Electrification of the Fjord1 fleet

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Fjord1

The leading ferry company in Norway

Summary

- Short introduction of partnership and locations.
- Presentation of Fjord1 AS and what is required to electrify the fleet:
    - Newbuilds and conversions.
    - Shore infrastructure and access to the grid.
    - Operation, human and technical support.
- Benefits from electrification of vessels.
- What's next: domestic and abroad.

Locations and partners

Ramsey Greig and Co. Ltd / CanFjord Ferries Ltd.

- Full management of ferry services.
- Technical management (technical operations, performance monitoring, procurement, budget control).
- Project management (specification, oversight, budget control, acceptance, delivery).
- Short and long term ferry charter.
- New build (design overview, specification, yard selection, supervision, delivery and commissioning).
- Crew management/Crew supply.

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About Fjord1

Fjord1's vision is to be the safest and most attractive supplier of environment-friendly and reliable transport to customers, clients and business partners alike.

Fjord1 is a leading ferry operator in the Norwegian ferry market. In addition to the ferry and passenger boat services, our operations also include catering and tourism.

Good humoured

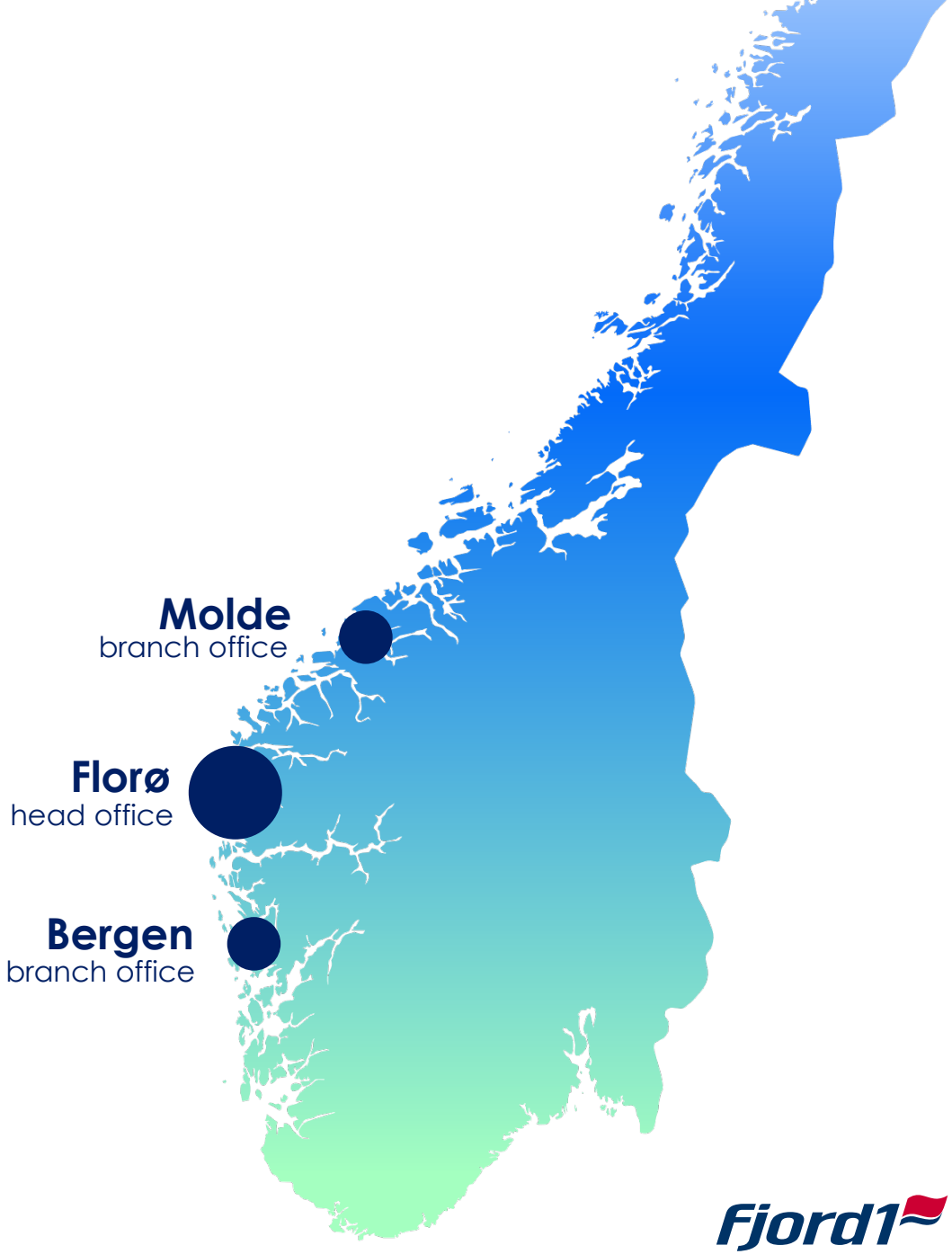
Open and honest

Reliable – we keep our promises

Profitable

Interaction and team spirit

Proud



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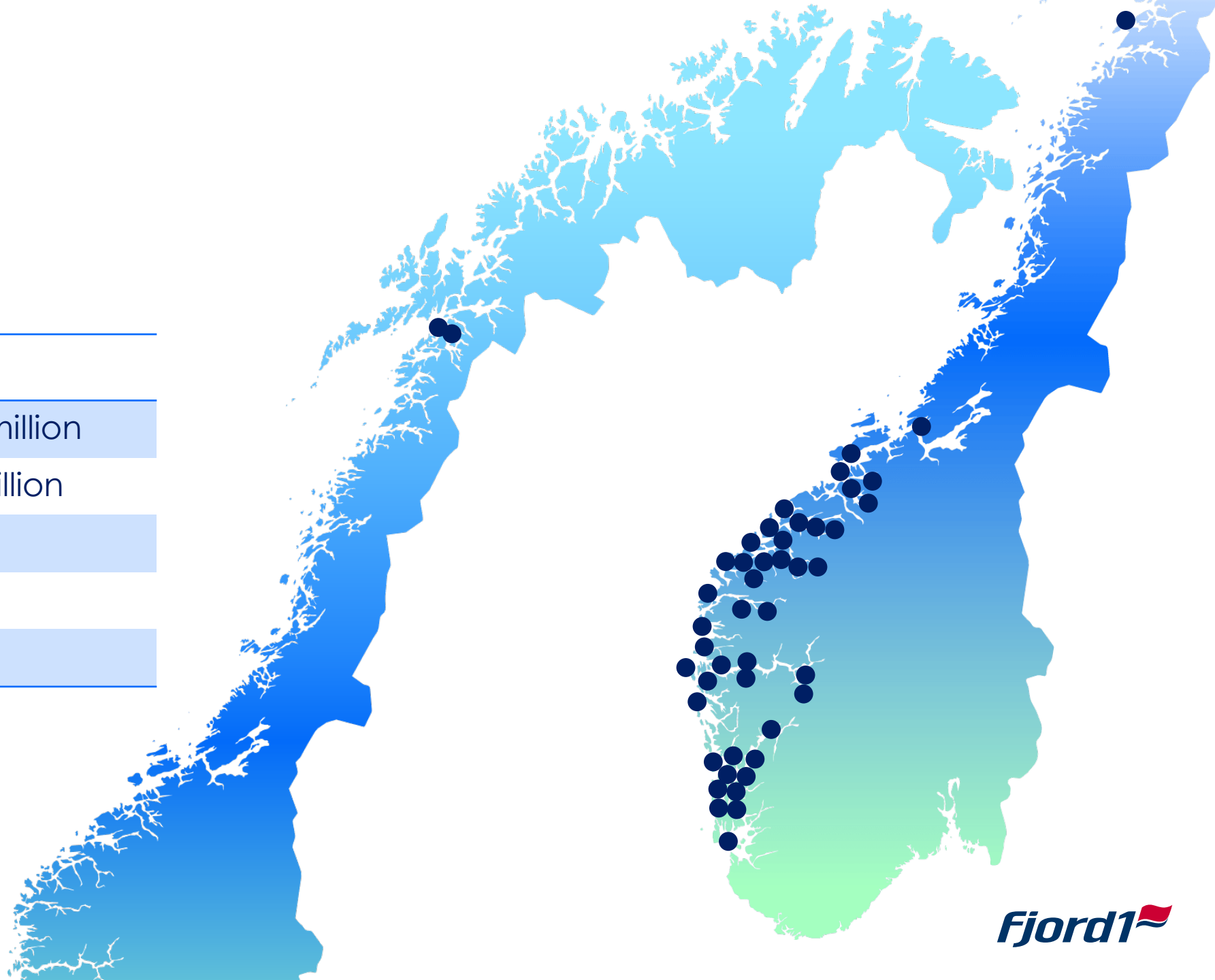
Key figures

