

The E-ferry Project

The E-ferry is the world's* largest zero emission, fully electric ferry.

The project is supported by the EU Horizon 2020 Program involving the design, building & demonstration of a fully electric powered 'green' ferry for medium range connections.



ÆRØ KOMMUNE



* At time of construction

E-ferry Specifications

Single ended, drive-through Ro-Ro passenger Ferry with one continuous main deck for trucks and cars.

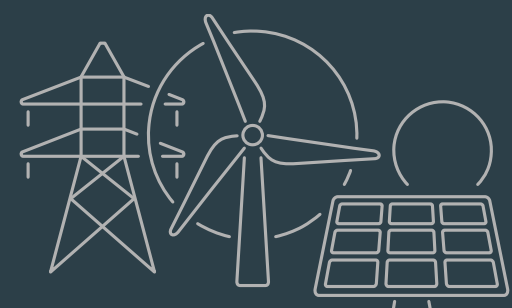


Battery system :	4.3 MWh, G-NMC	Battery service life :	10 years
Charging power :	3.9 MW DC	Maximum speed :	15.5 knots
Propulsion power :	1.5 MW (2 x 750 kW)	Propulsion motor :	Liquid cooled electric motor (Synchronous reluctance assisted permanent magnet technology)
Dimensions :	59.4m (length), 13.4m (width)	Light ship weight :	747 tons
Vehicle capacity :	31 cars or 5 HGV trucks + 8 cars	Passengers :	198





