

MARITIME

LNG as a fuel

The past, the present and the future developments

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20 April 2016

Ungraded

The drivers for alternative fuels in shipping are interlinked

More stringent environmental regulations



Fluctuating – highly volatile - fuel prices



Availability of new energy sources



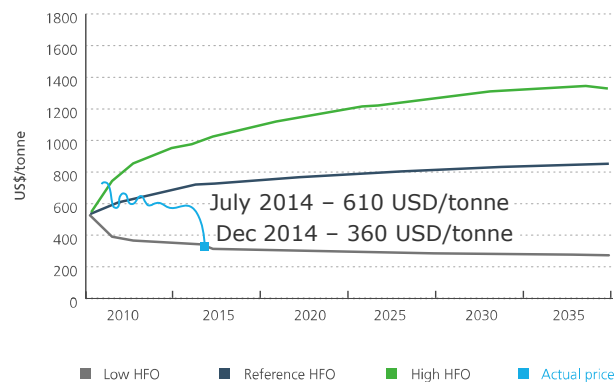
Stakeholder pressure to manage environmental and climate risks



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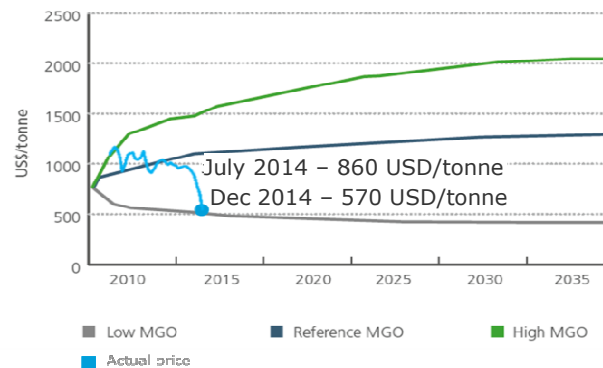
Fuel prices – who dares now to estimate future price paths?

HFO



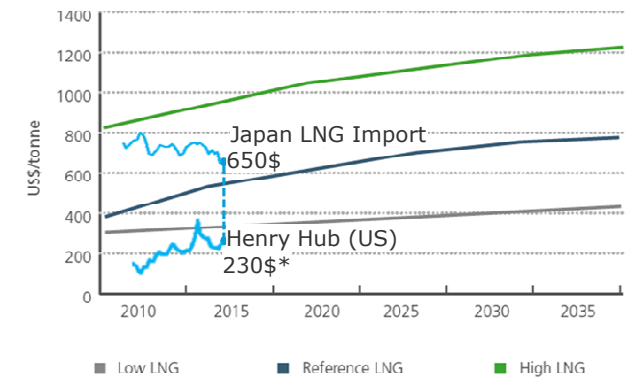
- Fuel price has been according to all three predicted scenarios....
- ... showing the complexity of prediction

MDO



- Moving in parallel with HFO, but has dropped less than HFO relatively
- Uncertainty about hybrid fuel alternative – will it be a saviour for int'l shipping?

LNG



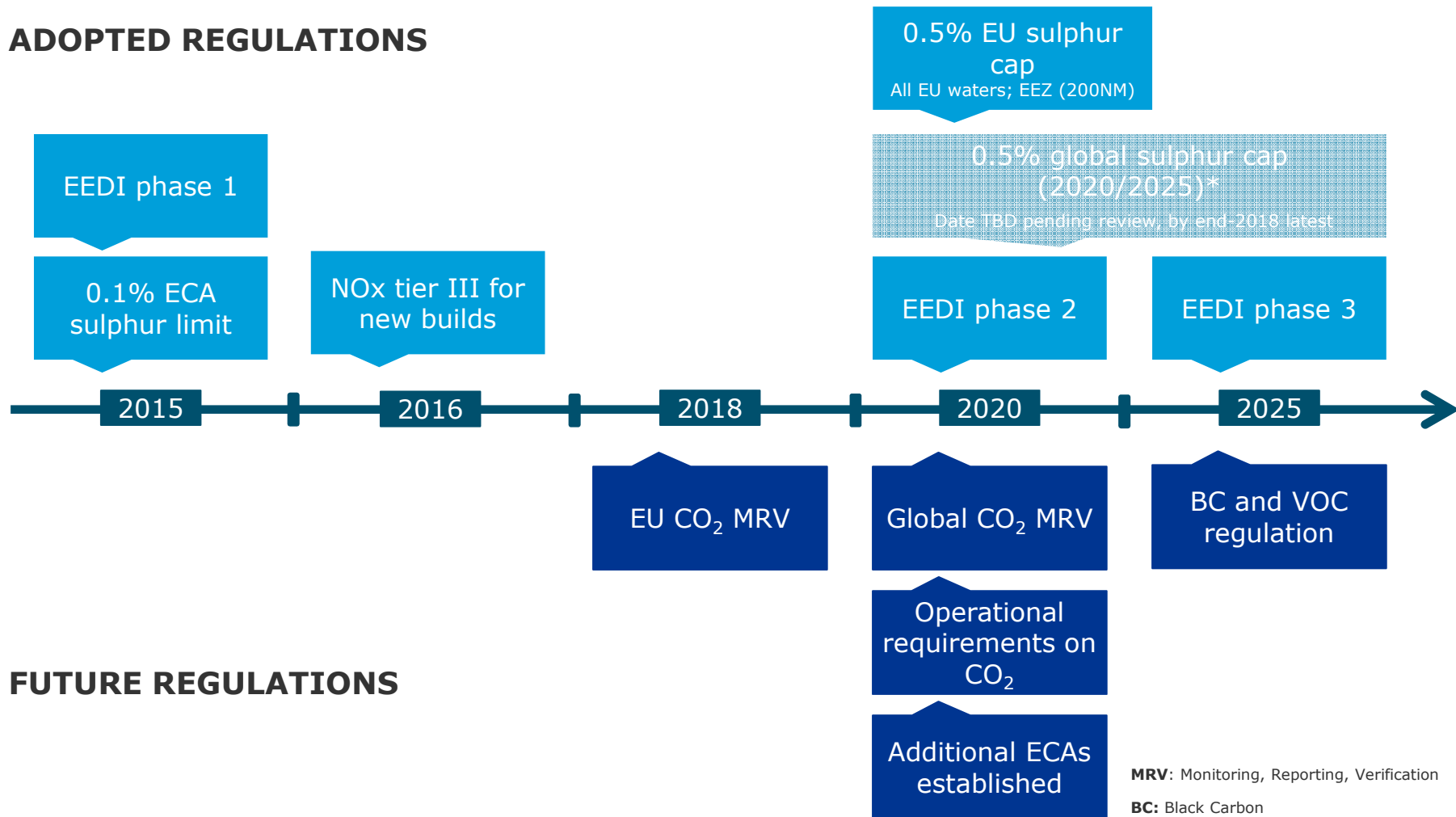
*liquefaction and processing cost is not included

