MARITIME

LNG as marine fuel

Status and trends in Norway

Tom O. Kleppestø, Shipping & Offshore Network

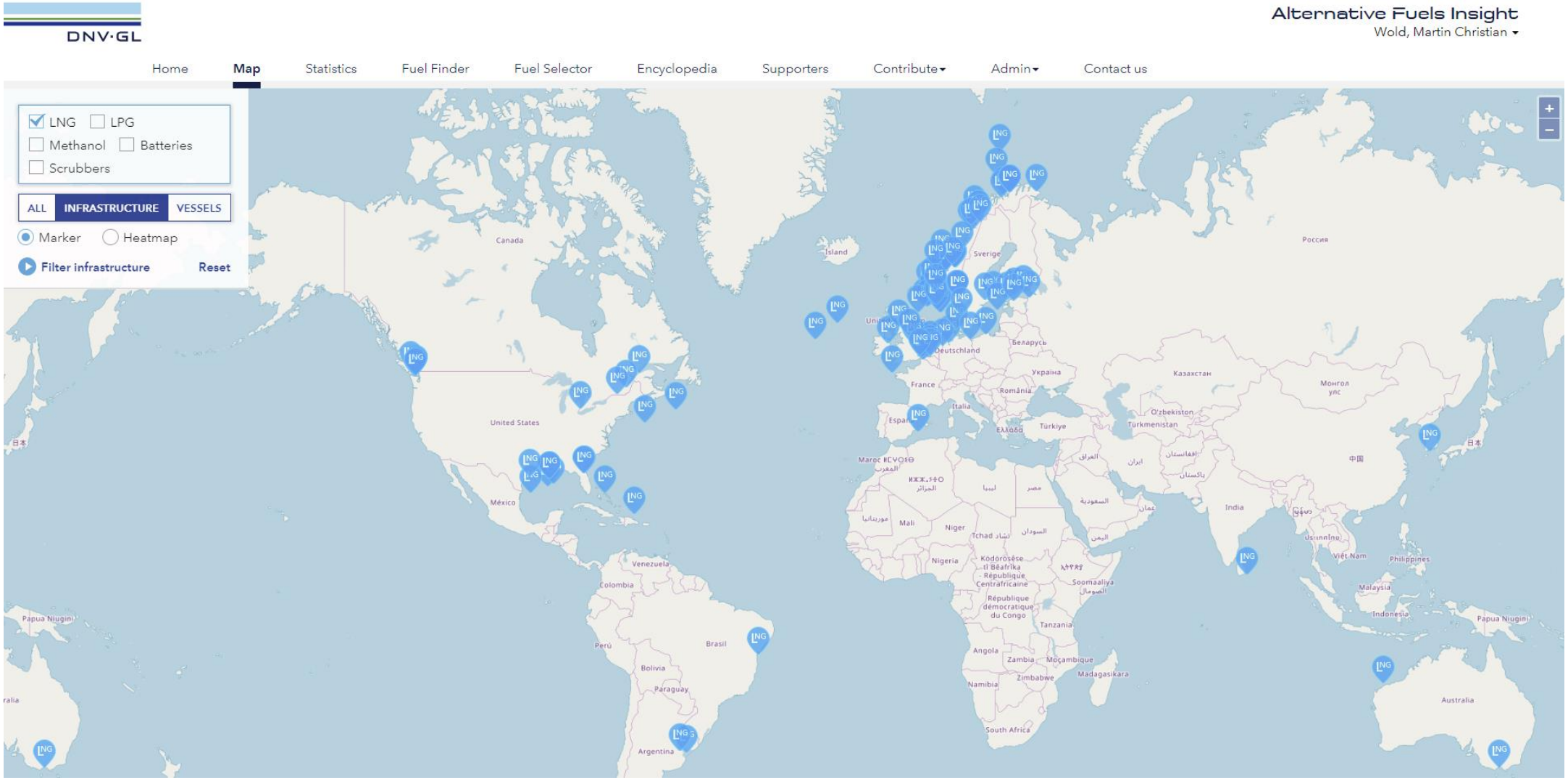
16 May 2019 courtesy of Martin Wold, DNV GL

Most information in this presentation is from DNV GL's Alternative Fuels Insight (AFI) Platform

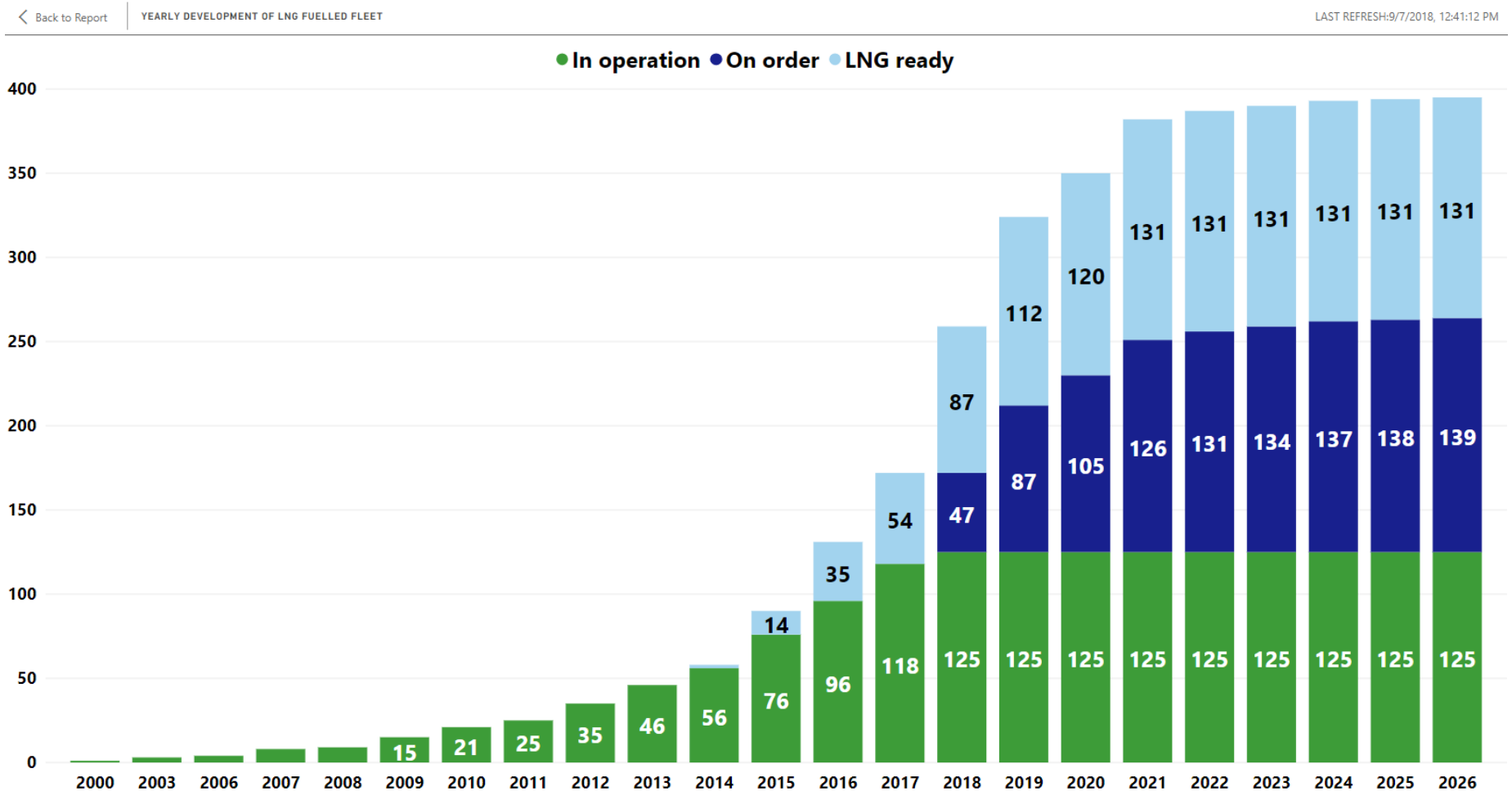
- LNG bunkering infrastructure world wide
- Uptake of alternative fuels and technologies on ships
  - LNG
  - Scrubbers
  - Batteries
- Continuously updated
- Several feasibility tools and features
- Free to access
- Details available for purchase (scrubbers, LNG and batteries)