**e-TRANSPORT
SOLUTIONS**

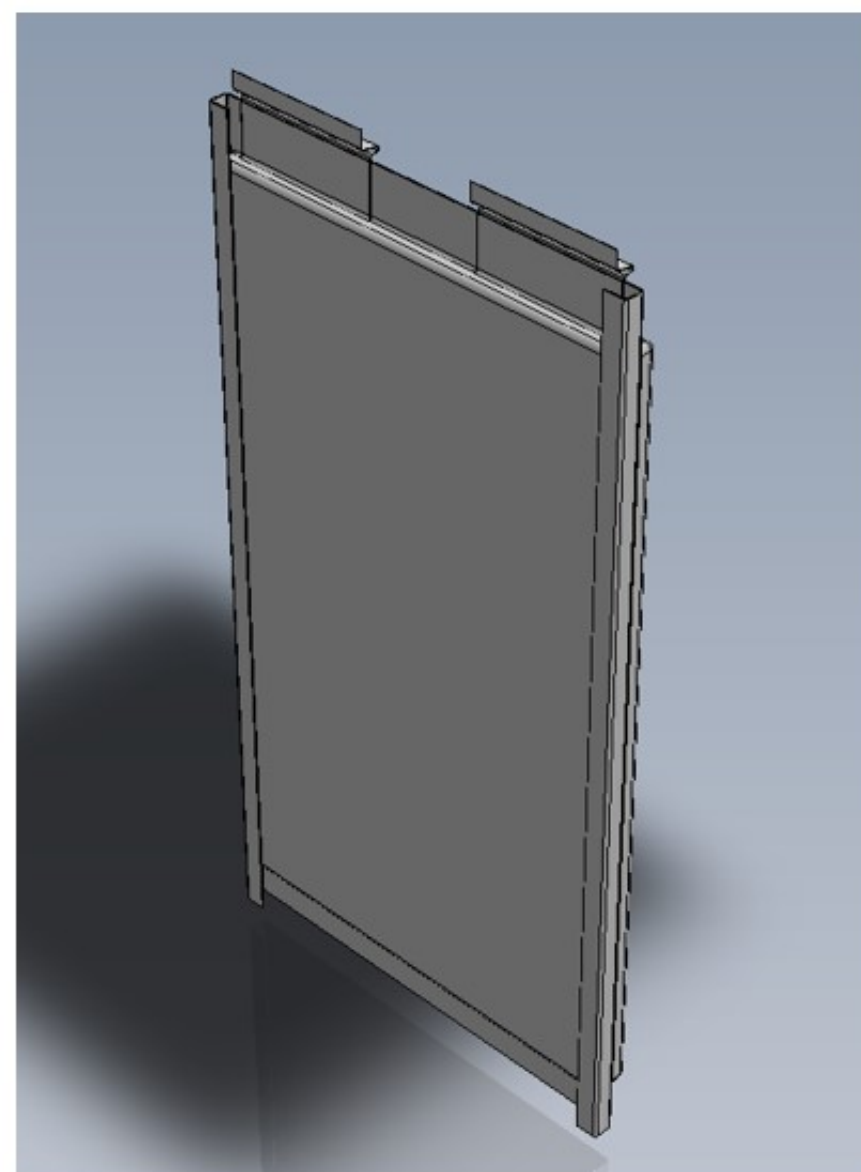


**STATIONARY
SOLUTIONS**

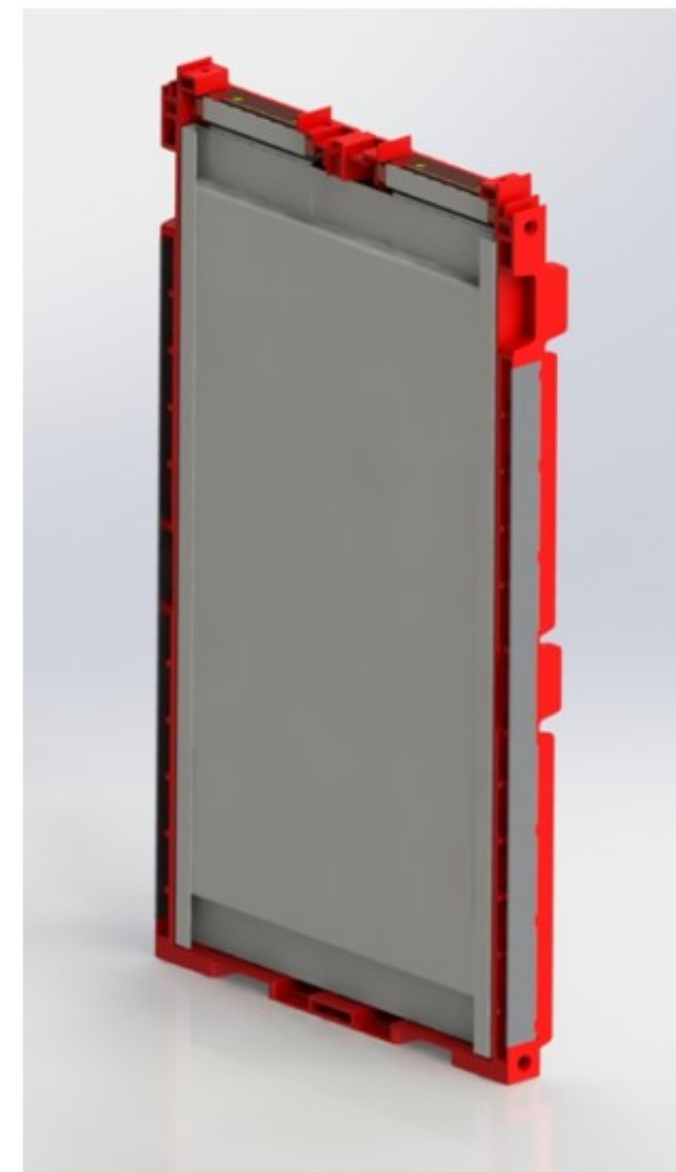


**SPECIALTY BATTERY
SYSTEMS**

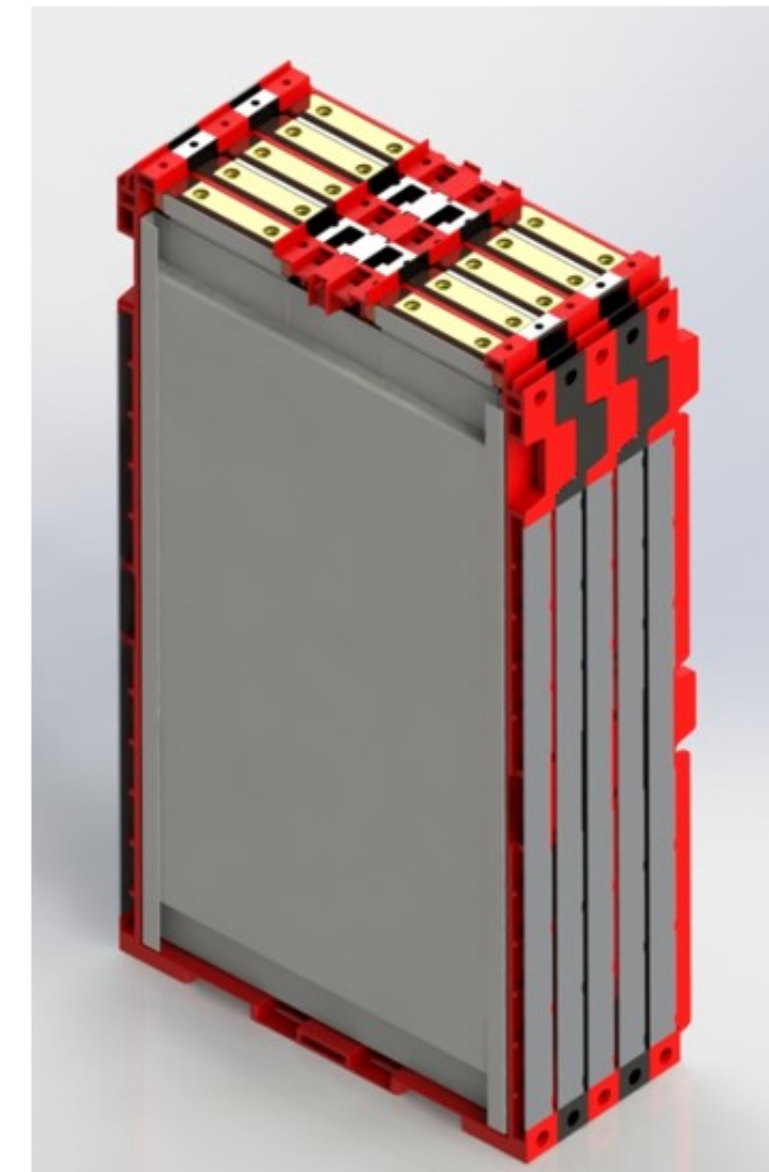
M2 Marine battery module



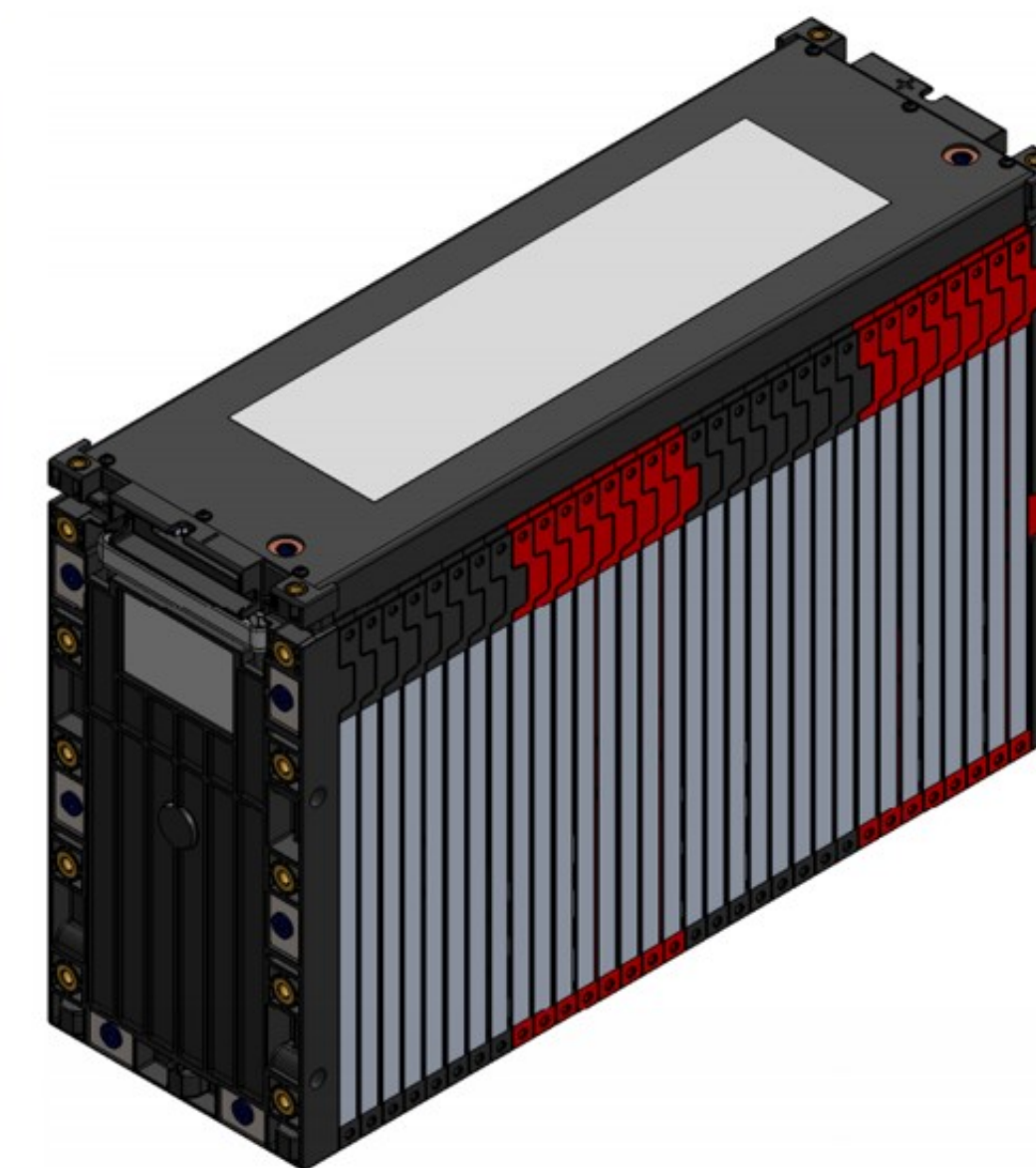
CELL



FRAME



STACK/BLOCK



MODULE

- Innovative scalable mechanical structure
- Battery cells are laser welded to welding supports
- Welded frames are connected together as stack (parallel cells)
- Module is built by connecting parallelly connected stacks together
- M2 module is UN38.3 certified
- M2 module is marine certified (88% tests passed)
- M2 module production line ramped up on 8/2016