- The LNG price has not dropped as much as HFO/MDO...
- ... and is varying according to geographical areas more than following the HFO price
- ...except for Japan – where it follows HFO development

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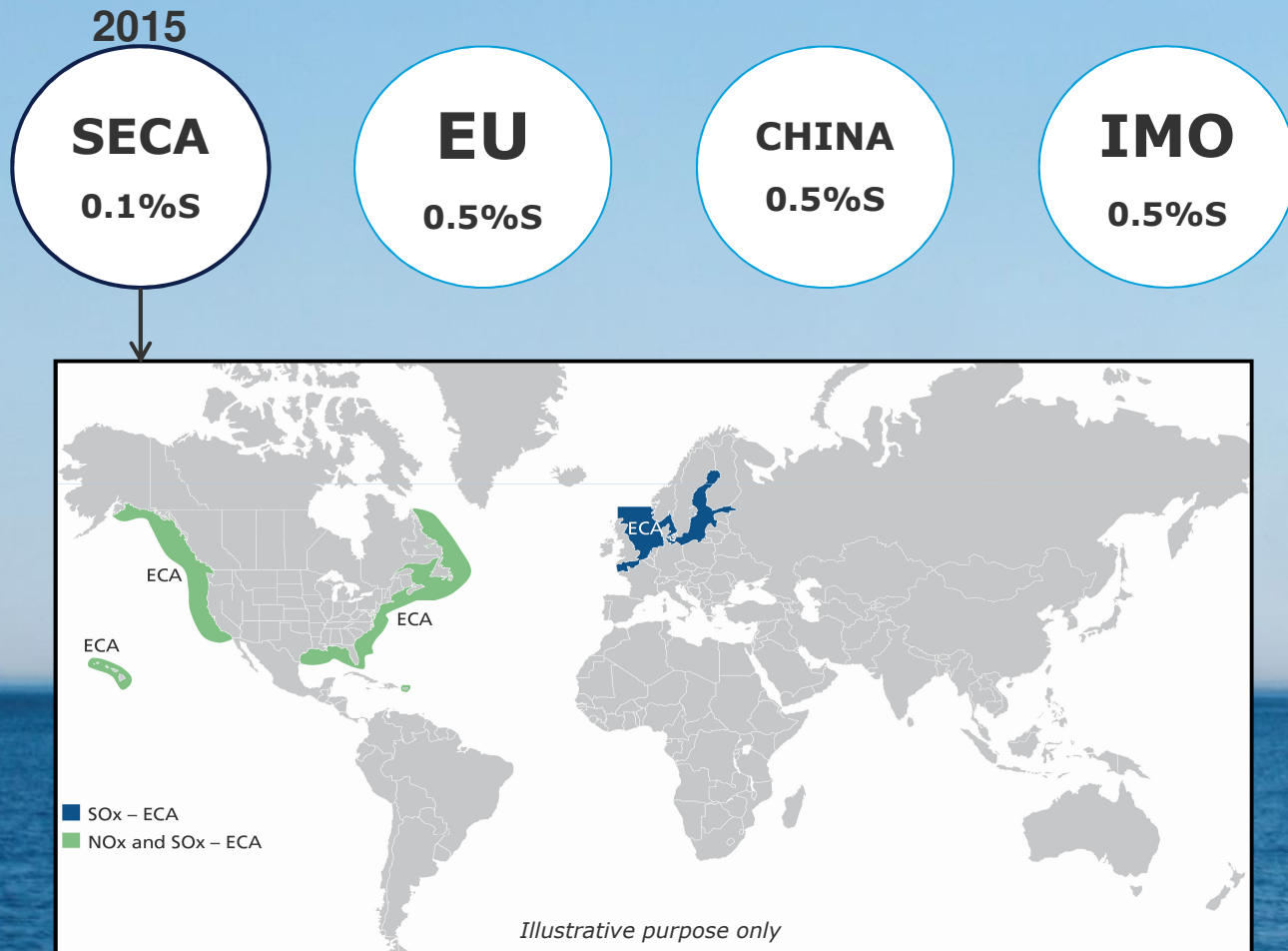
A number of environmental regulations are on the horizon