Employees	**1145**
Passengers	16,2 million
Vehicles	9,4 million
Vessels/electric	79/39
Fully electric routes	21
Charging facilities	41

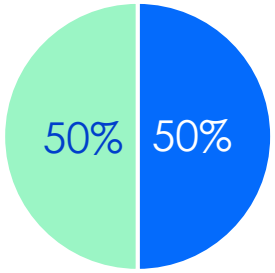


Tourism

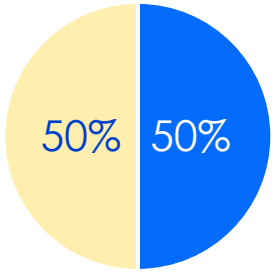
Fjord1 has a stake in a number of travel companies that all offer travel *experiences in the fjords*.

We have a long tradition of providing fjord-based travel experiences. In recent years, we have *concentrated our focus* in collaboration with various partners whose offerings, marketing and operative production are complementary.

Fjord Tours Group AS



The Fjords



Electrical Highspeed Services - Bergen/Stavanger

Ship of the year 2022:

MS «Medstraum» er Ship of The Year 2022. Foto: Marius Knutsen/Maritime Cleantech

MS «Medstraum» er Ship of The Year

- Re-entering Highspeed ferry market – zero emission service

Our environmental journey – a leading player in the transformation to low and zero emission operation

2000

MF Glutra – the first LNG operated ferry

2011

12 LNG Ferries in operation

2015

MF Fannefjord – the first LNG / battery hybrid ferry

2016

"Vision of the Fjords" – battery / diesel hybrid sightseeing vessel

2018

Commenced operation of first zero emission contract in Norway

2022

20 zero emission services in Norway

Electrification of a route – what is required?