M2 Marine battery module – fully integrated



BMU electronics integrated directly inside of module, protected from dirt and dust

Special measurement PCB (intermediate board) connects to BMU with all cell and temperature sensor measurements

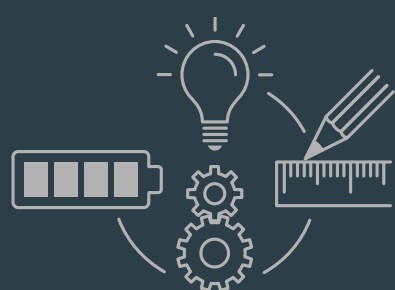
- Daisy chain connection of modules
- Different module types can be used in the same pack
- Fully environmentally tested: vibration, damp heat, dry heat, EMC
- UN38.3 tested and approved
- Module temperature management included



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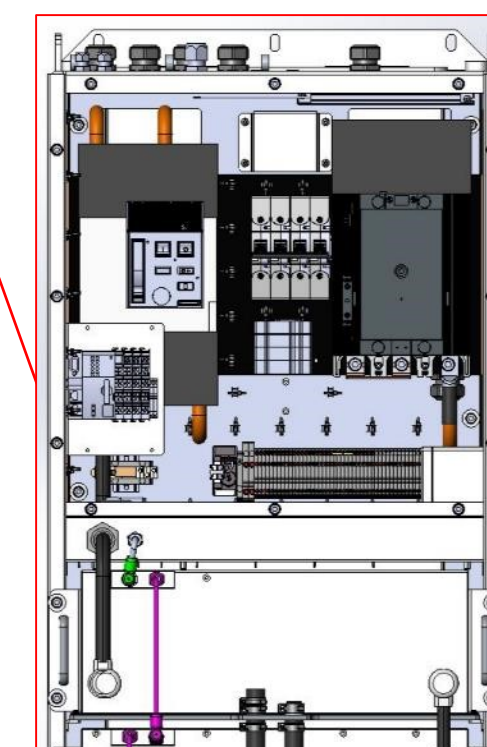


**SPECIALTY BATTERY
SYSTEMS**

MRS Marine Rack System



- MRS is Leclanché's answer to modern maritime safety requirements
- Modular scalable and flexible
- Suitable for both hotel and propulsion loads
- Available for both G/NMC and LTO cells
- Certificates:
 - DNV-GL, RINA, BV + Lloyds*
 - Danish Maritime Authority*



* In progress



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**SPECIALTY BATTERY
SYSTEMS**

Fire Fighting system architecture

FIFI4MARINE

Saves the Day & Saves Tomorrows

FIFICOLD fire and propagation
extinguisher foam injection system
Passed the DNV-GL and DMA fifi tests



5 Leclanché series displayed
10 series are installed per
battery room



Each module is double foam injected using inner-structure foam ducts
Foam volume required for one injection:

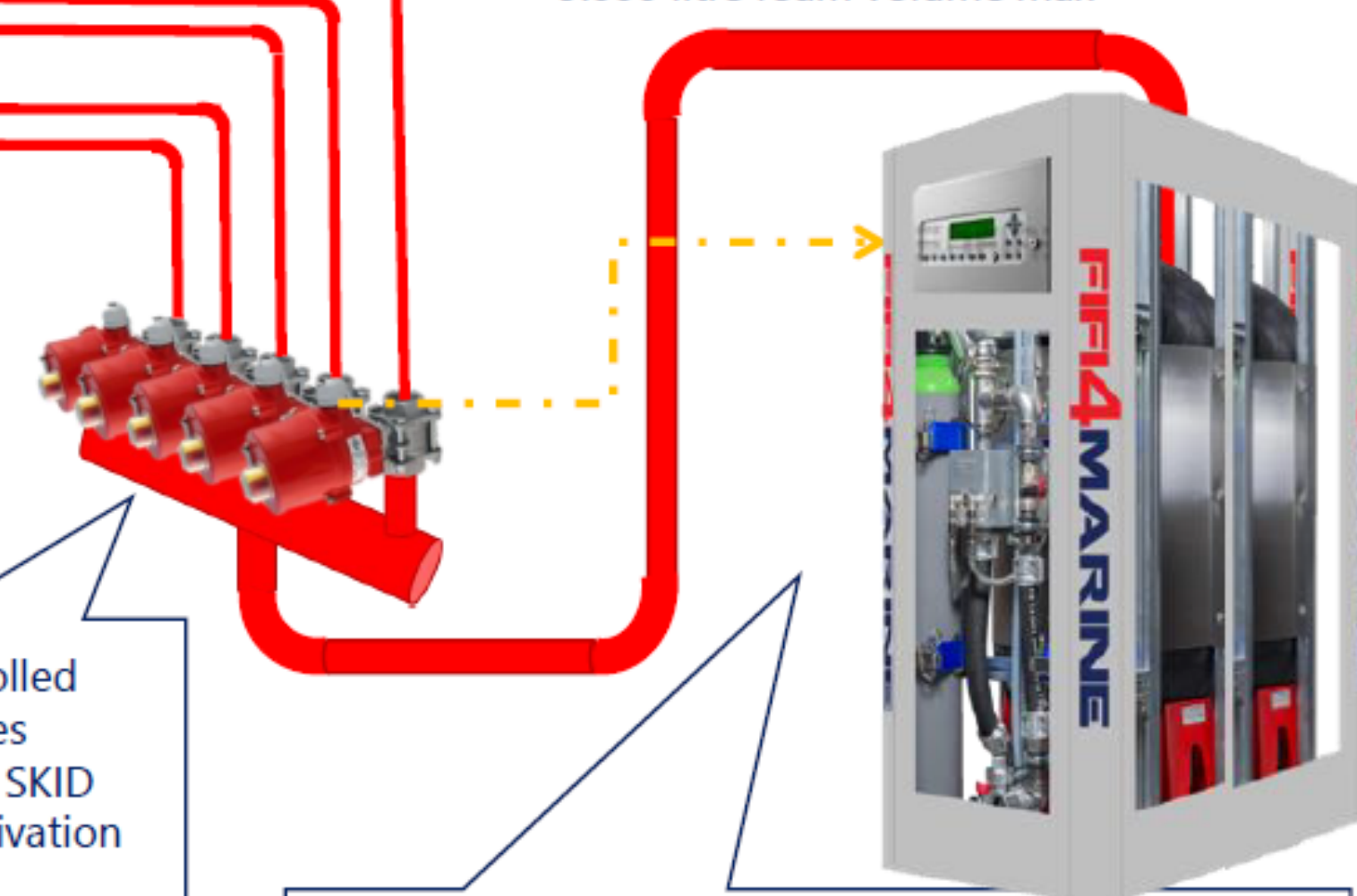
- Per module 9 litre
- Per module & rack/ducts 90 litre
- Per series 42 modules/ducts 450 litre
- Per battery room, 10 series 4.500 litre

5 valves displayed,
10 valves required
per battery room

Automatically controlled
series selection valves

- Controlled by the SKID detection and activation central
- In case of activation just 10% of battery capacity is injected
- Vessels operation is not effected.
- Repair / Cleaning limited to one battery series
- FifiCold limits collateral damage up to 90% of the injected batteries

FIFI4MARINE SKID 900L
9.000 litre foam volume max

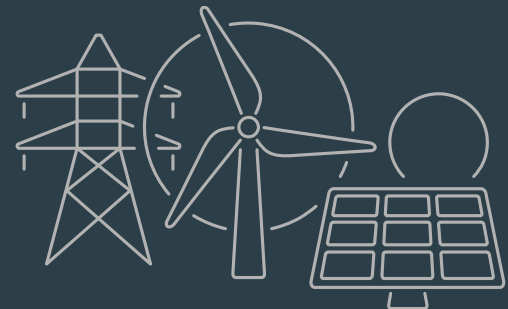


MARINE-SKID-900L custom CAFS-2 x 450 litre

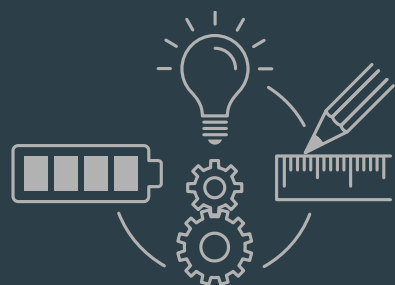
- Operates fully on compressed air, no emergency power demands or external HP-pumps.
- Dry-Foam is formed inside the SKID with clean air, avoiding gas polluted foam.
- Easy refill on board by the crew using premix and compressed air to refill the air bottles
- Non corrosive, non toxic, 100% biodegradable
- Remote and manual activation possible
- Service life 25 years