ADOPTED REGULATIONS



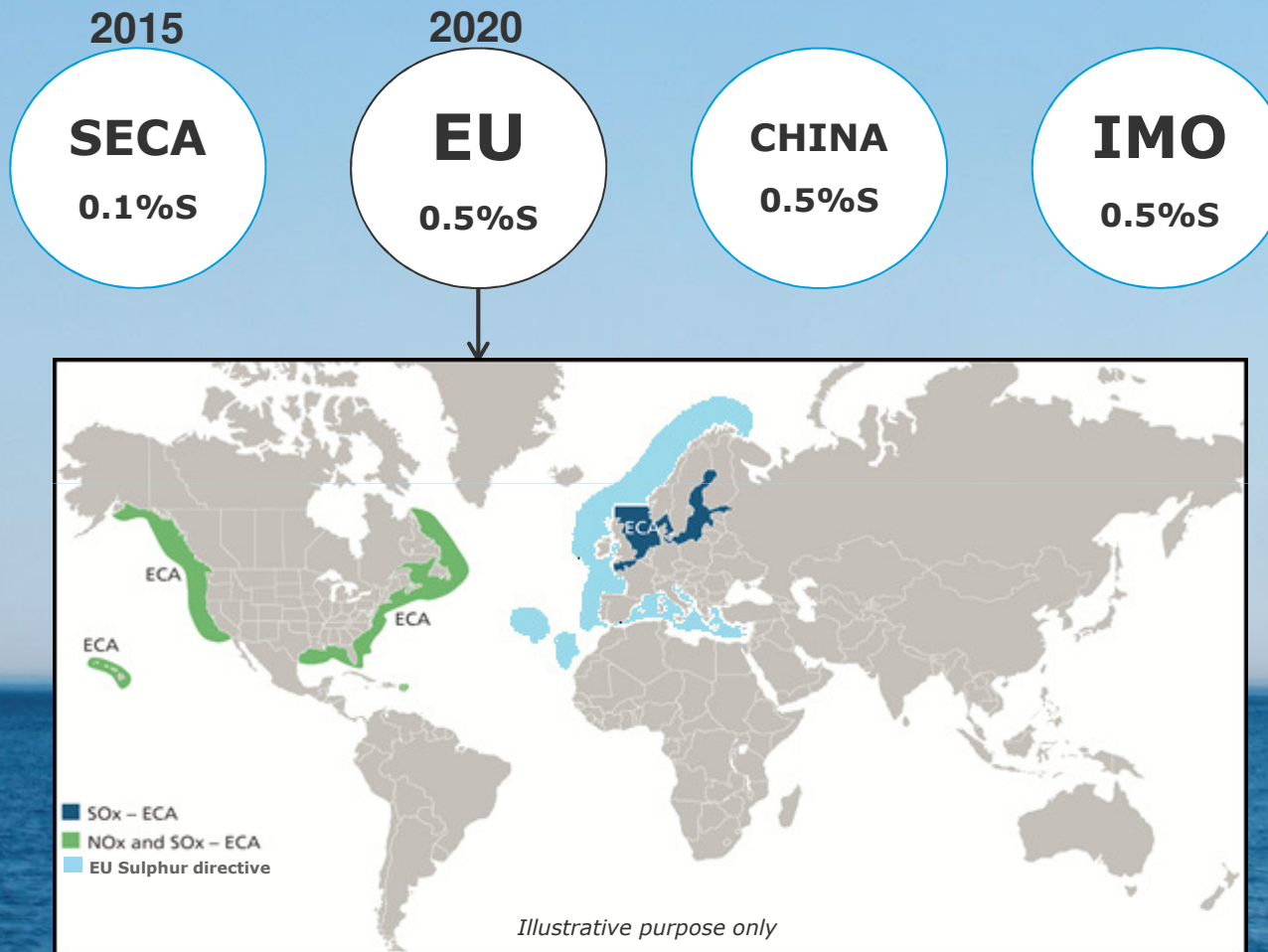
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Sulphur legislation



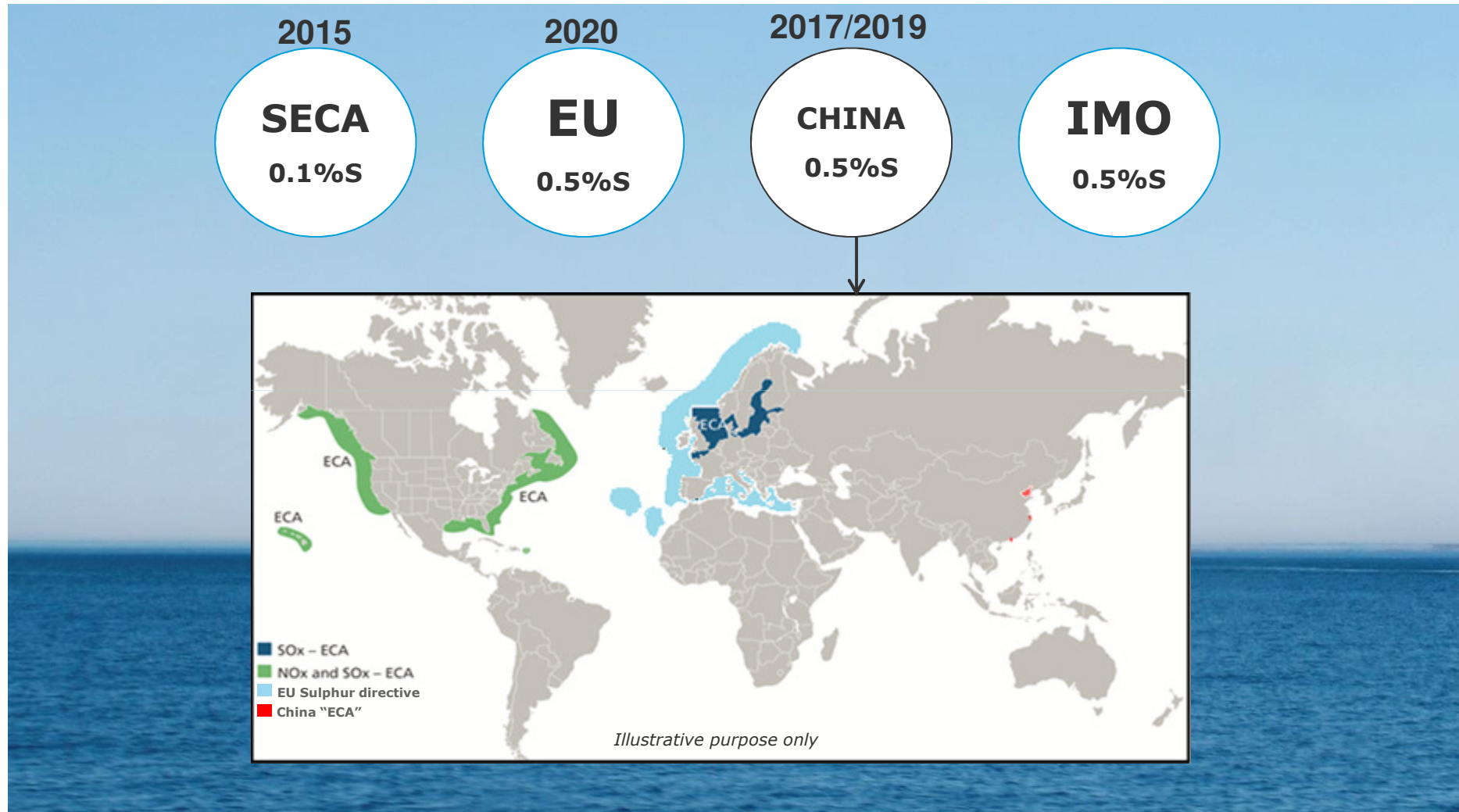
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Sulphur legislation



