog the initial setup phase that would have otherwise occurred. The panels were vacuum infused to ensure accurate resin uptake and avoid excess weight, and the decision to thermoform the core also afforded a significant overall weight saving.

Intelligent Battery Management System

The electric propulsion and power management system was custom developed for Ika Rere and the route.

The electrical distribution system is based on a DC bus concept, and power is distributed around the vessel at 750VDC which minimises conversion and distribution losses. The propulsion inverters and motors have exceptional efficiency, allowing for 97% efficiency from distribution grid to propeller shaft.

The ferry's batteries are arranged in redundant systems, with independent battery stacks in each hull. The advanced battery management system provides constant system supervision, providing safety functions as well as real-time system capacity and health data.

An advanced algorithm supplies a constant estimate of the vessel range, using benchmarked conditions and real-time feedback on performance of the vessel. The VCAM provides the skipper and crew with dynamic visual performance data and an overview of all the vessel's systems at any point in time - allowing them to make optimal operational decisions.

Whilst the electrical system has been optimised for a 20 knot 25km round trip at full passenger capacity (the typical commute), the ferry can operate at lower speeds for significantly longer distances and times between charges, allowing East by West to charter the ferry for dinner cruises and sightseeing trips.

Future-proofed Charging Infrastructure

The charging rate was a significant consideration in the boat's design, impacting areas such as hull size, battery specification, weight and displacement. Local electricity network capacity, access, viewshafts, aesthetics, and dockside infrastructure were equally important, as East by West Ferries' dock is located in a highly pedestrianised heritage area with restaurants and waterfront walkways. By bringing all interested parties together, a solution was found that meets the current charging needs of this ferry, and is future-proofed, ready for further growth in the electrification of Wellington's public transport.

The ferry has been designed and built to complete one return run of 25km before charging at the dockside at a rate of 1 MW for 15 minutes, while passengers disembark and board. For the first year of operation, it is being charged from a 300 kW charger at its overnight berth.

Commercial Viability

Analysis shows that whilst initial investment is higher for a carbon fibre electric vessel compared with the aluminium diesel alternative, when you consider materials and propulsion as part of the cost of the full vessel, and add in the operational costs over its lifetime, a carbon electric vessel is a viable option for a commercial environment.

East By West Ferries expect significant savings in their operational and maintenance costs of the electric ferry, with an anticipated 60% reduction in propulsion energy costs and 50,000 maintenance-free operational hours on the electric motors. They believe their investment is future-proofed through the expected longer in-service life and its appeal of being a zero operating emission vessel. In addition, the customer experience is much improved, with reduced noise pollution, less vibration and better sea keeping.

Ika Rere entered service in March 2022 as a landmark public transport project for the Greater Wellington Region and New Zealand.

Images courtesy of: Southlight Studio and Stellar Studios



Specification

LOA: 19m
 Beam: 7m
 Max pax: 132
 Service speed: 20 knots
 Installed battery capacity: 540kW hours
 Distribution bus: 750 Volts DC
 Propulsion: 2 x 325 kW motors
 Battery weight: 5.5 tonnes
 Charging rate: 1400A, 1 MegaWatt
 Construction: Carbon fibre composite