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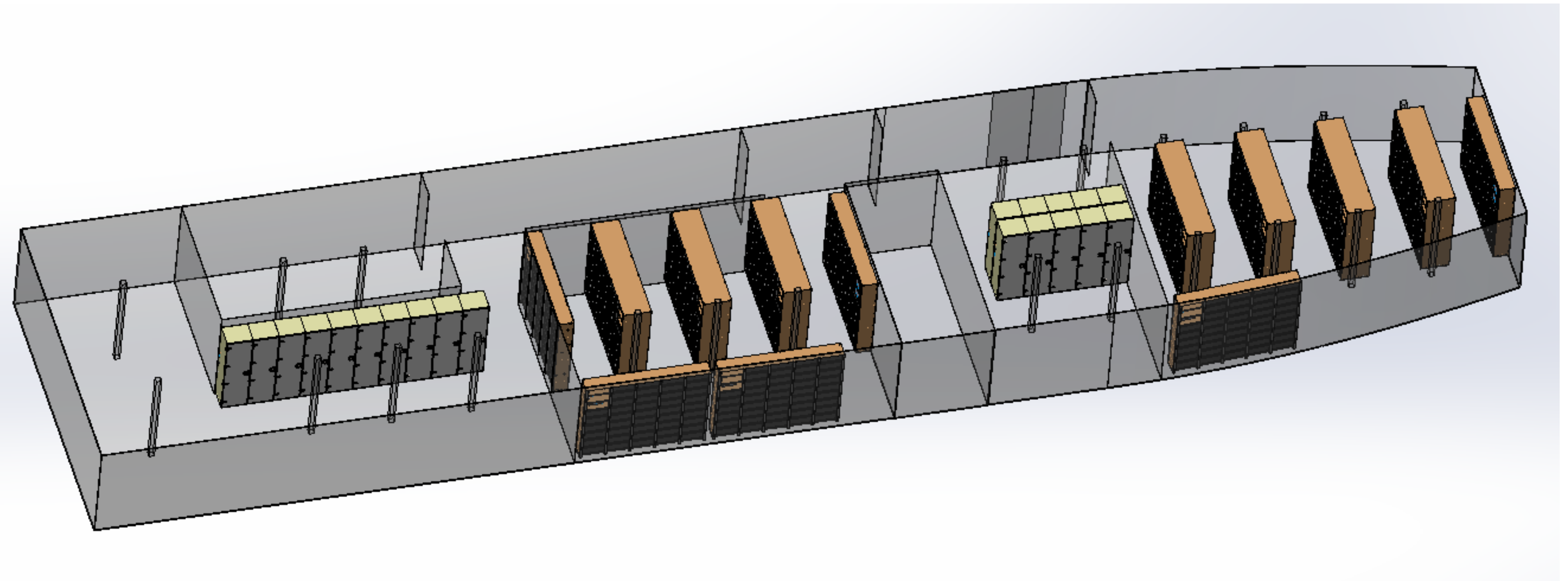


**STATIONARY
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**SPECIALTY BATTERY
SYSTEMS**

Early E-ferry layout



E-ferry Safety



- Double redundancy:

Batteries are distributed in two separate compartments connected to two separate propulsion systems. Battery packs are distributed in 10 separate strings in each compartment.

- Advanced fire-fighting system:

Automatic non-toxic foam-based fire-fighting system integrated into the battery system.

- Water-cooling:

The battery modules are water cooled to ensure a stable operating temperature (20°C +/- 4°C).

- Vessel design:

The E-ferry has a double hull with U-shaped tanks ensure very high survivability in case of leakage

Enclosure

IP65housing
Steel construction
Dedicated exhaust channel
No gas build up in modules or system
Separation between modules
Underpressure maintained in exhaust channel at all times – no contamination of battery room

Cooling System

Liquid cooled battery system
Each module separately cooled
Reduces thermal propagation
Improves system longevity by maintaining benign thermal environment for cells

Fire suppression system (FiFi)

Heat and smoke triggered (prevents false alarms)
Use of environmentally safe foam or water based systems
Can be used to protect against external fires



E-ferry Innovations

- 100% electric ferry (no hybrid solutions) powered by electricity from wind power or other RES (green electricity market).
- Expected to reduce emissions annually by*:
 - 2,000 tonnes of CO2
 - 42 tonnes of NOx
 - 2.5 tons of particulates
 - 1.4 tons SO2.
- Maximum range up to 22nm (41km)
- Cruising speed speed up to 15.5 knt.
- Electrical equipment in place of hydraulics.



*Compared to conventional ferry services on the same route.