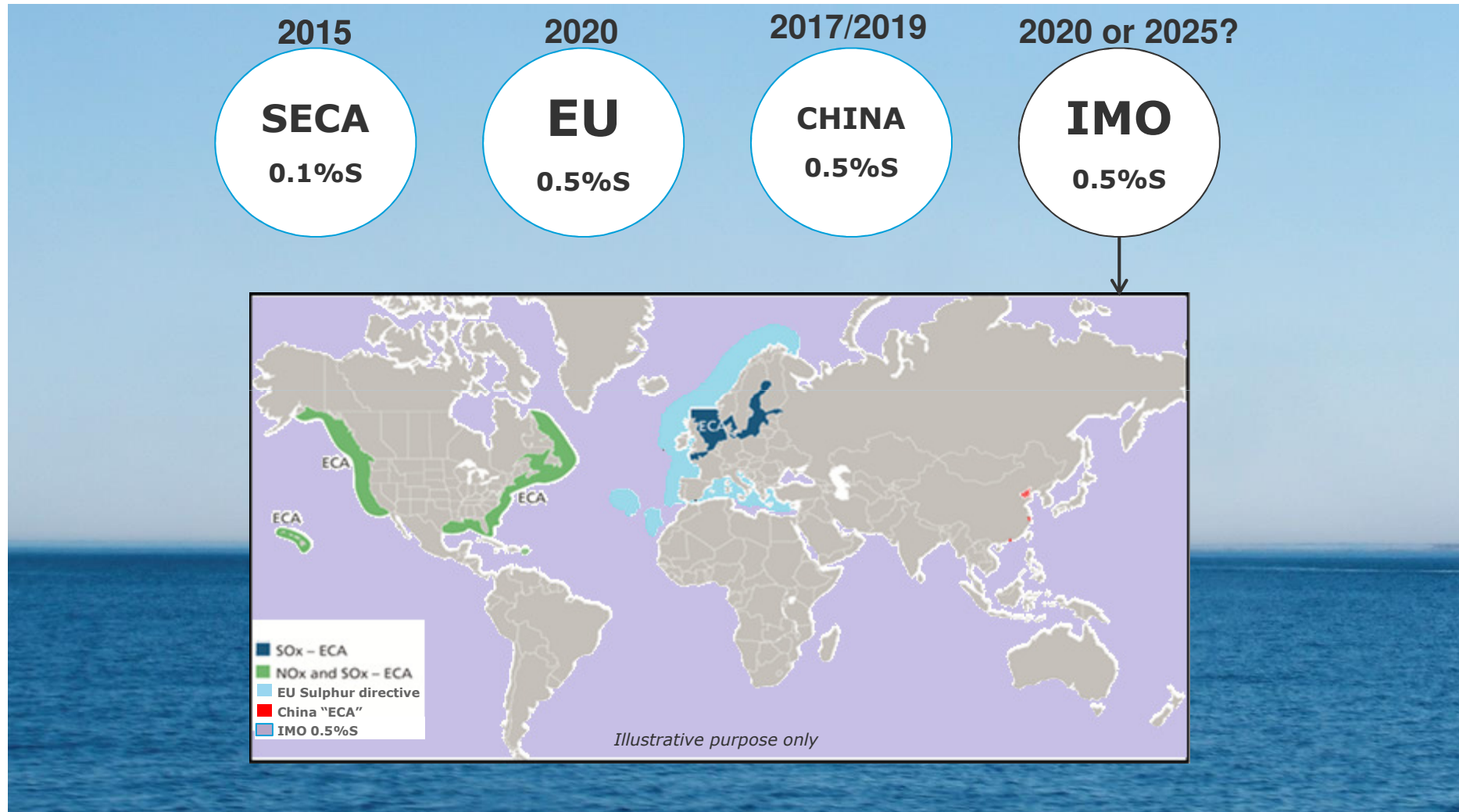
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Sulphur legislation



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Sulphur legislation



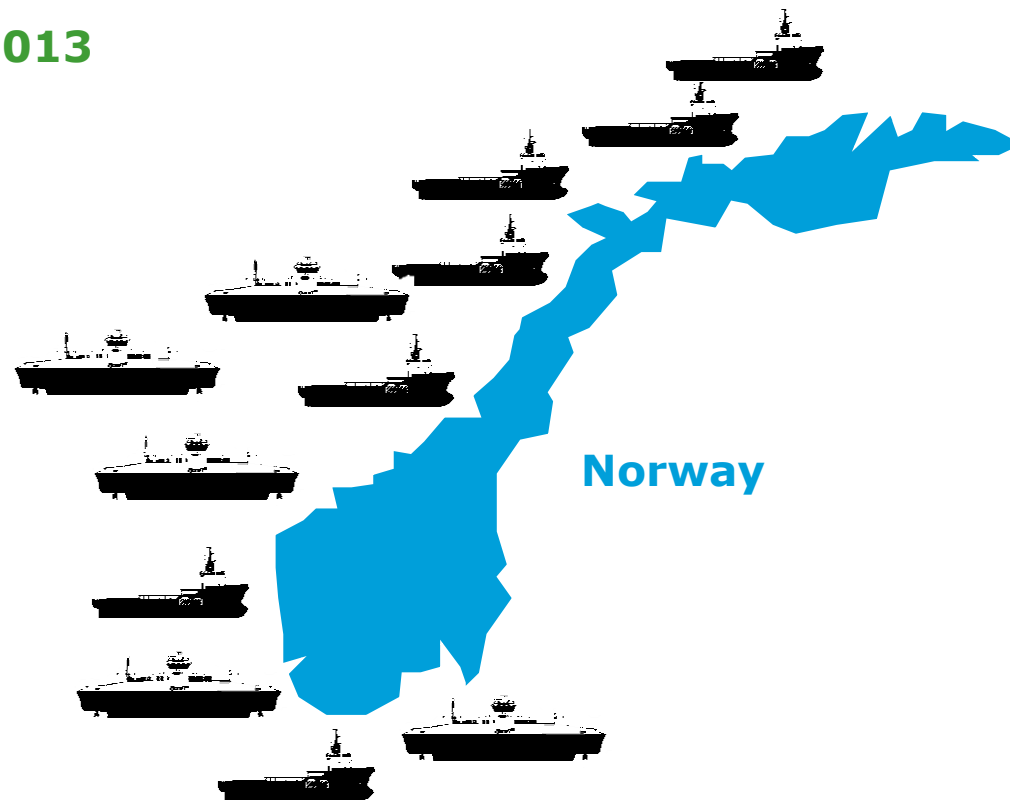
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LNG Fuelled Fleet Development

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The development trend is moving from LOCAL ...

