# Onboard fuel cells

## A viable fuel cell system represents an important step in marine decarbonization

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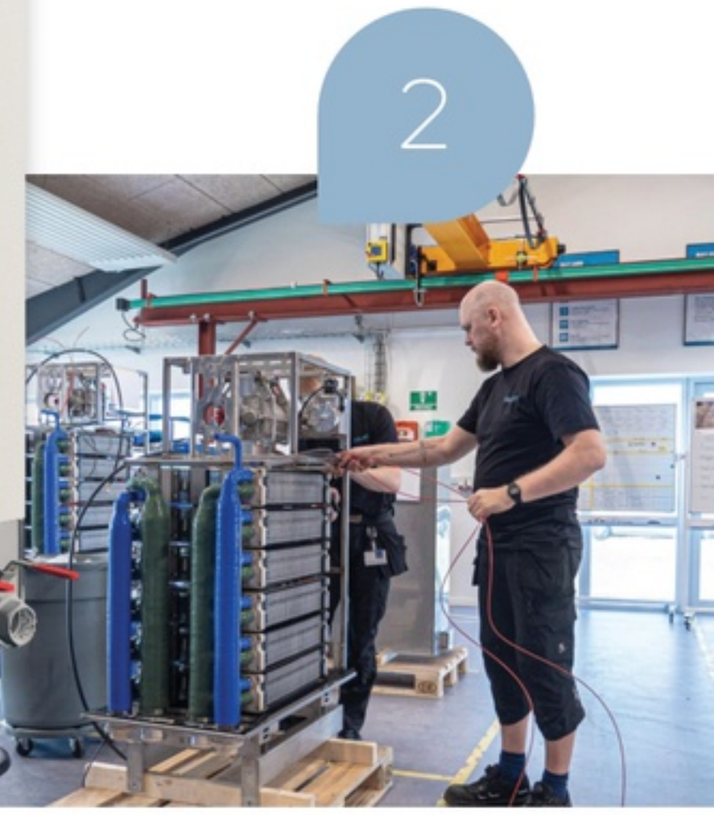


1. Ballard Power Systems' FCwave fuel cell module
2. Build and test of FCwave at Ballard Power Systems' Marine Center of Excellence in Denmark

Representing an important breakthrough in commercializing fuel cell modules for vessels, FCwave from Ballard Power Systems is the world's first fuel cell module to be awarded Type Approval for marine applications by DNV. It offers a deployment-ready solution that supports shipowners and operators in reducing development time and cost as the marine industry makes the switch to zero-emission operations.

Certified by DNV, FCwave provides fuel cell power for vessels ranging from short- to long-haul routes and offers faster implementation and increased confidence in fuel cells as a zero-emission solution. Ballard regards the module as a catalyst for accelerating net-zero technology in an industry that currently accounts for 3% of global GHG emissions – and one working to meet global targets to cut emissions from ships by at least 50% by 2050.

The Type Approval process involves a series of simulations and tests carried out at Ballard's global Marine Center of Excellence in Hobro, Denmark, where FCwave is also developed, tested and manufactured.

"The Type Approval certifies FCwave as the first product to meet the stringent safety, functional, design and documentation requirements that are essential for global marine commercialization," says Søren Østergaard Hansen, general manager of marine and stationary at Ballard Power Systems Europe. "For shipowners, the solution offers ease of integration, shorter implementation time and a reduction in overall cost through proven technology – and operators now have access to a deployment-ready alternative, paving the way for volume applications, including fleets."

### Theory into practice

One of the first customer applications for the newly classified FCwave is Norwegian ferry operator Norled, which will introduce the world's first liquid hydrogen-powered ferry into passenger service later in 2022. Powering the MF Hydra's two 200kW modules, FCwave offers high performance, as well as reduced fuel consumption, emissions and maintenance costs. In addition, fuel cell power delivers a zero-emission solution for environmentally sensitive areas or emission control zones, such as the Norwegian World Heritage fjords – which are progressing to become the world's first zero-emission zones at sea by 2026.

The plug-and-play FCwave module provides a replacement for conventional internal combustion engines. FCwave is a high-power, adaptable engine in a hybrid electric system that incorporates fuel cells working together with batteries to provide efficient, zero-emission power. The system uses proven components from Ballard's four decades of experience with heavy-duty applications, delivering reliable performance, high power density and favorable economics. The FCwave – built in 200kW modules – facilitates scalable power output and flexible integration on board the vessel.

The modular design incorporates Ballard's FCgen-LCS stack technology, which delivers scalability and serviceability and includes product support. Featuring integration functionality to advance the scope and potential of marine design and technology, FCwave includes connections for cooling, electrical direct current outage, ventilation, and hydrogen inlets situated below floor level.

It also meets rigorous industry safety standards, with its protective management system containing 16 sequential barriers to prevent an unlikely on-vessel incident from escalating into a more serious accident.

FCwave's industry-leading durability delivers operating lifetime and efficiency that matches and exceeds marine requirements. The lightweight build also offers flexibility through modular components for scalable power.

Supplementary support delivers on-site assistance for integration, certification and commissioning; flexible service that covers the module's lifetime; as well as complete training to cover installation, operation and maintenance.

"Hydrogen and fuel cell technology is the most promising solution to meet future emission requirements. FCwave is designed for – and together with – the marine industry to deliver the most robust and reliable fuel cell technology available," explains Østergaard Hansen.