E-ferry Battery

Leclanché Energy Storage Systems were selected to supply the batteries to power the E-ferry.

- The system used is the Leclanché Marine rack System (MRS).
- Designed to be safe, the MRS has undergone numerous fire propagation tests and is DNV-GL certified.
- This battery system uses;
High energy lithium-ion G-NMC (Graphite - Nickel Manganese Cobalt) cells.

These cells have unique safety features including bi-cell laminate design and ceramic separators to ensure performance does not come at the cost of safety.
- Leclanché develops and manufactures its own cells with both graphite/NMC (Lithium Nickel Manganese Cobalt oxide) and LTO (Lithium Titanate Oxide) technologies.



E-ferry Sailing Route

Area of Operation

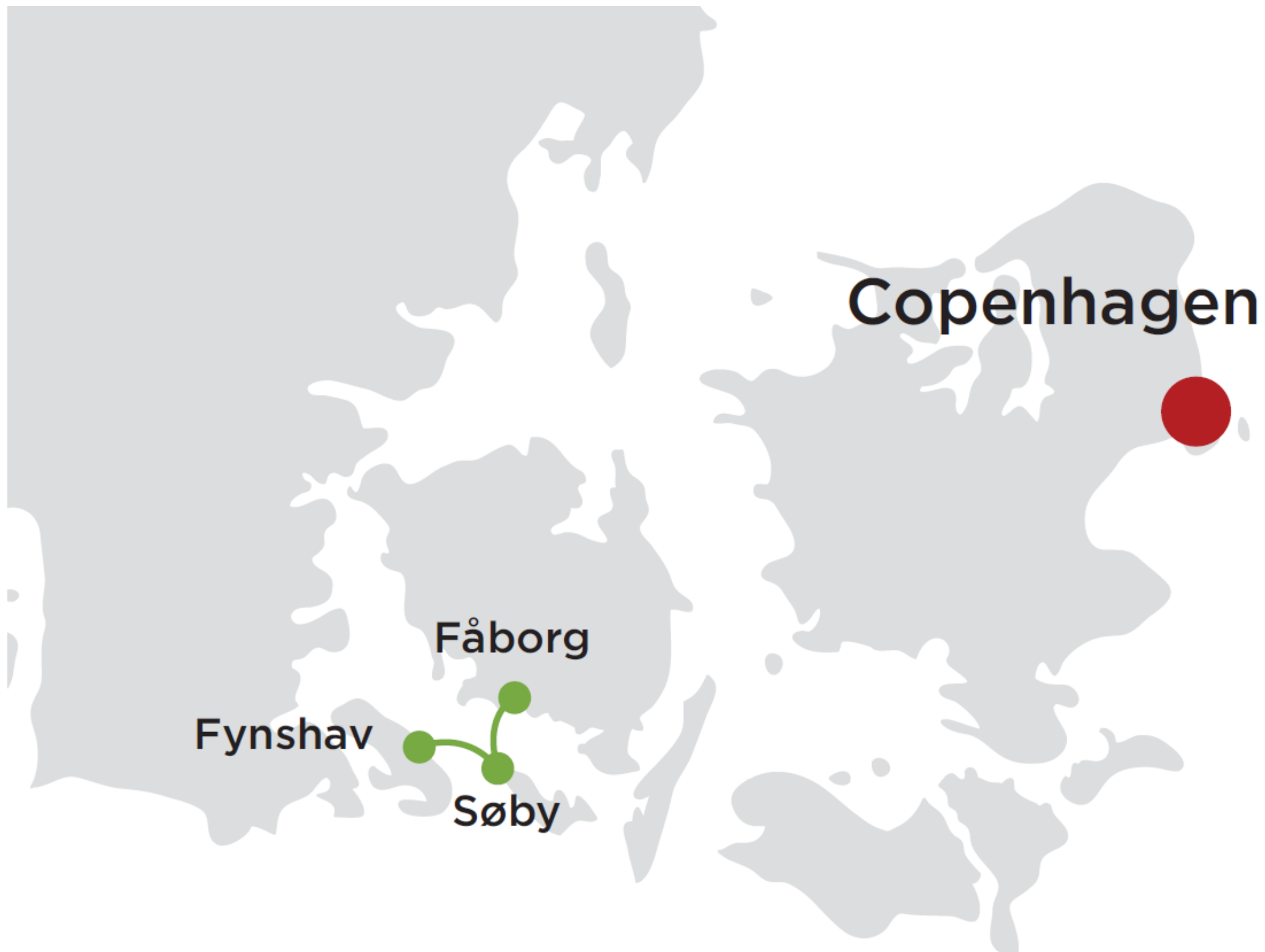
- Southern Funen archipelago, Denmark

Routes:

- Søby-Fynshav: 20km
- Søby-Faaborg: 18km

Operation date:

- The first official passenger trip was on 15th August 2019.



