Echandia Marine’s newly retrofitted electric ferry, Movitz, carries 100 passengers on a one-hour Stockholm inner city route. Photo courtesy Echandia Marine/Green City Ferries.

Electric Future

How renewable energy technologies are impacting the ferry sector

BY GUY DAUNCEY

Electric boats have been around since the late 19th century, hybrid diesel-electric propulsion systems since 1903, and electric submarines for most of the 20th century. However, 100% electric ferries have only recently been conceived, designed, and built as a commercial reality. The climate crisis is driving a wave of innovation as engineers and architects seek ways to heat, transport, and power our lives using renewable energy instead of fossil fuels.

Sweden started in 2014 with a 100% electric passenger ferry. This year, Norway is trumping that with an electric car ferry. Both will result in lower operating costs, zero greenhouse gases, zero air pollution, and almost no noise.

Sweden’s newly retrofitted electric ferry, Movitz, carries 100 passengers on a one-hour Stockholm inner city route. It has two 125 kW electric motors and 180 kW batteries that are supercharged during the 10-minute turnaround, using renewable electricity. The batteries are high-power density lithium-titanate-oxide and super-advanced nickel-metal-hydride.

Before its retrofit, Movitz had a 250 kW diesel engine that burned 50,000 litres of diesel, cost 30% more to run, and produced 130 tons of carbon dioxide and 1.5 tons of nitrous oxide a year, as well as making a lot of noise. The company behind the ferry, Echandia Marine, is embarking on other projects to launch passenger electric ferries around Europe.

In Norway, the Ministry of Transportation wanted to protect the idyllic surroundings of Sognefjord (Norway’s longest fjord) by replacing a retiring diesel ferry with a cleaner and quieter electric ferry. The contract for the route was up in 2015, so the government decided to award the route to whoever came up with the most environmentally-friendly ferry that would be 15-20% more efficient than the retiring ferry.
Electric Future continued

Four ferry operators bid, and a 10-year contract to operate the ferry was won by the Norwegian operator Norled, with its innovative MV Ampere, also known as ZeroCat. This vessel has been built in partnership with Siemens at the Norwegian shipyard Fjellstrand, and is due to begin operating this year.

The 80-m ZeroCat will carry 120 cars and 360 passengers, making 34 trips a day on a 20-minute, 5.7 kilometer route linking the villages of Lavik and Oppedal. The ferry was designed from the bottom up, pooling Fjellstrand’s knowledge of energy-efficient shipbuilding with Siemens’ electric propulsion expertise. It has a catamaran design with two slim aluminum hulls that offer less resistance to the water and are much lighter than steel. The aluminum also reduces corrosion problems, eliminating the need for anti-rust paint, and the hulls will require less maintenance than normal.

The ferry is powered by electricity from two 450 kW lithium polymer batteries, which can provide 1000 kWh of electricity. The batteries are topped up during the 10-minute turnarounds from two 260 kW shore batteries, which slowly recharge from the grid using 100% renewable power. At night, the ferry’s batteries are recharged directly from the grid, when local demand is low. Even though ZeroCat’s batteries weigh ten tons, the ship’s weight is half that of a conventional ferry due to its catamaran design and use of aluminum.

LED lights, solar panels, and BlueDrive

In addition to being electric, ZeroCat has LED lighting, solar panels, on-demand electric water heaters, and waste heat recovery units. One of the two electric motors drives its Rolls-Royce azimuth thrusters, enabling the ferry to operate at 10 knots. It also uses Siemens’ BlueDrive PlusC variable speed propulsion, which lowers operational costs and provides maintenance and repair savings and a reduced number of electrical components. The BlueDrive is programed to optimize energy consumption and engine speed under different load conditions, with sub-controllers for the batteries, thrusters, and remote controls.

In 2014, ZeroCat won the prestigious “Ship of the Year” industry award, presented in Hamburg. The ferry it will replace burned a million litres of diesel a year, and produced 2,680 tonnes of CO₂ and 37 tonnes of nitrogen oxide air pollutants.

ZeroCat costs more than a regular diesel ferry, but its fuel cost is 70% lower—$3.30 per kilometer compared to $10.60 for a conventional diesel-electric ferry. Its fuel is only 8% of its operational expenditure and 4% of the total vessel cost, compared to 20-25% and 15% for a conventional ferry. The 10-year contract was needed to enable Norled to recoup its investment.

Weight and distance

When it comes to considering electric drive for larger ferries, the challenge concerns weight as well as distance. A large car ferry on a busy route might have a displacement of 11,000 tons, compared to approximately 1,000 tons for ZeroCat. A 3-fold increase in distance (a 1.5 hour crossing) combined with a 10-fold increase in weight will require a 30-fold increase in battery size.
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Even if new ferries built from aluminum were half the weight, they will still need a 15-fold increase in size. Battery technology is improving steadily, with reduced costs and increased range. Will the large ferries of the future be hybrid-electric, using biofuel or green hydrogen to generate additional electricity enroute, or will they simply use larger batteries to be 100% electric? The engineers at Siemens may have ideas, but so far they’re not sharing in public.

The climate crisis is compelling us to design ships that no longer need fossil fuels. Sooner or later, every ship in the world will stop using diesel, and the companies that lead the innovation will be well placed to capture the market. Sweden’s Echandia Marine, Norway’s Norled, and Germany’s Siemens have taken an unchallenged lead; Norled has identified 50 ferry routes of up to 30 minutes in Norway and beyond where electric ferries would be viable.

Many in Norway want their country to become a leading green maritime nation, and Norway’s Maritime Battery Forum has a vision to make the Norwegian maritime cluster world leading within battery-based value creation. The forum has 43 business and organizational members, including DNV GL; Siemens; Rolls-Royce; ABB; the Norwegian Maritime Authority; the Norwegian Shipowners’ Association; Statoil; the University of Oslo; and the Norwegian armed forces. Their goals are that Norway’s industry will deliver the most environmentally friendly, innovative, and competitive solutions for the future, and that electric and hybrid-electric vessels will become a pillar of Norwegian environmental policy.

Wherever a crossing is 30 minutes or less, today’s electric drive technology can work well. The Staten Island ferry from Manhattan to Staten Island is a 25-minute run; the SeaBus from Vancouver to North Vancouver is a 10-minute run with a 12-minute turnaround; BC Ferries has 10 routes in British Columbia of 30 minutes or less; river-crossing ferries all around the world operate short routes. And for passenger ferries, any route of up to an hour is fair game.

The transition from fossil fuels to renewable energy is sparking mass innovation, just as the entry to the age of fossil fuels did 250 years ago. Historically, the age of fossil fuels will last some 300 years (1750-2050). The solar age that follows, using renewable energy, will last until the sun begins to turn in a red giant in 1.75 billion years. And with every passing year, renewable energy technologies will improve and become cheaper.

Guy Dauncey is a speaker, author, activist and eco-futurist who works to develop a positive vision of a sustainable future, and to translate that vision into action. He is founder and communications director of the BC Sustainable Energy Association.

Deeper Dive
To learn more about the topics explored in this article, check out the following sites.

Echandia Marine: www.echandiamarine.com
ZeroCat: www.fjellstrand.no/flyers/flyer_1696.pdf
Videos on ZeroCat (in Polish): www.youtube.com/watch?v=0Olrcz8y3-Q
Siemens BlueDrive PlusC video: www.vimeo.com/105129769
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