Economic sense
The battery-powered ferry is considerably cheaper to run than diesel equivalents. Firstly, it takes its power from the hydroelectric electricity grid and, secondly, it uses less energy than equivalent vessels. One reason for this is its novel weight-saving design.

Unlike many electric cars, the Norled ferry was developed from the ground up. The result is significantly reduced weight. Despite its ten-ton batteries and capacity for 360 passengers and 120 vehicles, the ship is only half as heavy as a conventional ferry. This is because it is made exclusively of light aluminium, rather than normal shipbuilding steel. The ship's robust corrosion-resistant aluminum structure also means no corrosion-resistant paint is required and maintenance is reduced.

A further energy-reducing initiative is the BlueDrive PlusC propulsion system. The vessel has two 450kW azimuth thrusters driven by Siemens' electric motors and controlled from the bridge using BlueDrive PlusC's energy management system. Vessel machinery is also supervised from the bridge using Siemens' Flexible 300 integrated alarm and monitoring system.

A battery-powered future?
The Norled ferry is a milestone on the road to operating emission-free ferries along Norway's long coastline, with at least 50 other routes currently able to sustain battery-operated vessels. Furthermore, batteries are expected to become considerably more efficient and less expensive in the next few years, which tip the scales further away from diesel as the most popular fuel source.

Siemens AS
Marine & Shipbuilding
Bratsbergveien 5
NO-7037 Trondheim
Tel: + 47 73 95 90 00

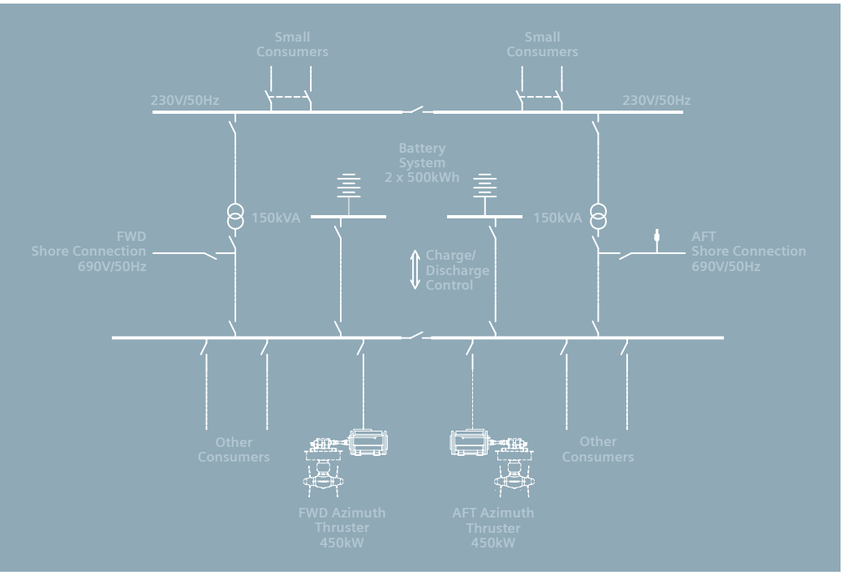
SIEMENS

www.siemens.no

BlueDrive PlusC

Emission-free shipping becomes reality

Oneline diagram of the main electric system onboard the ferry



Siemens and Fjellstrand Shipyard have joined forces to build the world's first emission-free, electric-powered ferry. This unique vessel enters service in early 2015 on the ferry link across Sognefjord between Lavik and Oppedal, Norway.

The vessel does not emit greenhouse gases and operates almost silently. It's run entirely on batteries, which take their power from the local hydroelectric-powered electricity net. Hence, there are no direct or indirect emissions at all.

Competition winner
In 2011, Norway's Ministry of Transport and Communications launched a competition to develop the country's most environmentally friendly ferry, with a concession for the fjord link between the idyllic villages of Lavik and Oppedal as the prize. Currently, diesel-operated ferries work the route, but the ministry decided to prioritize ships with low noise and greenhouse gas emissions.

The charging station on each pier

Norled, a Norwegian ferry operator with around 50 ferries operating on the country's west coast, partnered with Siemens and Fjellstrand and entered the competition. It's a good match – Fjellstrand is known for energy-efficient shipbuilding and Siemens for its electric-propulsion expertise. The result is a unique and sophisticated, emission-free vessel with unrivalled environmental credentials. In contrast, a conventional ferry traveling the same route consumes around one million liters of diesel fuel, produces 2,680 tons of carbon dioxide and emits 37 tons of nitrogen oxide annually. The jury was won over by the innovative new vessel.

Inspiration from the deep
For over 100 years, battery-powered submarines have been a reality, but can these drive systems be used effectively on the surface? Siemens first tried answering this question in 1999, but it proved too soon. Since then, technology has advanced and lifecycle assessment issues are given more importance, which has led to Siemens successfully applying the concept in the Norled vessel.

The fully electric ferry will travel six kilometers across the fjord 34 times a day, with each trip taking around 20 minutes. The ferry, which is 80 meters long, is driven by two electric motors, each with an output of 450 kilowatts. Both use Siemens' BlueDrive PlusC electric-propulsion system powered by lithium-ion batteries. These have a combined capacity of 1,000 kilowatt-hours (kWh), which is enough to make several trips before they need to be recharged, but is a long way from the 34 crossings needed each day. Theoretically, the batteries can be recharged at each side of the crossing before the ferry sets off again. However, there is only ten minutes available each side for recharging and the local grid can't support such sudden and large requests for power.

Increasing range
Fjellstrand and Siemens have found a simple answer to the recharging issue. One lithium-ion battery will be installed at each pier to serve as a buffer. The 260-kWh units recharge the ferry's batteries while it waits. Afterwards, the onshore batteries slowly recoup all energy from the grid until the ship returns to drop off passengers and recharge again. Charging stations will be housed in small buildings about the size of newsstands. The ship's onboard batteries will be recharged directly from the grid at night when the ferry is not in use. Alternatively, the option is to expand the entire electricity grid to accept the additional demand, but this is cost prohibitive.