New ferries

Grid power

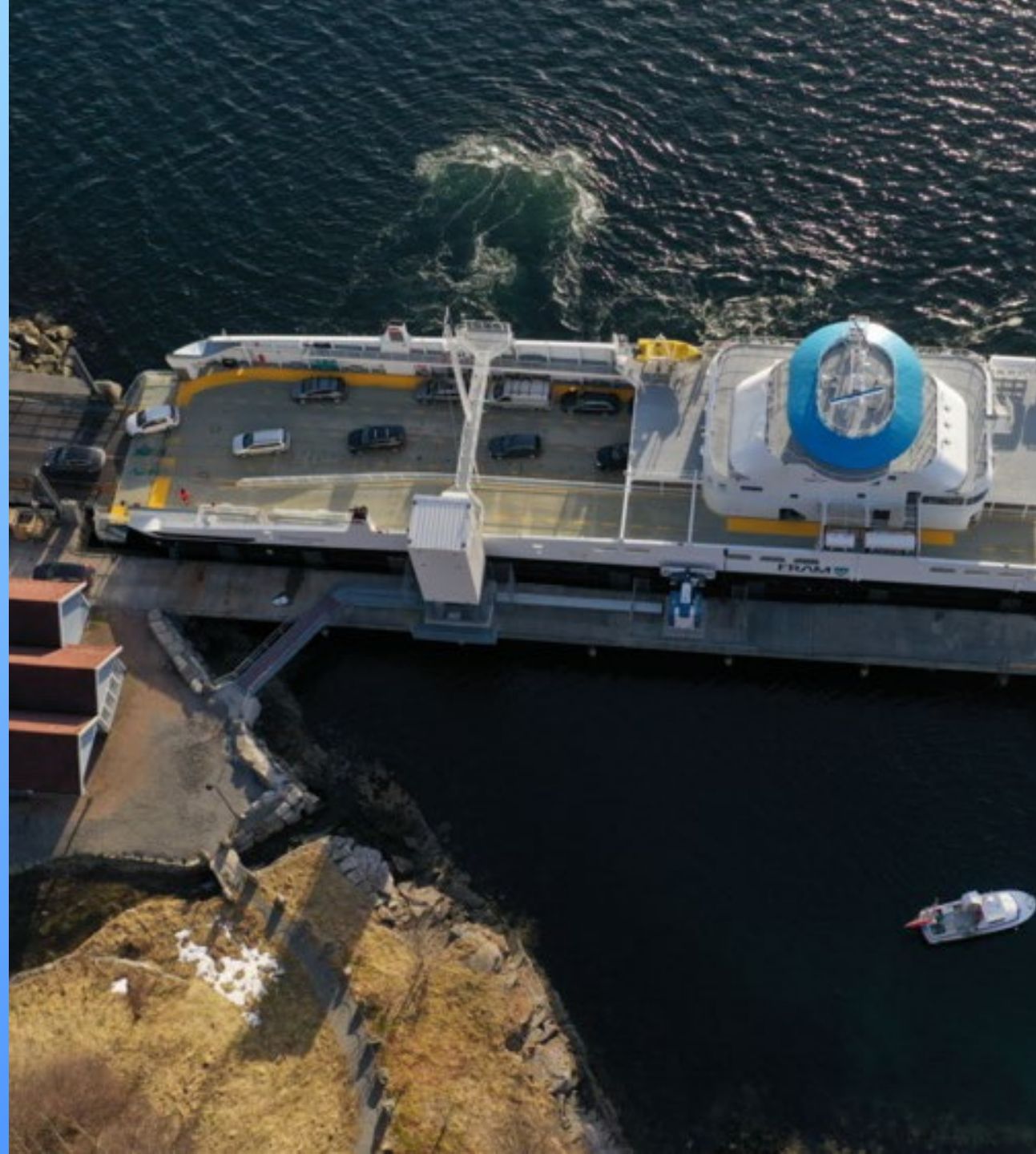
Charging infrastructure

Charging system

At sea and on shore

Newbuilding and conversion programme

- 26 newbuilds during December 2017 to September 2021- all battery hybrid
  - 14 built in Norway
  - 12 built in Turkey
- 11 conversions from diesel/LNG to battery hybrid
  - All at yards in Norway
- 2 newbuilds ongoing in Turkey for delivery end 2023
- 3 new zero emission high speed passenger vessels for delivery in 2024



Newbuilds in electric era

- Electric ferries – what's new?
  - New level of focus on energy efficiency
  - New battery technology
  - New rules and regulations (partly in place)
  - New suppliers – new types of equipment
- Dock/terminal responsibility
  - Operator being responsible also for shore-side equipment for el-operation
    - Procurement, permits, construction and operation

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Newbuilds in electric era

- Ship design requirements not only route-operational requirements

- Onboard electrical systems also defined/dimensioned by
  - Available charging power from shore grid and charge time
  - Type of selected charging equipment at quay
  - Direct real-time communication between shore and ship systems
  - Other specific shore side limitations

- Shore based and shipboard equipment
  - Designed in same integrated process
  - Typically delivered by same supplier with overall responsibility
  - Interface design with high precision level