Global trends for LNG fuel

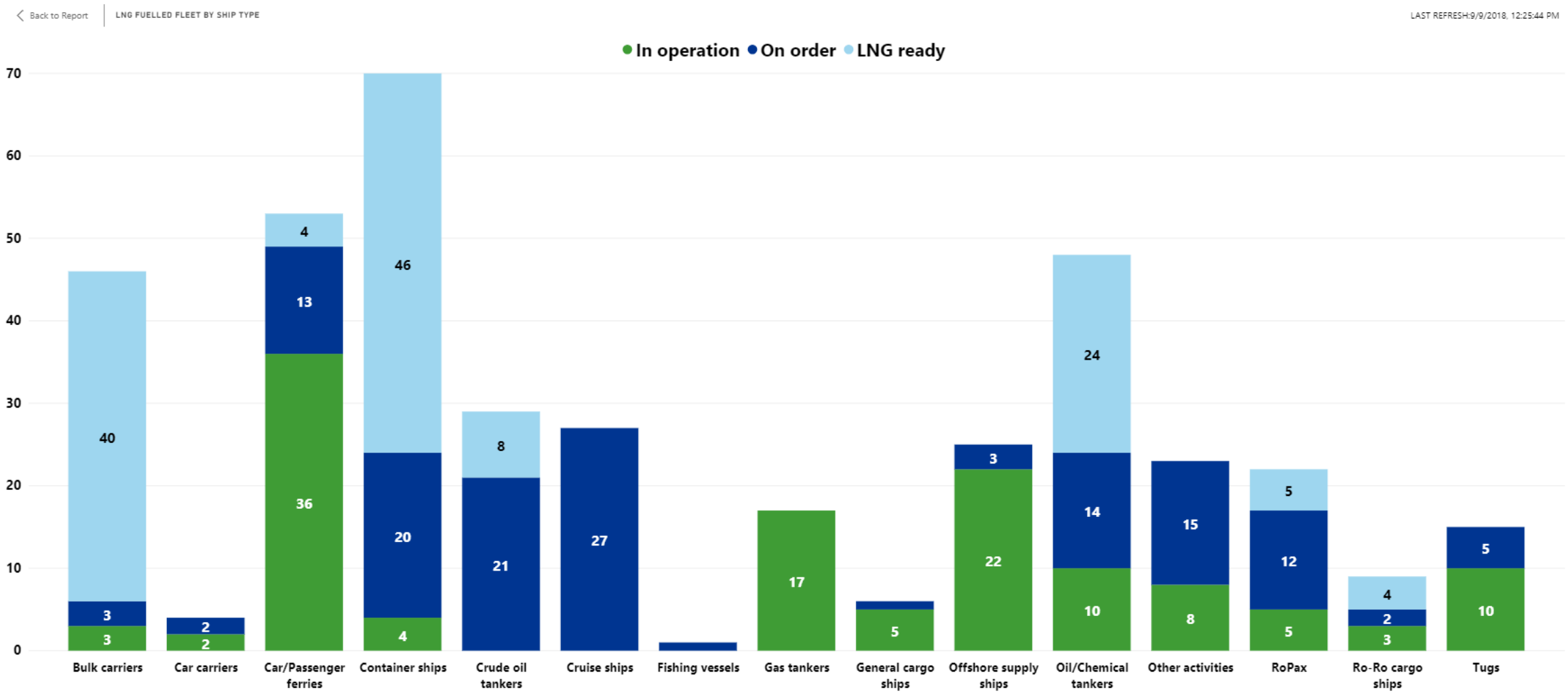
AIS data from the Alternative Fuels Insight platform shows that LNG fuelled ships are already covering a large area