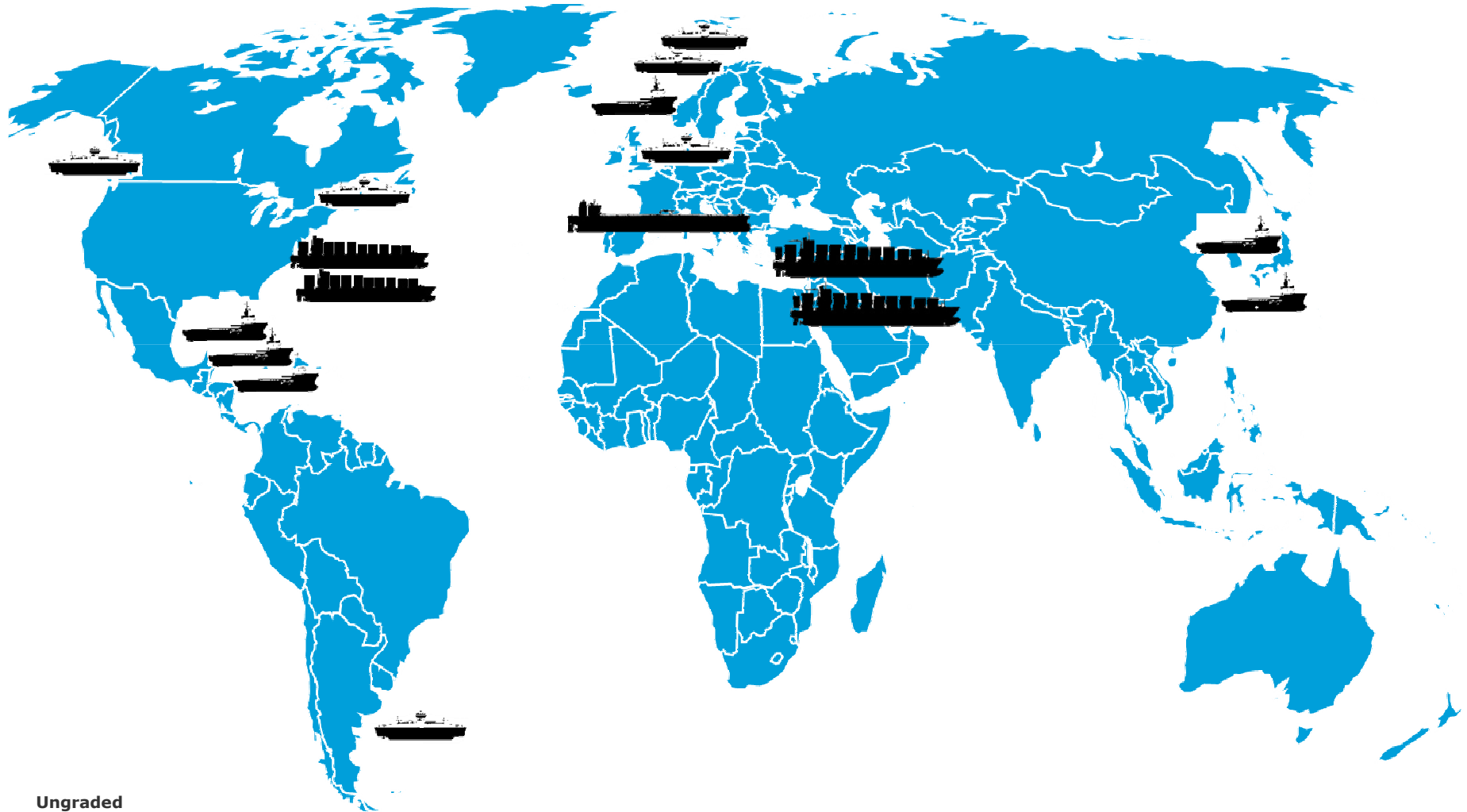
2000 – 2013



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... to GLOBAL ...

2013 - ...