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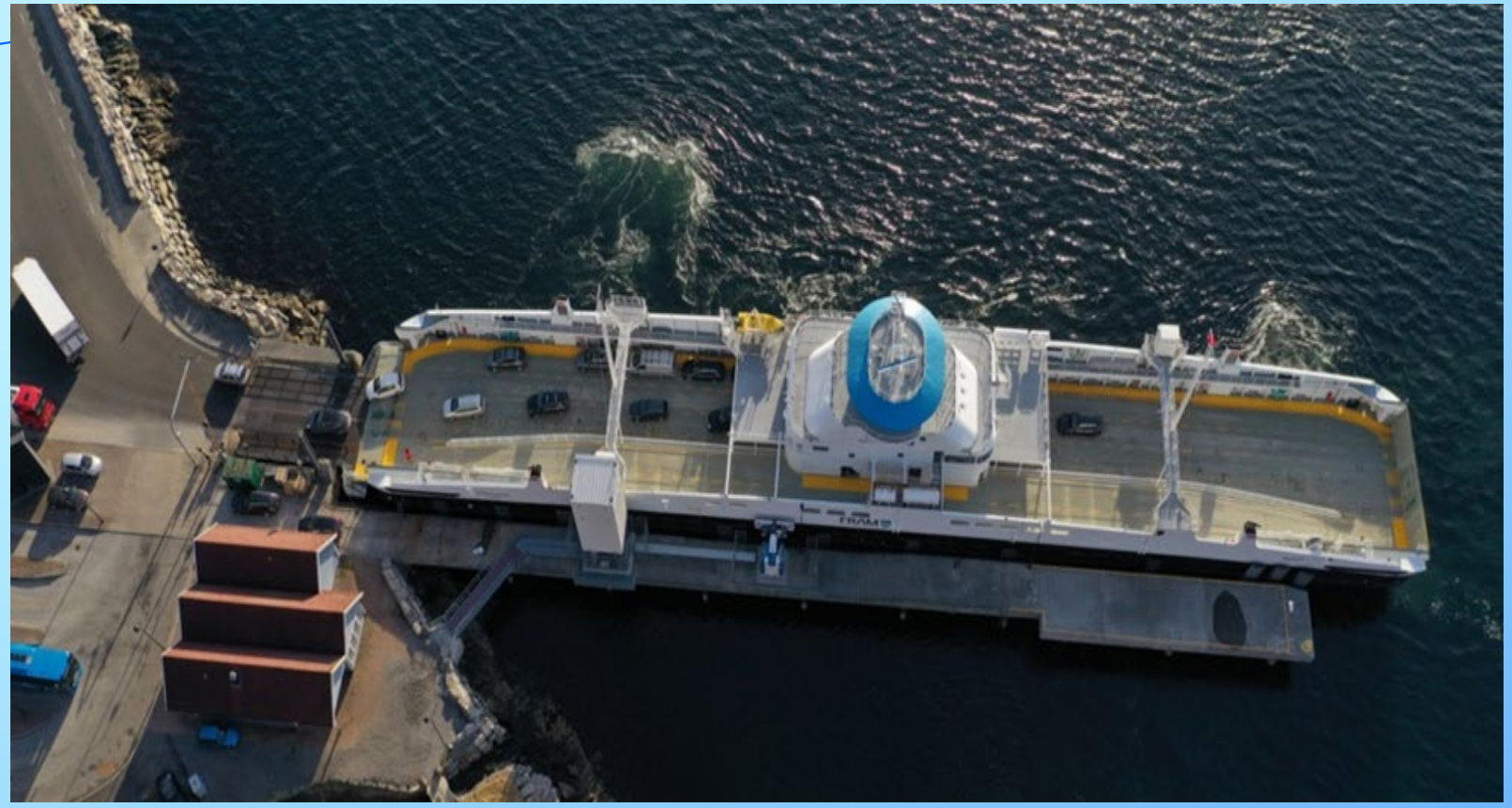
Newbuild program – Quay interface



- Critical with Quay interface early in ship design progress
  - Owner (& Ship designer) focus – Shipyards no competence nor responsibility
  - Tolerances and tide impact - maintenance and service area needed
  - Available area differs between ports

On shore

Ferry charging infrastructure

- Technical buildings for High and Low Voltage transformers/converters
- Grid power from 0,3 to 6,2 MW
  - Charging at every terminal stay (5 to 10 min)
- Power consumption varies from route to route and vessel to vessel
  - From 70 to 900 kWh
- The shore ferry charging system is integrated with – and controlled by the ferry