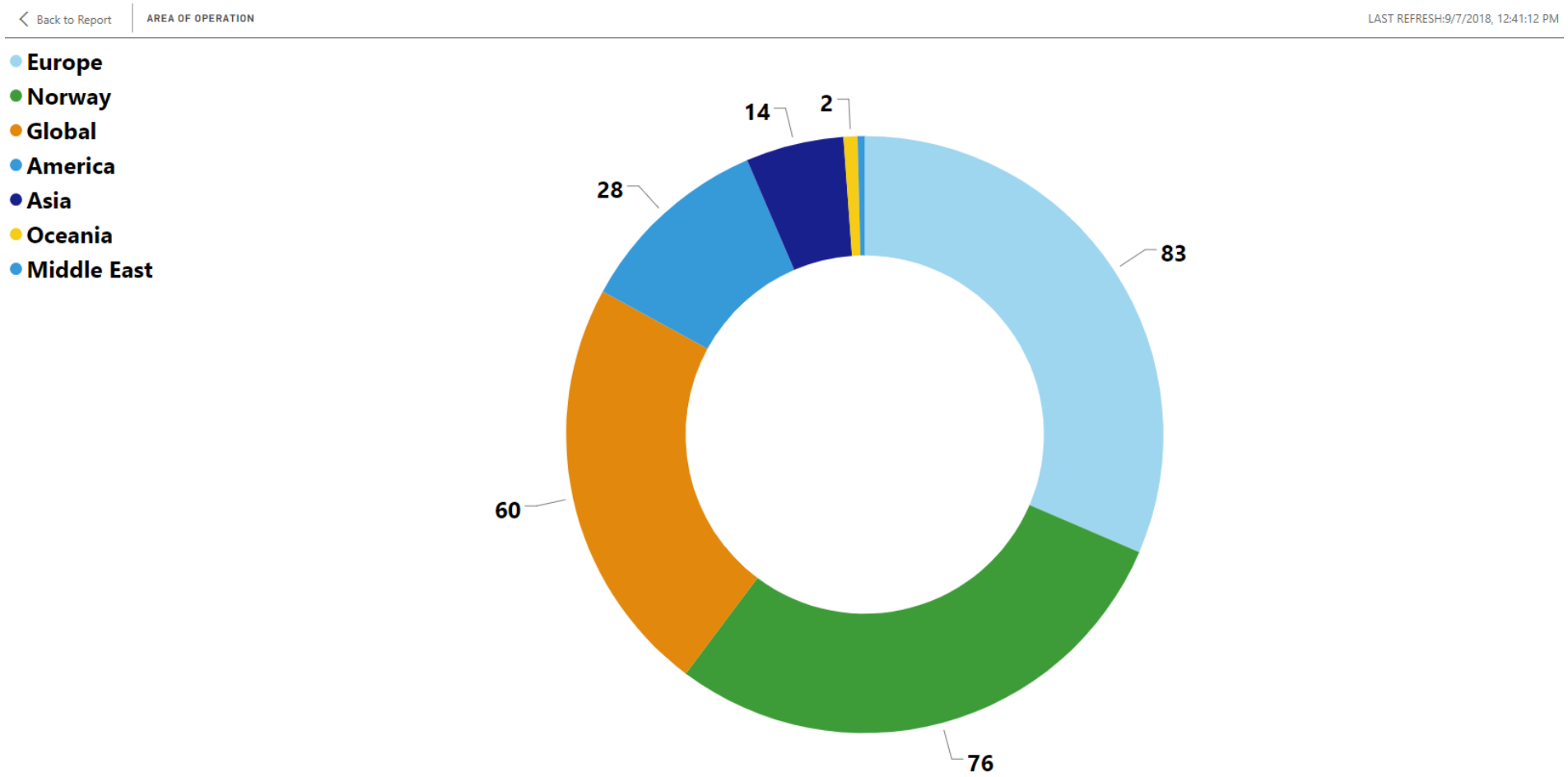
There are currently 264 confirmed LNG fuelled ships, and 131 additional LNG ready ships