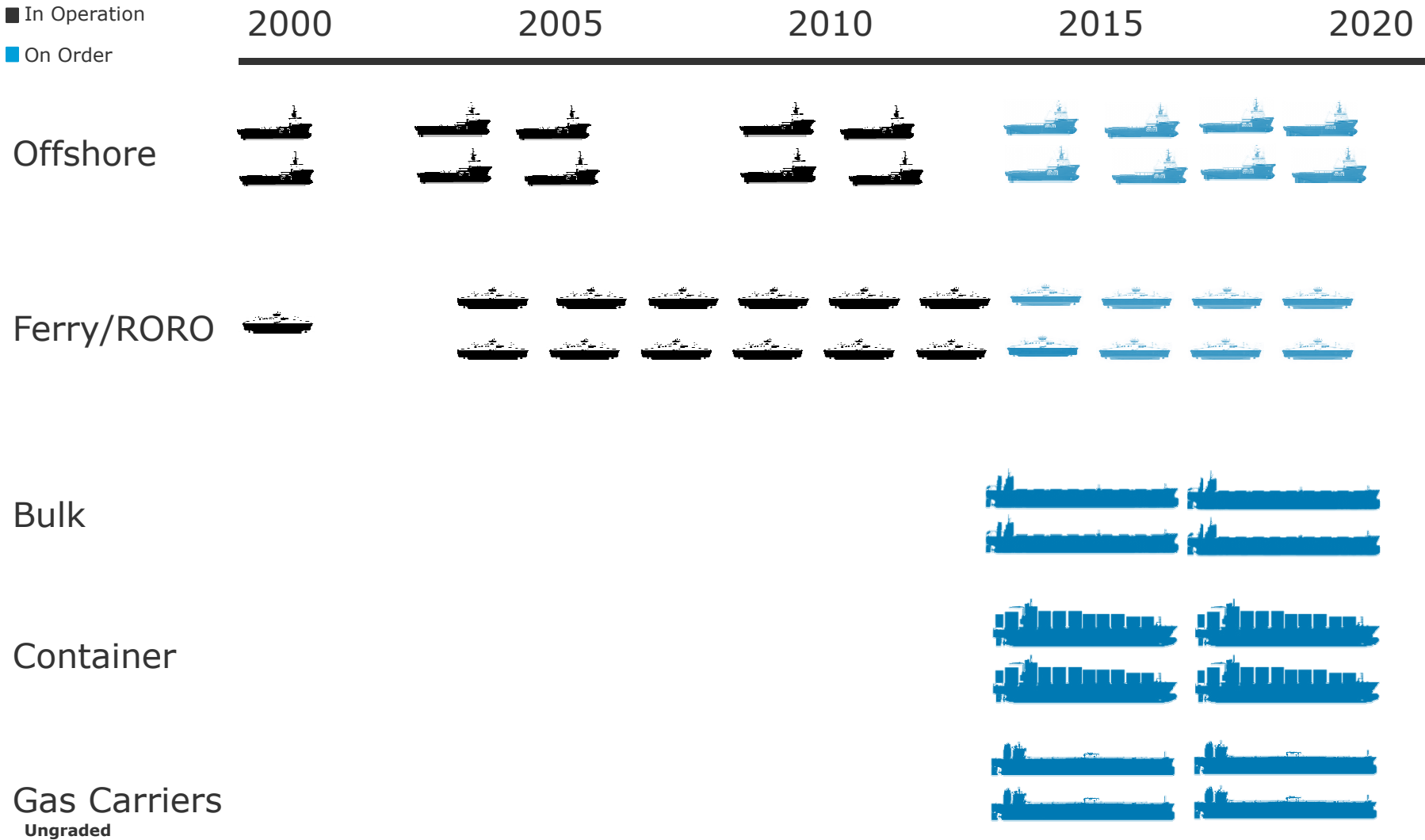


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... and from SMALLER to LARGER vessels

■ In Operation

■ On Order



76 LNG fuelled ships in operation worldwide (1/2)

Ships in operation

Year	Type of vessel	Owner	Class	Year	Type of vessel	Owner	Class
2000	Car/passenger ferry	Fjord1	DNV GL	2012	PSV	Eidesvik	DNV GL
2003	PSV	Simon Møkster	DNV GL	2012	PSV	Olympic Shipping	DNV GL
2003	PSV	Eidesvik	DNV GL	2012	PSV	Island Offshore	DNV GL
2006	Car/passenger ferry	Fjord1	DNV GL	2012	General Cargo	Nordnorsk Shipping	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL	2012	PSV	Eidesvik Shipping	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL	2012	PSV	Island Offshore	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL	2012	Car/passenger ferry	Torghatten Nord	DNV GL
2007	Car/passenger ferry	Fjord1	DNV GL	2012	Car/passenger ferry	Torghatten Nord	DNV GL
2008	PSV	Eidesvik Shipping	DNV GL	2012	Car/passenger ferry	Torghatten Nord	DNV GL
2009	PSV	Eidesvik Shipping	DNV GL	2013	PSV	REM	DNV GL
2009	Car/passenger ferry	Tide Sjø	DNV GL	2013	RoPax	Viking Line	LR
2009	Car/passenger ferry	Tide Sjø	DNV GL	2013	Car/passenger ferry	Torghatten Nord	DNV GL
2009	Car/passenger ferry	Tide Sjø	DNV GL	2013	Tug	Incheon Port Authority	KR
2009	Patrol vessel	Remøy Management	DNV GL	2013	General Cargo	Eidsvaag	DNV GL
2009	Car/passenger ferry	Fjord1	DNV GL	2013	RoPax	Fjordline	DNV GL
2010	Patrol vessel	Remøy Management	DNV GL	2013	High speed RoPax	Buquebus	DNV GL
2010	Car/passenger ferry	Fjord1	DNV GL	2013	Tug	CNOOC	CCS
2010	Patrol vessel	Remøy Management	DNV GL	2013	Tug	CNOOC	CCS
2010	Car/passenger ferry	Fjord1	DNV GL	2013	Car/passenger ferry	Norled	DNV GL
2010	Car/passenger ferry	Fjord1	DNV GL	2014	Car/passenger ferry	Norled	DNV GL
2010	Car/passenger ferry	Fosen Namsos Sjø	DNV GL	2014	Tug	Buksér & Berging	DNV GL
2011	PSV	DOF	DNV GL	2014	RoPax	Fjordline	DNV GL
2011*	Oil/chemical tanker	Tarbit Shipping	DNV GL	2014	Patrol vessel	Finish Border Guard	DNV GL
2011	Car/passenger ferry	Fjord1	DNV GL	2014	Tug	Buksér & Berging	DNV GL
2011	PSV	Solstad Rederi	DNV GL	2014	Gas carrier	Anthony Veder	BV
2012*	Car/passenger ferry	Fjord1	DNV GL	2014	Gas carrier	Anthony Veder	BV

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Ungraded * **Conversion project**

Excluding LNG carriers and inland waterway vessels

76 LNG fuelled ships in operation worldwide (2/2)

Ships in operation

Year	Type of vessel	Owner	Class
2014	PSV	Remøy Shipping	DNV GL
2014	General Cargo	Egil Ulvan Rederi	DNV GL
2014	General Cargo	Egil Ulvan Rederi	DNV GL
2014	PSV	Siem Offshore	DNV GL
2015	PSV	Harvey Gulf Int.	ABS
2015	Ro-Ro	Norlines	DNV GL
2015	Car/passenger ferry	Samsoe municipality	DNV GL
2015	PSV	Simon Møkster Shipping	DNV GL
2015	PSV	Siem Offshore	DNV GL
2015	Ro-Ro	Norlines	DNV GL
2015*	Oil/chemical tanker	Bergen Tankers	LR
2015	Car/passenger ferry	Society of Quebec ferries	LR
2015	Gas carrier	Evergas	BV
2015	Gas carrier	Evergas	BV
2015	Tug	CNOOC	CCS
2015*	Car/passenger ferry	AG Ems	DNV GL
2015	Tug	NYK	NK
2015	Gas carrier	Chemgas Shipping	BV
2015	Gas carrier	Evergas	BV
2015	PSV	Harvey Gulf Int.	ABS
2015	Container ship	TOTE Shipholdings	ABS
2015	Car/passenger ferry	AG EMS	DNV GL
2015	Bulk ship	Erik Thun	LR
2016	Container ship	TOTE Shipholdings	ABS