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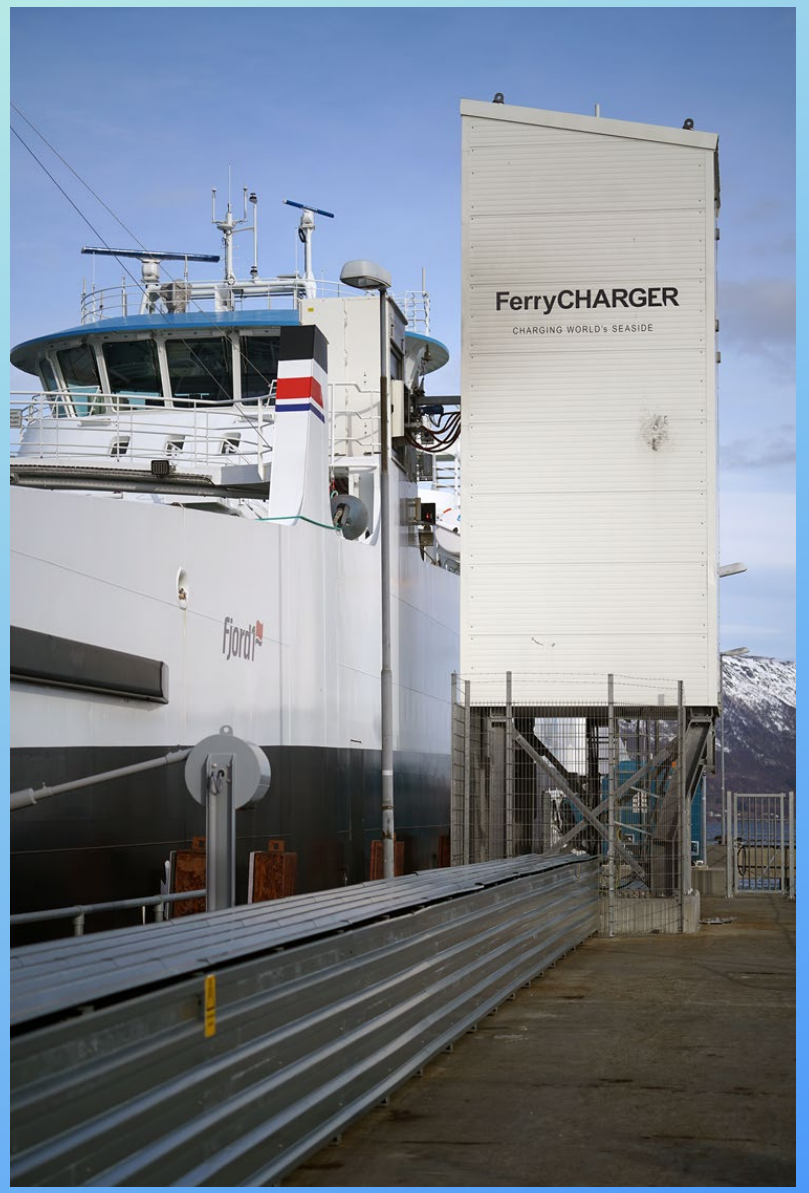
Shore charging systems

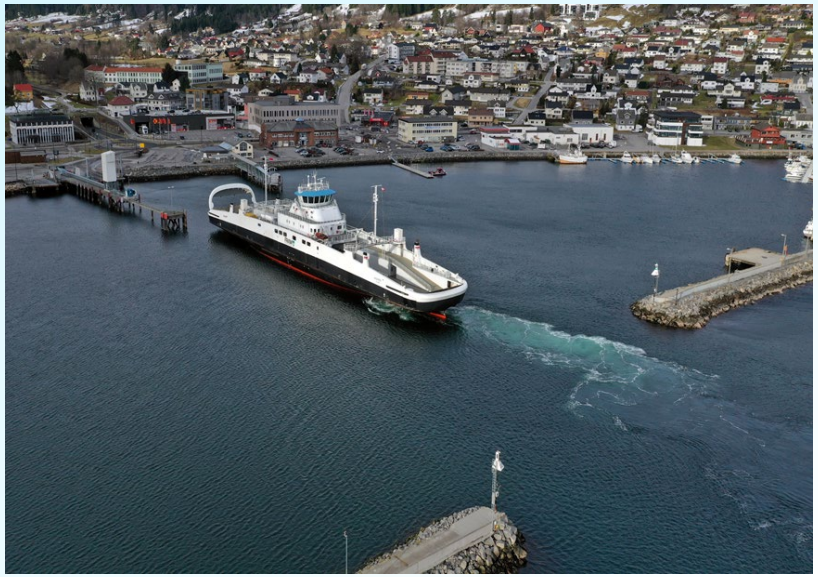
- The ferry operator is responsible for designing, constructing and maintaining the shore ferry charging systems during the contract period.
- Fully automated charging sequence.
- Charging system is matched to the ferry.