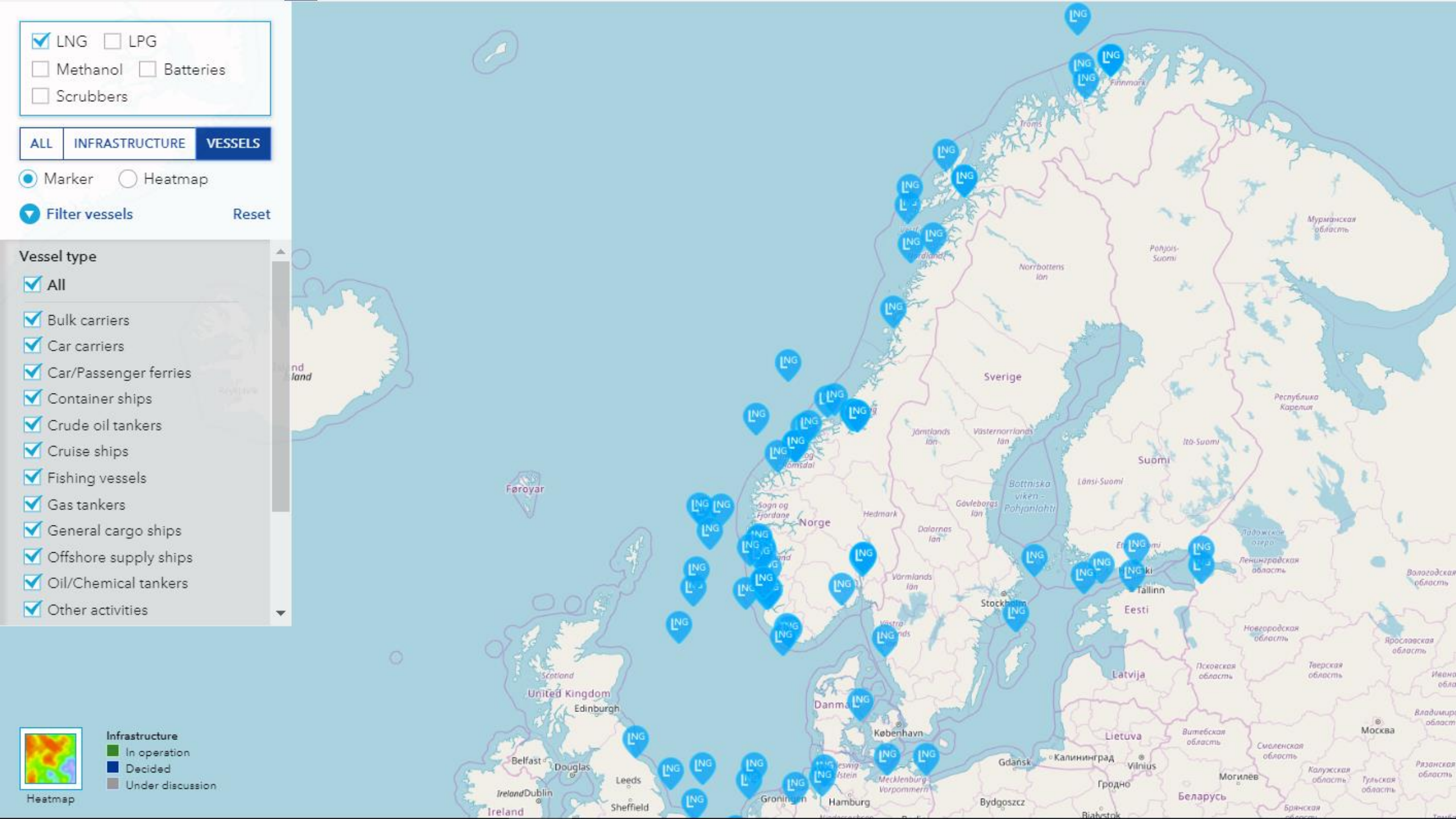
LNG uptake by vessel segment



Area of operation of LNG fuelled vessels



Status for LNG fuelled ships in Norway


LNG
LPG
Methanol
Batteries
Scrubbers
ALL
INFRASTRUCTURE
VESSELS
Marker
Heatmap
Filter vessels
Reset
Vessel type
All
Bulk carriers
Car carriers
Car/Passenger ferries
Container ships
Crude oil tankers
Cruise ships
Fishing vessels
Gas tankers
General cargo ships
Offshore supply ships
Oil/Chemical tankers