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Ungraded * **Conversion project**

Excluding LNG carriers and inland waterway vessels

86 confirmed LNG fuelled newbuilds – DNV GL also first choice for future projects (1/2)

Confirmed orderbook

Year	Type of vessel	Owner	Class
2016	Car/passenger ferry	Society of Quebec ferries	LR
2016	Car/passenger ferry	Society of Quebec ferries	LR
2016	PSV	Harvey Gulf Int.	ABS
2016	Tug	CNOOC	CCS
2016	Tug	Drydocks World	
2016	PSV	Harvey Gulf Int.	ABS
2016	PSV	Harvey Gulf Int.	ABS
2016	PSV	Siem Offshore	DNV GL
2016	PSV	Siem Offshore	DNV GL
2016*	Oil/chemical tanker	Furetank Rederi	BV
2016	Gas carrier	Evergas	BV
2016	Gas carrier	Evergas	BV
2016	Gas carrier	Evergas	BV
2016	PSV	Harvey Gulf Int.	ABS
2016	Icebreaker	Finnish Transport Agency	LR
2016	PSV	Siem Offshore	DNV GL
2016	PSV	Siem Offshore	DNV GL
2016	Gas carrier	Chemgas Shipping	
2016	Oil/chemical tanker	Terntank	BV
2016	Oil/chemical tanker	Terntank	BV

Year	Type of vessel	Owner	Class
2016	Oil/chemical tanker	Terntank	BV
2016*	Ro-Ro	TOTE Shipholdings	ABS
2016	Car carrier	UECC	LR
2016	Car carrier	UECC	LR
2016	Car/passenger ferry	Boreal	DNV GL
2016	Car/passenger ferry	Boreal	DNV GL
2016	Container ship	GNS Shipping	ABS
2016	Container ship	GNS Shipping	ABS
2016	Ro-Ro	Searoad Holdings	DNV GL
2016	Car/passenger ferry	BC Ferries	LR
2016	Car/passenger ferry	BC Ferries	LR
2016	Gas carrier	Ocean Yield	DNV GL
2016	Gas carrier	Ocean Yield	DNV GL
2016	Gas carrier	Ocean Yield	DNV GL
2016	Car/passenger ferry	Seaspan Ferries Corp.	BV
2016	Car/passenger ferry	Seaspan Ferries Corp.	BV
2016	Gas carrier	Navigator Gas	ABS
2016	Gas carrier	Navigator Gas	ABS
2016	Gas carrier	Navigator Gas	ABS
2016	Gas carrier	Navigator Gas	ABS
2016*	RoPax	Baleària	BV
2016	Dredger	DEME	BV
2016	Dredger	DEME	BV
2016*	Container ship	Wessels Reederei	BV

Ungraded * **Conversion project**

Updated 21 March 2016
Excluding LNG carriers and inland waterway vessels

86 confirmed LNG fuelled newbuilds – DNV GL also first choice for future projects (2/2)

Confirmed orderbook

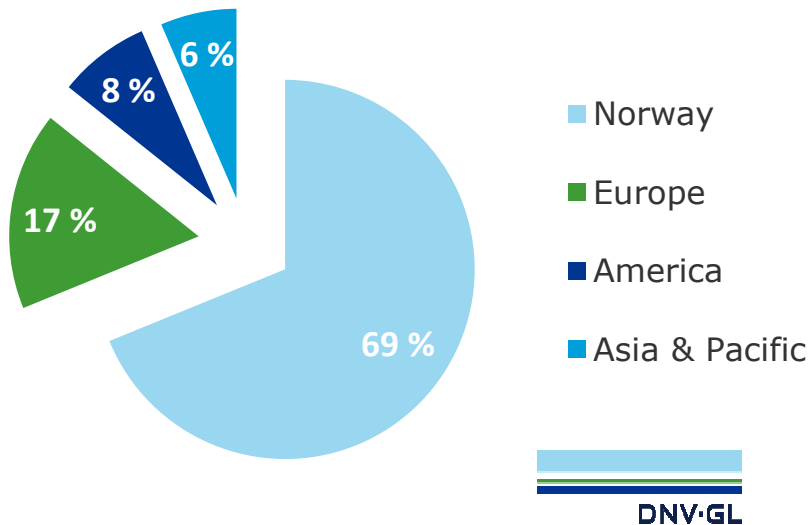
Year	Type of vessel	Owner	Class	Year	Type of vessel	Owner	Class
2016	Hopper Barge	Bremenports	DNV GL	2018	Car/passenger ferry	CHFS	LR
2017	Cable layer	DEME Tideway	DNV GL	2018	Car/passenger ferry	CHFS	LR
2017	Gas carrier	Evergas	BV	2018*	Ro-Ro	TOTE Shipholdings	ABS
2017	Gas carrier	Evergas	BV	2018	RoPax	Rederi AB Gotland	DNV GL
2017	Tug	Østensjø Rederi		2018	General cargo ship	Nordnorsk Shipping	
2017	Tug	Østensjø Rederi		2018	Container ship	Containerships	ABS
2017	Tug	Østensjø Rederi		2018	Container ship	Containerships	ABS
2017	RoPax	Rederi AB Gotland	DNV GL	2018	Heavy lift vessel	Heerema Offshore	LR
2017	Car/passenger ferry	Caronte & Tourist	RINA	2018	Oil/chemical tanker	Furetank Rederi	
2017	Oil/chemical tanker	Groupe Desgagnés	BV	2018	Oil/chemical tanker	Furetank Rederi	
2017	Oil/chemical tanker	Groupe Desgagnés	BV	2018	DEME	Dredger	
2017	Container ship	GNS Shipping	ABS	2018	Cruise ship	Carnival Corporation	RINA
2017	Container ship	GNS Shipping	ABS	2019	Cruise ship	Carnival Corporation	RINA
2017	Car/passenger ferry	BC Ferries	LR	2019	Oil/chemical tanker	Ålvtank	
2017	Oil/chemical tanker	Terntank	BV	2019	Oil/chemical tanker	Thun Tankers	
2017	Container ship	Crowley Maritime Corp.	DNV GL	2019	RoPax	Baleària	BV
2017	Container ship	Crowley Maritime Corp.	DNV GL	2020	Cruise ship	Carnival Corporation	RINA
2017	RoPax	Tallink	BV	2022	Cruise ship	Carnival Corporation	RINA
2017	Container ship	Brodosplit	DNV GL				
2018	Container ship	Brodosplit	DNV GL				
2018	Bulk ship	ESL Shipping	DNV GL				
2018	Bulk ship	ESL Shipping	DNV GL				
2018	Container ship	Brodosplit	DNV GL				
2018	Container ship	Brodosplit	DNV GL				