"Fjord1 made a strategy to have strong inhouse technical competency on new zero emission technology"

Fjord1 Zero emission operation

- 21 ferry routes operated with zero emission ferries
- 33 ferries - ranging from 50 to 130 PCU
- 41 shore charging systems in operation
- Crossings ranging from 10 to 45 minutes
- Energy consumption per crossing ranging from 70 to 900 kWh



New Operation - The human element

- A new way of ship operation
  - Training
  - Attitude
  - Competence

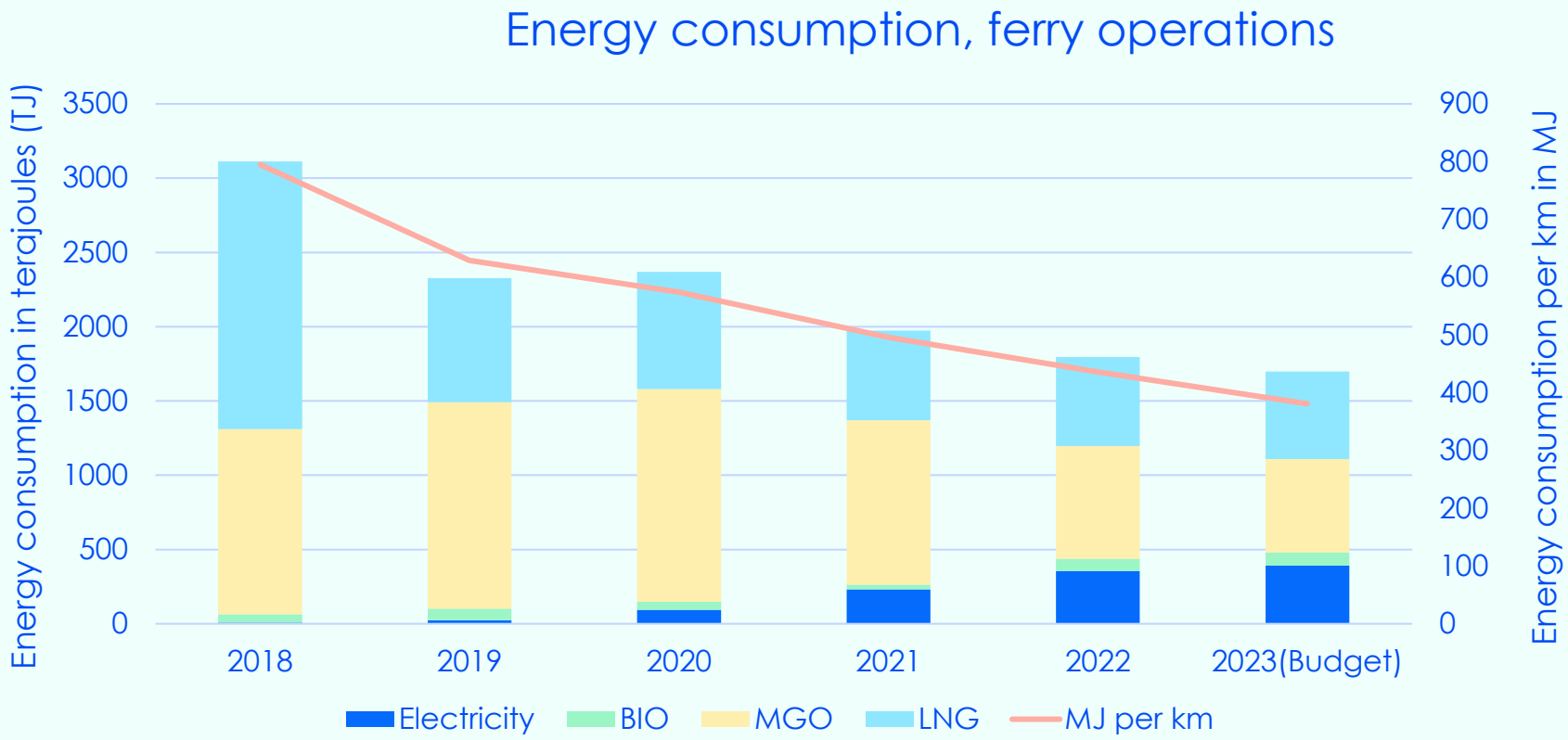
- ISM Safety management system
  - Procedures for charging
  - Procedures for working on electrical installations on board and ashore
  - Contingency planning for emergencies including drill program