Other activities
Heatmap
Infrastructure
In operation
Decided
Under discussion
Sverige
Norge
Suomi
Eesti
Latvija
Lietuva
Беларусь
Føroyar
United Kingdom
Ireland
Scotland
Edinburgh
Belfast
Douglas
Leeds
Sheffield
Dublin
København
Hamburg
Gdańsk
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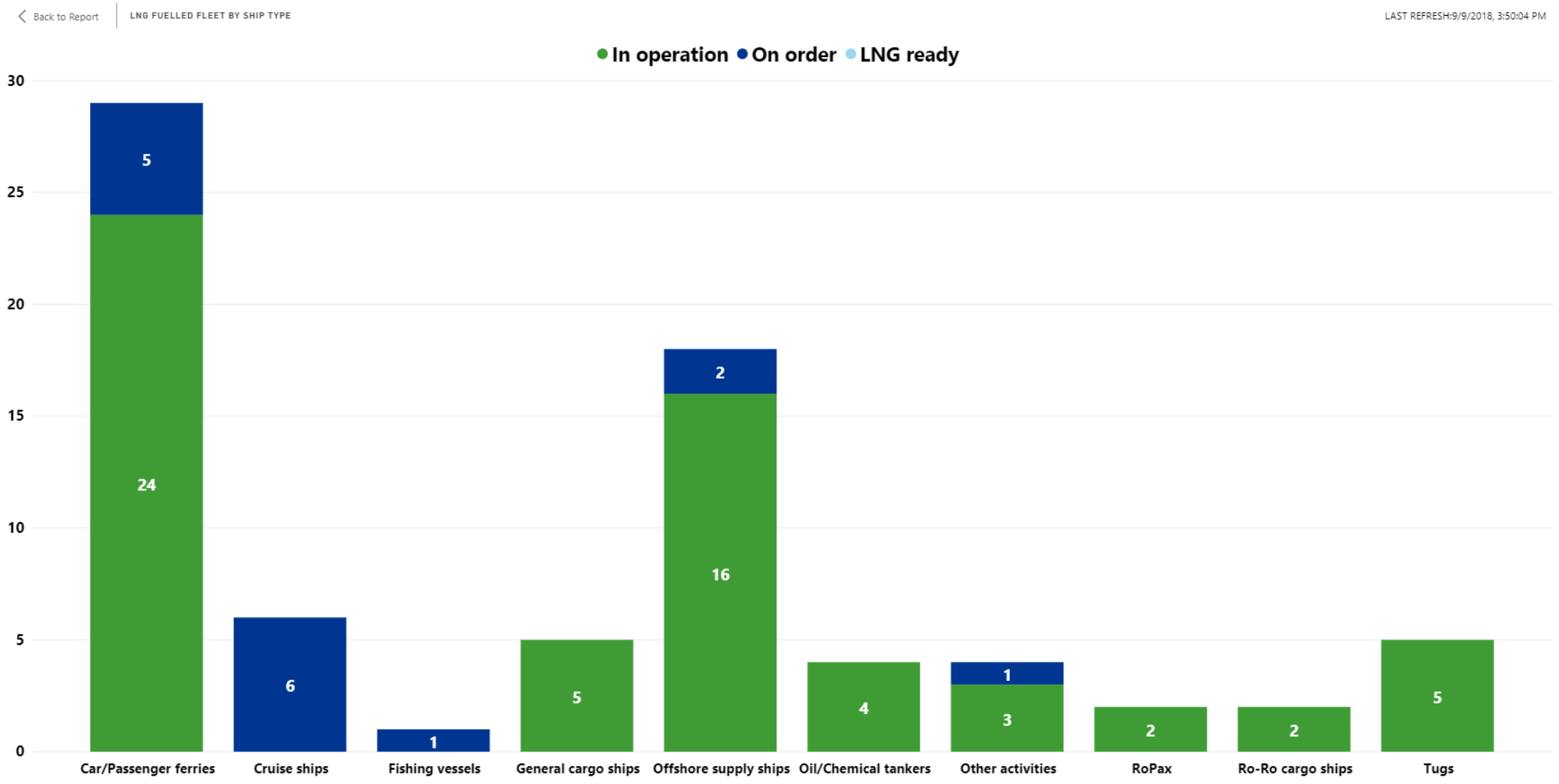
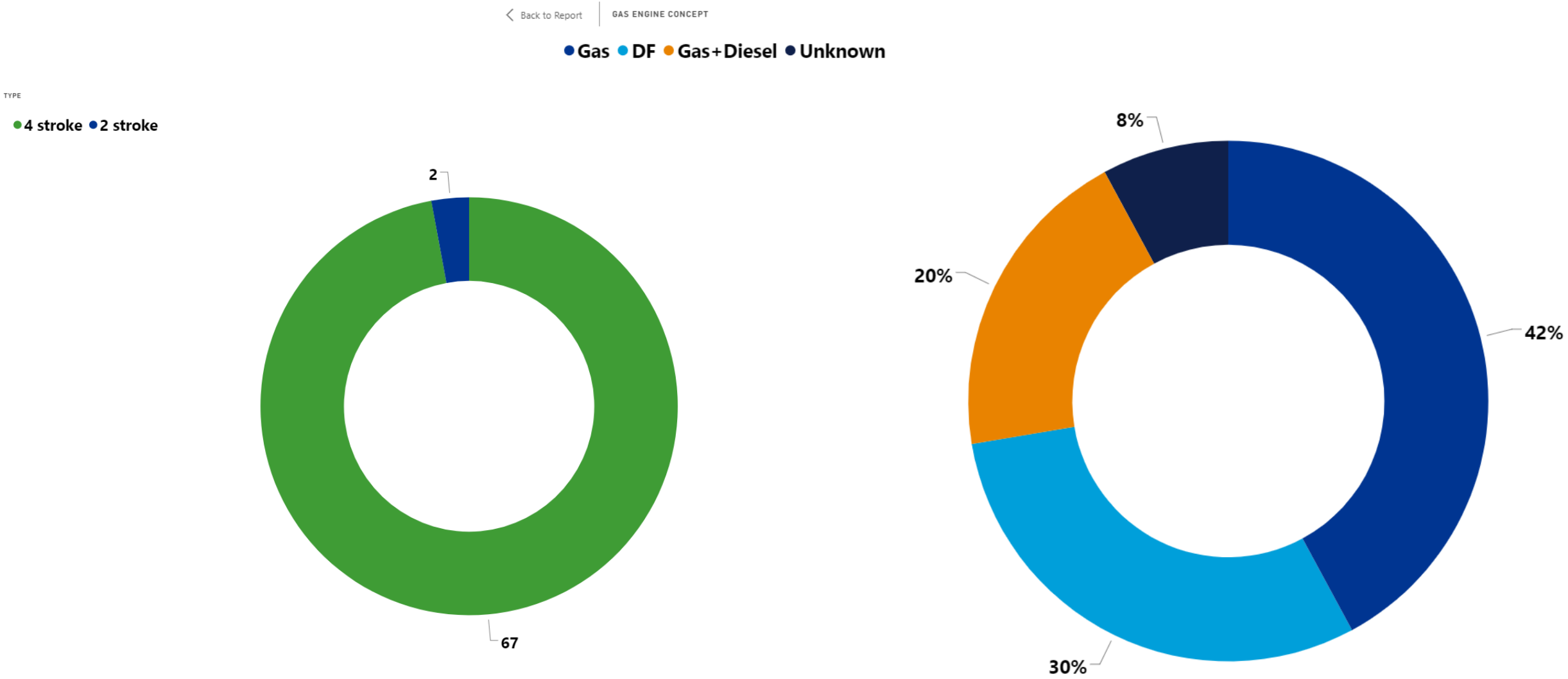
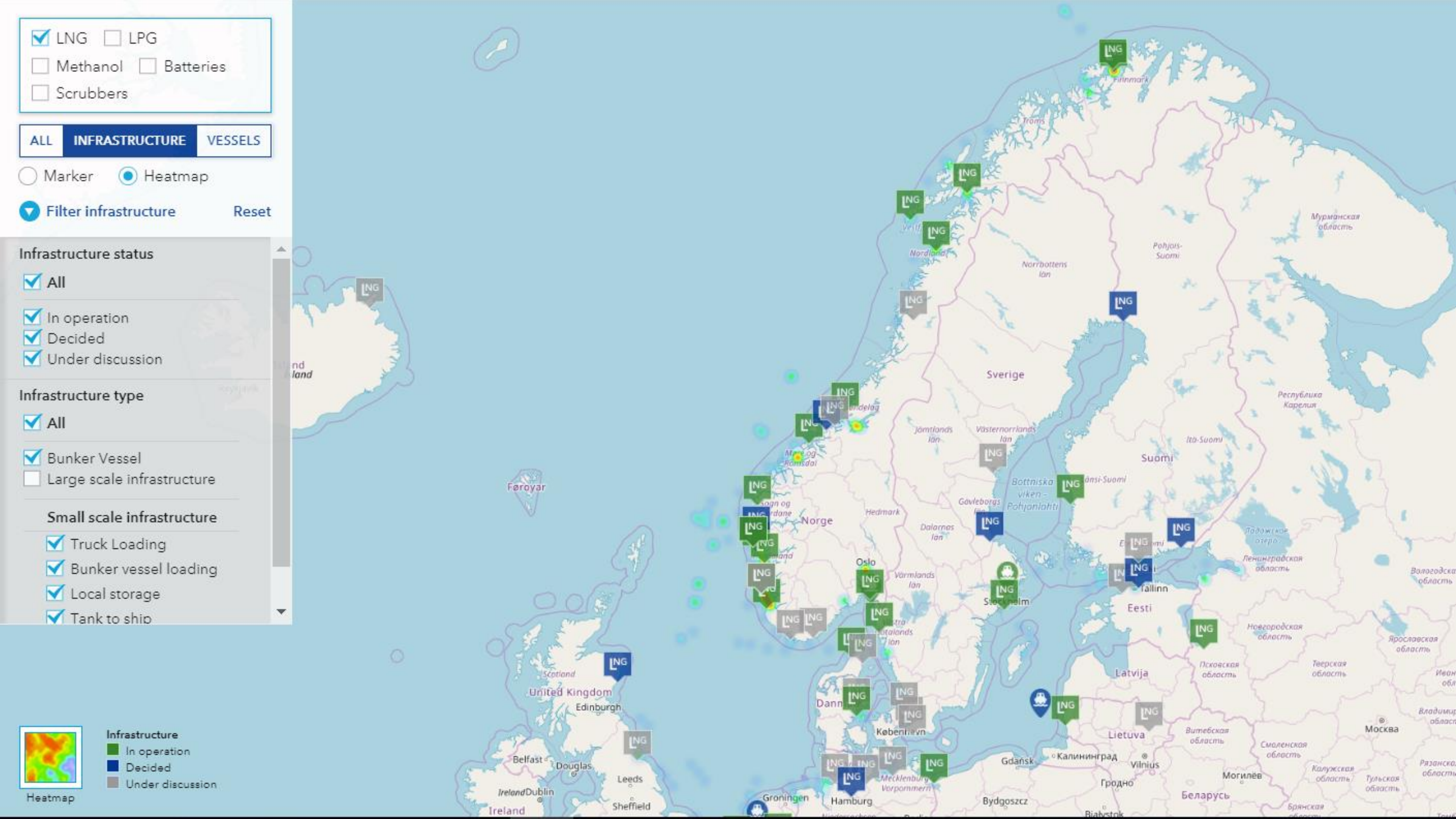
Гродно
Могилев
Москва
Калининград