E-ferry Images

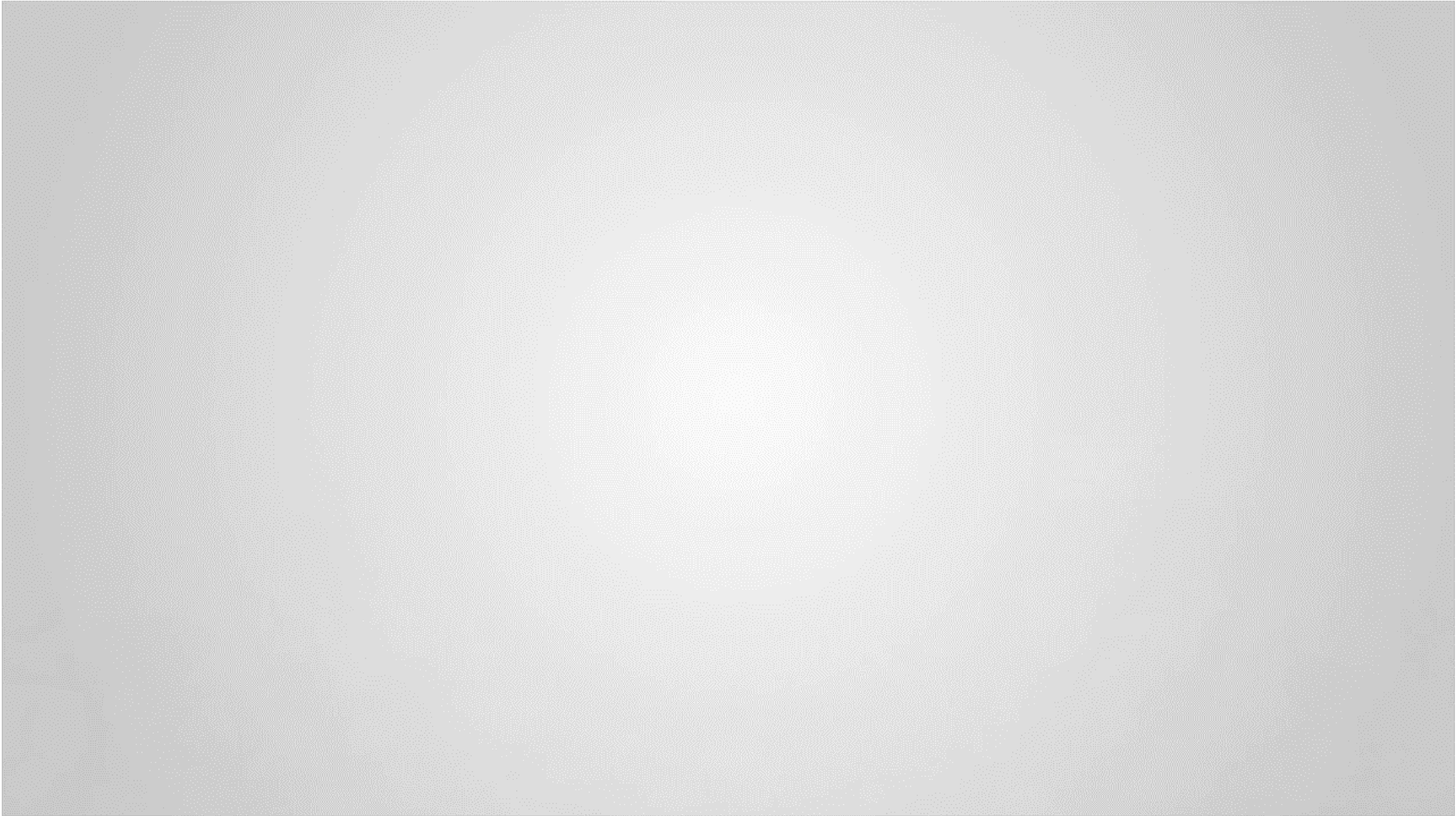


E-ferry Images

- Ellen was christened by Christina Clausen on June 1, 2019.



E-ferry Video



Electric Ferry Facts

An electric ferry makes up
for the CO2 pollution in
battery production in just
1,4 months

According to the NOx Fund's paper, 2016

7 out of 10 routes
in Denmark alone would
be profitable with pure
battery operation

Source: Siemens report, 2016

65-80 %
of Nordic ferry routes
are suitable for electrical
operation.

Source: Green Ferry Vision report, 2014



- E-Marine
Business
Division



THANK YOU FOR YOUR
ATTENTION!