Lessons learned

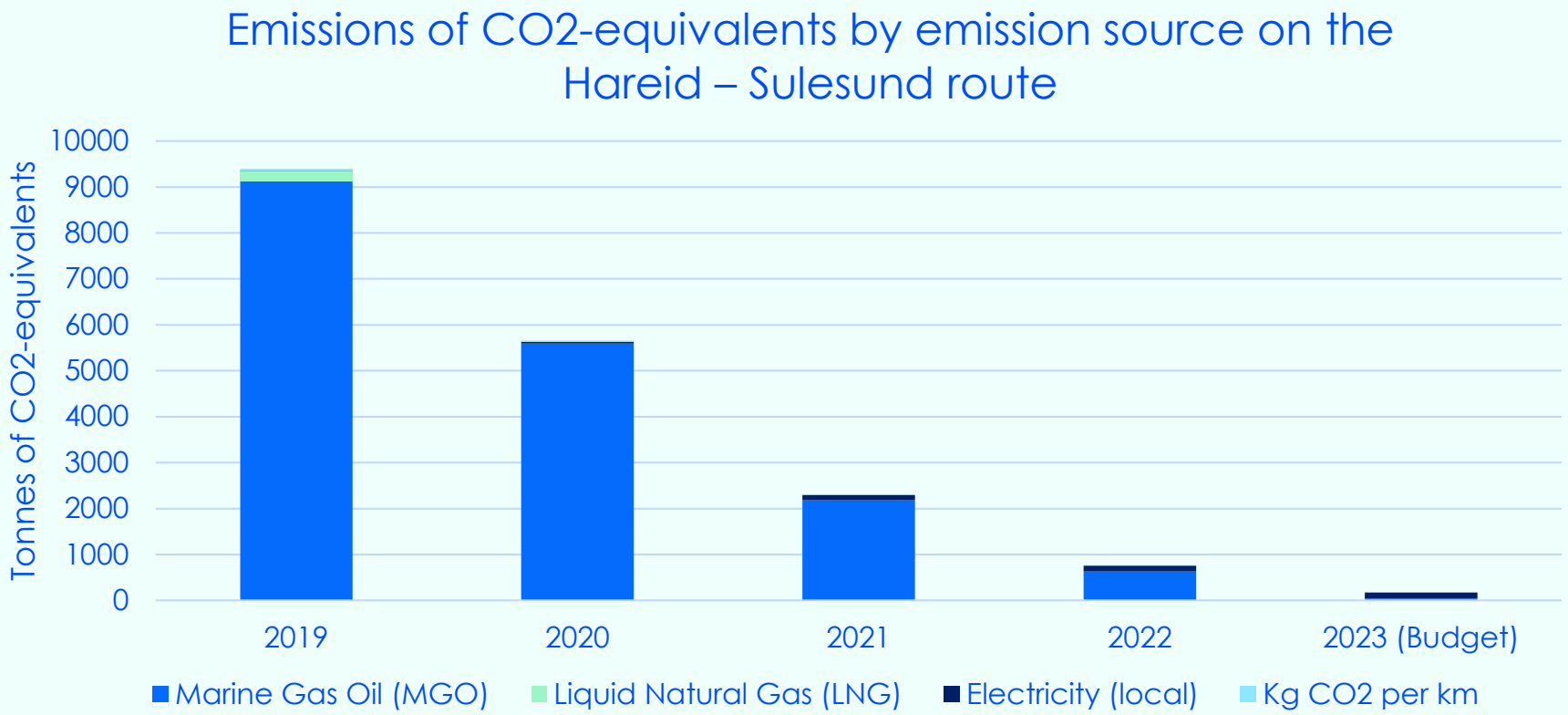
- The technology works
- Charging plug system is a critical component
- Downtime in charging system due to:
  - Incidents
  - Technical problems
  - Operational limitations (tide, weather)
  - Availability of spare parts
- Charging system requires preventive maintenance
  - The «new» suppliers needed to build up new service organizations
  - Costly service and support contracts
- Complex systems
  - Crew training to understand the system and the alarms
  - User interface
  - Alarm warnings

Energy consumption

Looking further forward, the number of ferries whose primary energy source is onshore electricity will increase in the period to 2024.



Hareid - Sulesund: A ferry service that points the way



Fjord1 moving forward domestically

The conversion from fossil to zero emission will continue:

- Short sea, with the intention to expand the trading area.
- Highspeed vessel using adapted concepts:
  - Public transportation
  - Tourist- and seasonal services.

- It is what the customer request in the domestic marked.
- The most efficient way short sea.
- Well suited platform to do more remote- and autonomous operation.
- It is sustainable, climate friendly and in line with the expectation of the younger generation and by governments globally.

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Thank you for your attention
Fjord1
The leading ferry company in Norway