Ferries and offshore vessels have driven the developments in Norway



Globally DF engines are the preferred choice but in Norway 2/3 of LNG fuelled ships have pure gas engines installed





LNG
LPG
Methanol
Batteries
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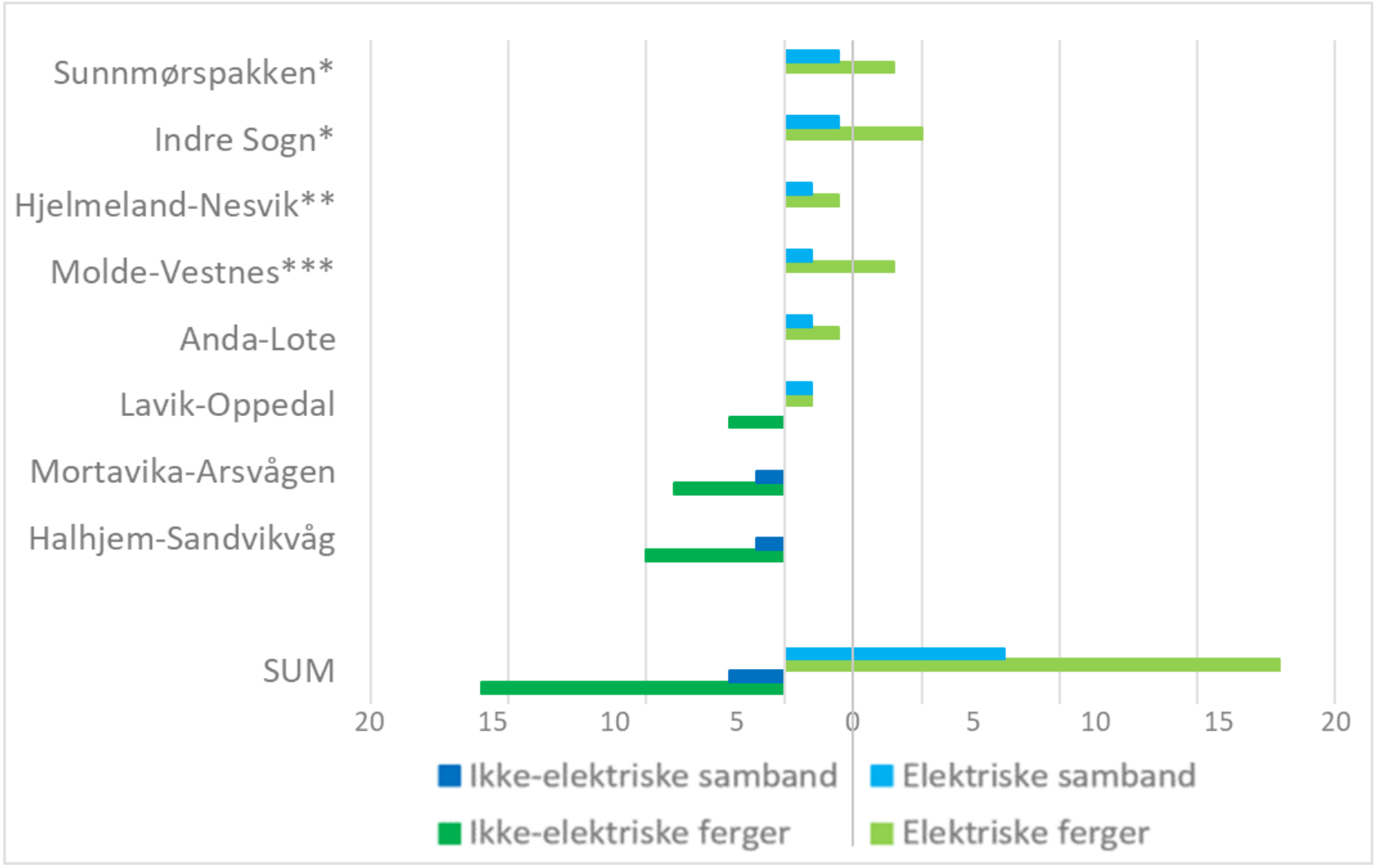
ALL
INFRASTRUCTURE
VESSELS
Marker
Heatmap
Filter infrastructure
Reset
Infrastructure status
All
In operation
Decided
Under discussion
Infrastructure type
All
Bunker Vessel
Large scale infrastructure
Small scale infrastructure
Truck Loading
Bunker vessel loading
Local storage
Tank to ship
Heatmap
Infrastructure
In operation
Decided
Under discussion
Føroyar
Norge
Sverige
Suomi
Oslo
Eesti
Tallinn
Latvija
Lietuva
United Kingdom
Edinburgh
Belfast
Douglas
Leeds
Sheffield
Dublin
Hamburg
Gdańsk
Vilnius
Москва
Беларусь

What’s the outlook for LNG fuel in Norway?

National road authorities has put a requirement for fully battery powered ships where technically feasible



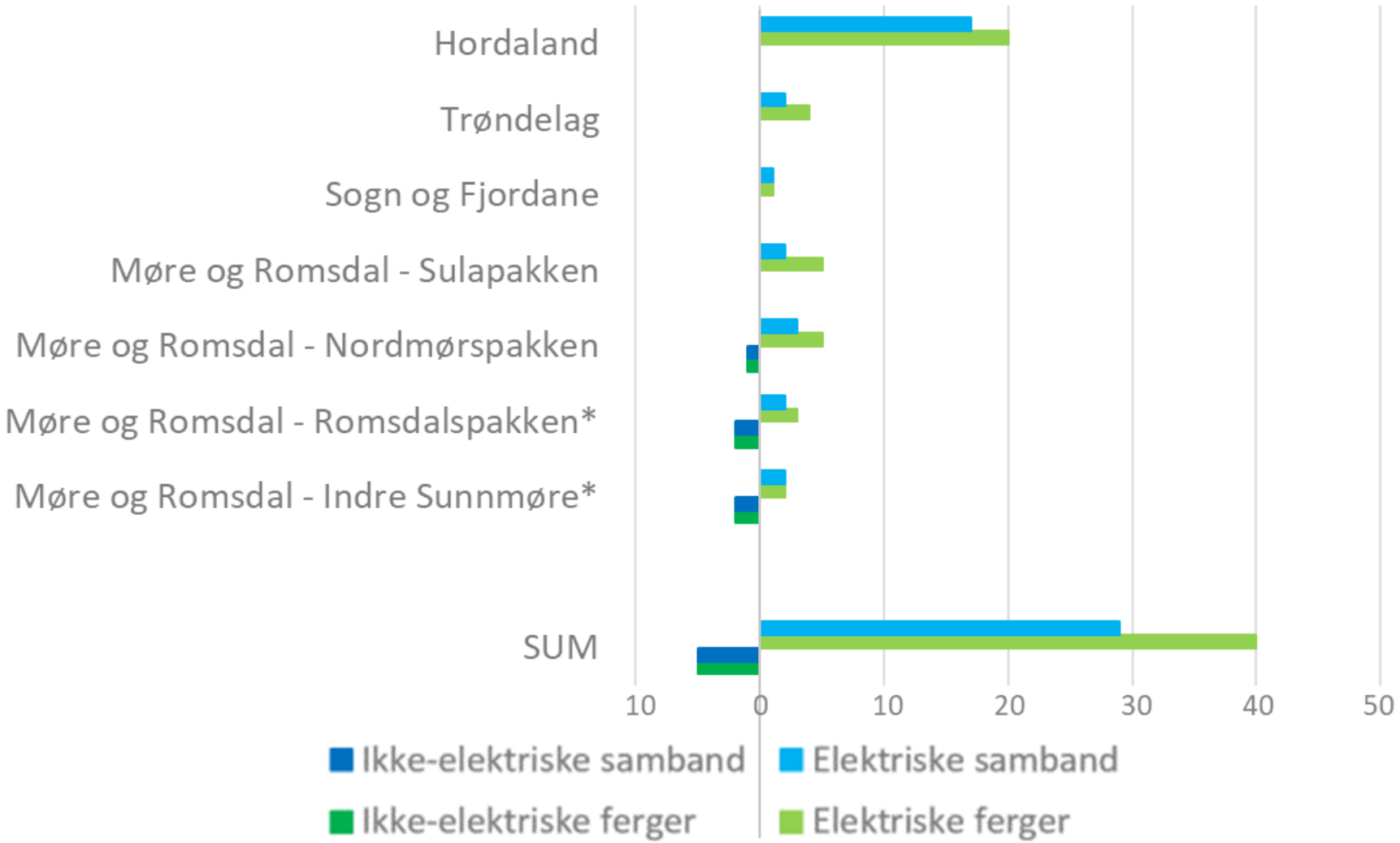
Statens vegvesen

*Not signed

** Not signed (one H2-ferry)

***Tender documents under preperation

Local counties have been able to follow up with funding from ENOVA and the NOx-fund



* Contract not signed yet

Kystruten (11 cruise/RoPax vessels) will run on LNG (and shore power) from 2021 following a state requirement for 25% CO2 reduction

Hurtigruten to Install LNG-Fueled Hybrid Power on Nine Cruise Ferries

File image courtesy Carsten Pedersen/Hurtigruten

BY **MAREX** 2018-04-20 13:13:00

Norwegian cruise ferry operator Hurtigruten has announced a major investment in environmentally-friendly propulsion. Together with Rolls-Royce, it will repower as many as nine of its conventionally-powered cruise ships with LNG-fueled hybrid propulsion systems. The agreement is among the largest retrofit orders for LNG propulsion ever announced in the passenger vessel sector.

Hurtigruten's arrangement with Rolls-Royce includes hybrid power systems, battery packs and LNG-fueled engines for six existing passenger cruise vessels, with an option for a further three. The upgrade will enable the former diesel-powered ships to reduce their CO_2 emissions by at least 25 per cent.

Havila Will Need to Build Four New Ships in 30 Month Window

March 23, 2018 | Monty Mathisen

Havila is set to operate four new coastal cruise-style ships on a route on the Norwegian coast, according to a decision from the Norwegian Ministry of Transportation and Communications, which has split the coastal route between Hurtigruten and the newcomer, Havila.

Liegruppen has ordered the world's first LNG fuelled fishing vessel

- 86 m purse-seiner by Salt Ship Design
- MAN 6L51/60DF main engine
- 350 m3 LNG tank

MAN Diesel & Turbo to equip world's first LNG fueled fishing vessel

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Libas *Salt Ship Design*

MAY 24, 2018 — A trawler on order at Cemre Shipyard, Turkey, for Norway's Liegruppen AS, will be the world's first fishing vessel with LNG fueled propulsion and will also feature a large battery pack.

Named *Libas*, the 86 m purse-seiner has been designed by Salt Ship Design.

MAN Diesel & Turbo will provide a complete propulsion package and fuel-gas system for the vessel, which will feature a MAN 6L51/60DF main engine, Renk gearbox, MAN Alpha propeller system and MAN Cryo LNG fuel-gas system with a 350 cu.m tank.

Wayne Jones, Chief Sales Officer with MAN Diesel & Turbo, said: "This is a pioneering project. At MAN we are convinced that low-emission gas fuels are the silver bullet to decarbonising the shipping industry and we have made it our mission to guide our customers through that transition."

Lex Nijsen, Head of Four-Stroke Marine, MAN Diesel & Turbo said: "This is a very noteworthy win. Our ability to provide this efficient, low-emission, proven LNG-fueled propulsion package – a world's first for this environmentally sensitive segment – really puts our credentials as a system provider on display."

"We offer a full system approach with regards to gas propulsion," Nijsen added "This includes newbuilds as much as retrofits of existing vessels. In 2017 MAN has retrofitted the world's first container vessel to LNG and more projects are being realized as we speak."

Norwegian CO2 tax exemption for LNG fuel lifted – significantly reducing/cancelling out the operational savings

- Tax on LNG fuel comparable with CO2 tax on MGO (per ton CO2 emitted) – abt. 1400 NOK/ton MGO equivalent

- Industry and interest organisations still fighting to reverse the decision

Norway Tax Will Discourage Uptake of LNG Bunkers: SEA\LNG

Tuesday May 1, 2018

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A recently approved domestic CO2 tax on **LNG** fuel in **Norway** will deter the uptake of liquefied natural gas (LNG) bunkers in the country, according to **SEA\LNG**.

The group, which advocates the use of the alternative marine fuel, said the move was badly timed and will likely increase emissions.

"Emissions reductions is a key driver behind the tax; while we clearly support such an aim, a CO2 tax outside a wider framework could lead to unintended consequences," SEA\LNG said.

SEA\LNG says the move will also disincentive LNG bunkers in Norway. File Image / Pixabay

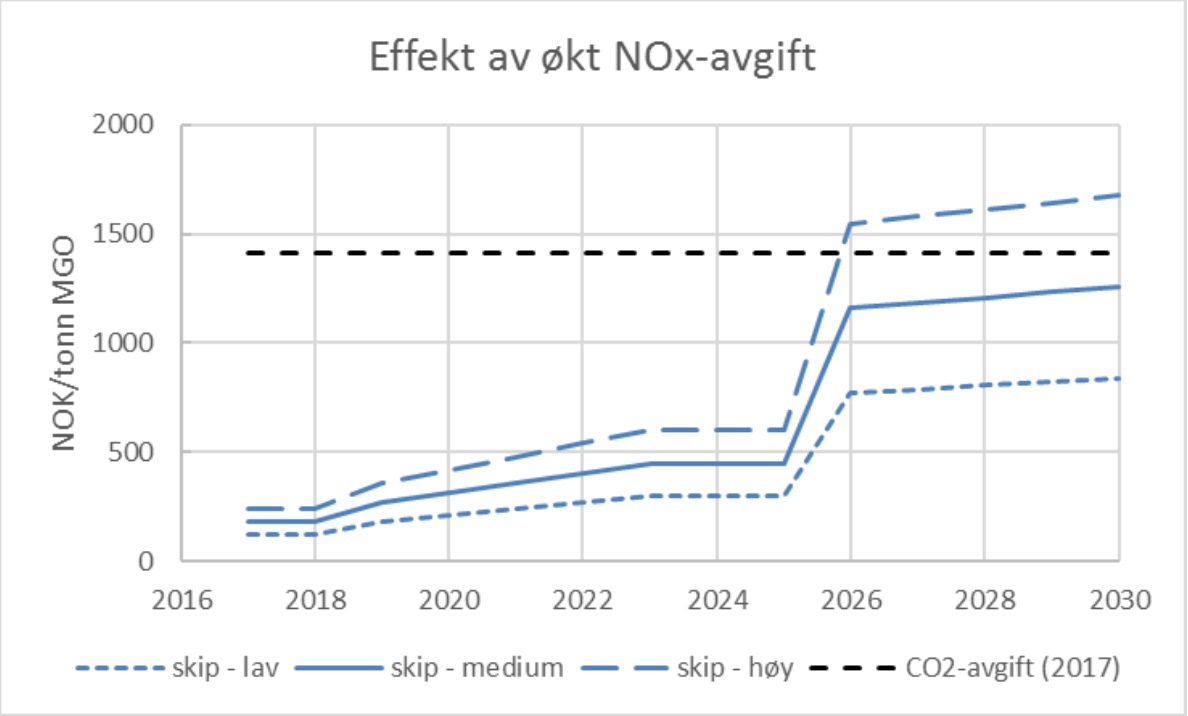
Norwegian NOx-fund agreement extended until 2025

Continued investment support up to 80%

- LNG remains a focus area for the NOx-fund under the new agreement

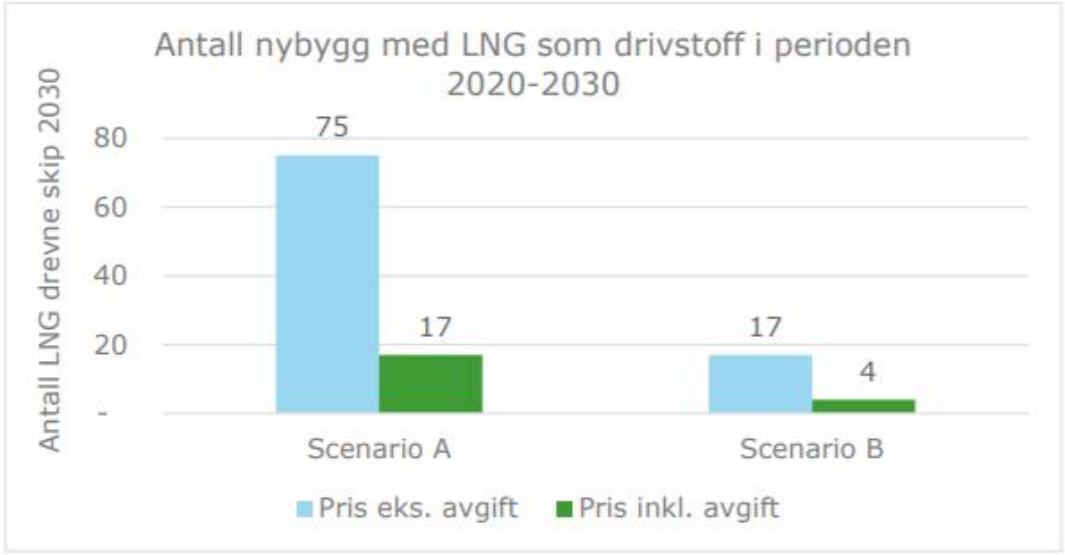
Increase in NOx-tax will give additional incentive

- The fee paid to the fund will be gradually increased before the high fiscal tax is re-introduced in 2026



Summing up

- GHG emissions high on the regulatory/political agenda
- Cargo owners and charterers are starting to get interested
- Good opportunities for investment support for LNG and other emission reduction technologies
- No more LNG fuelled ferries (actually less)
- Batteries only take you so far…
- How quick will H2 mature?



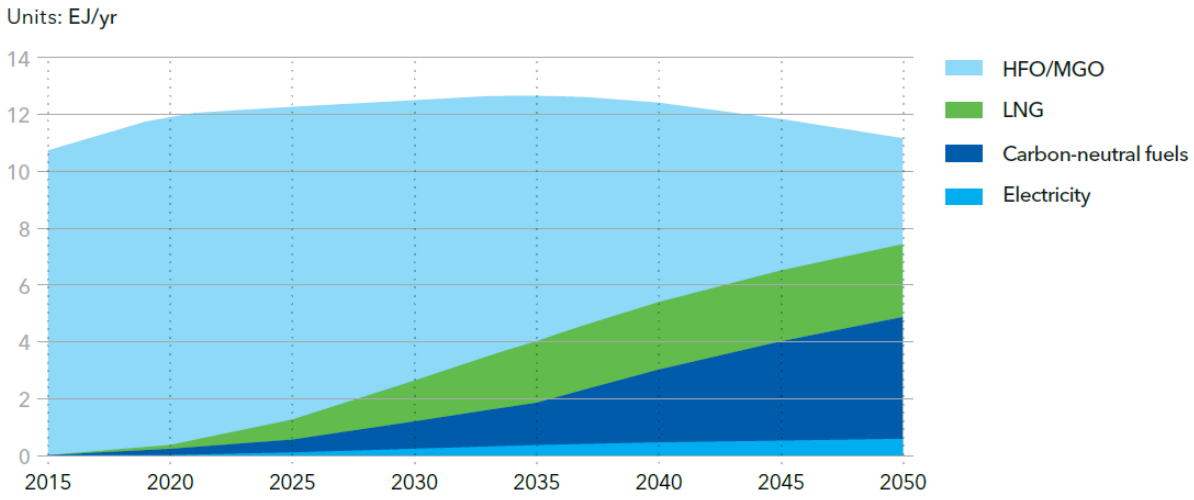
Figur 7: Prognose for antall skip med LNG som drivstoff i 2030 for lav (A) og høy (B) LNG pris med og uten CO_2-avgift.

DNV GL Energy Transition Outlook (2018)

- The "final" GHG solution for shipping remains unclear
- We will likely see a mosaic of fuels

FIGURE 6.3.1

Shipping energy mix

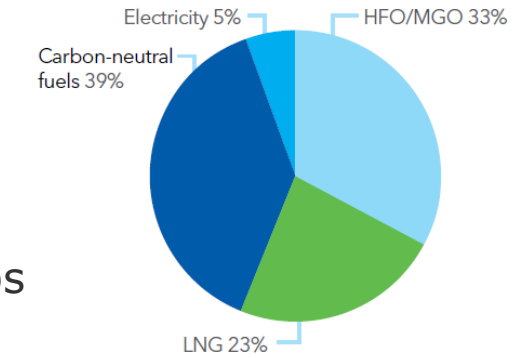


38 1 EJ = 23.9 Mtoe = 278 TWh

- Low and zero GHG solutions for deep sea shipping are limited
- LNG may play a significant role
- Carbon neutral fuels may also contain liquefied gases (i.e. LBG or power-to-gas)

FIGURE 6.3.2

Shipping energy mix 2050, total



LNG fuel for ships =~50 MTPA

Thank you

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