Ungraded * **Conversion project**

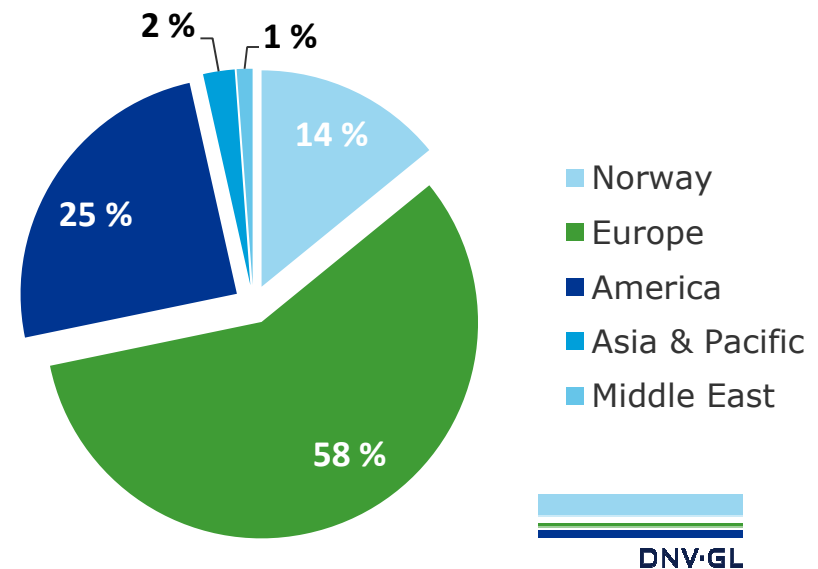
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Excluding LNG carriers and inland waterway vessels

Area of operation of LNG fuelled vessels

Operating area
ships in operation



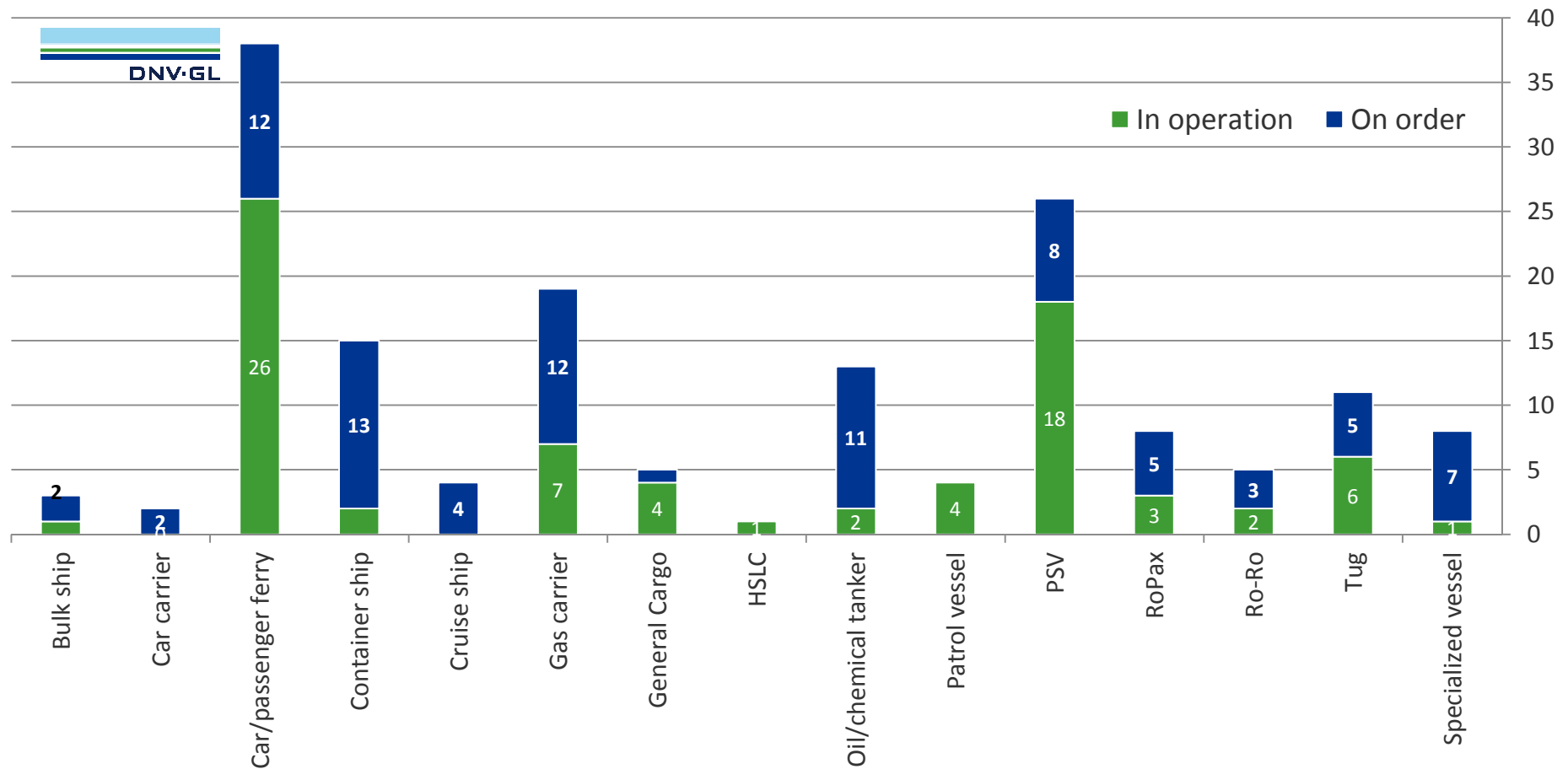
Operating area
confirmed orderbook



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Excluding LNG carriers and inland waterway vessels

LNG uptake by vessel segment



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Excluding LNG carriers and inland waterway vessels

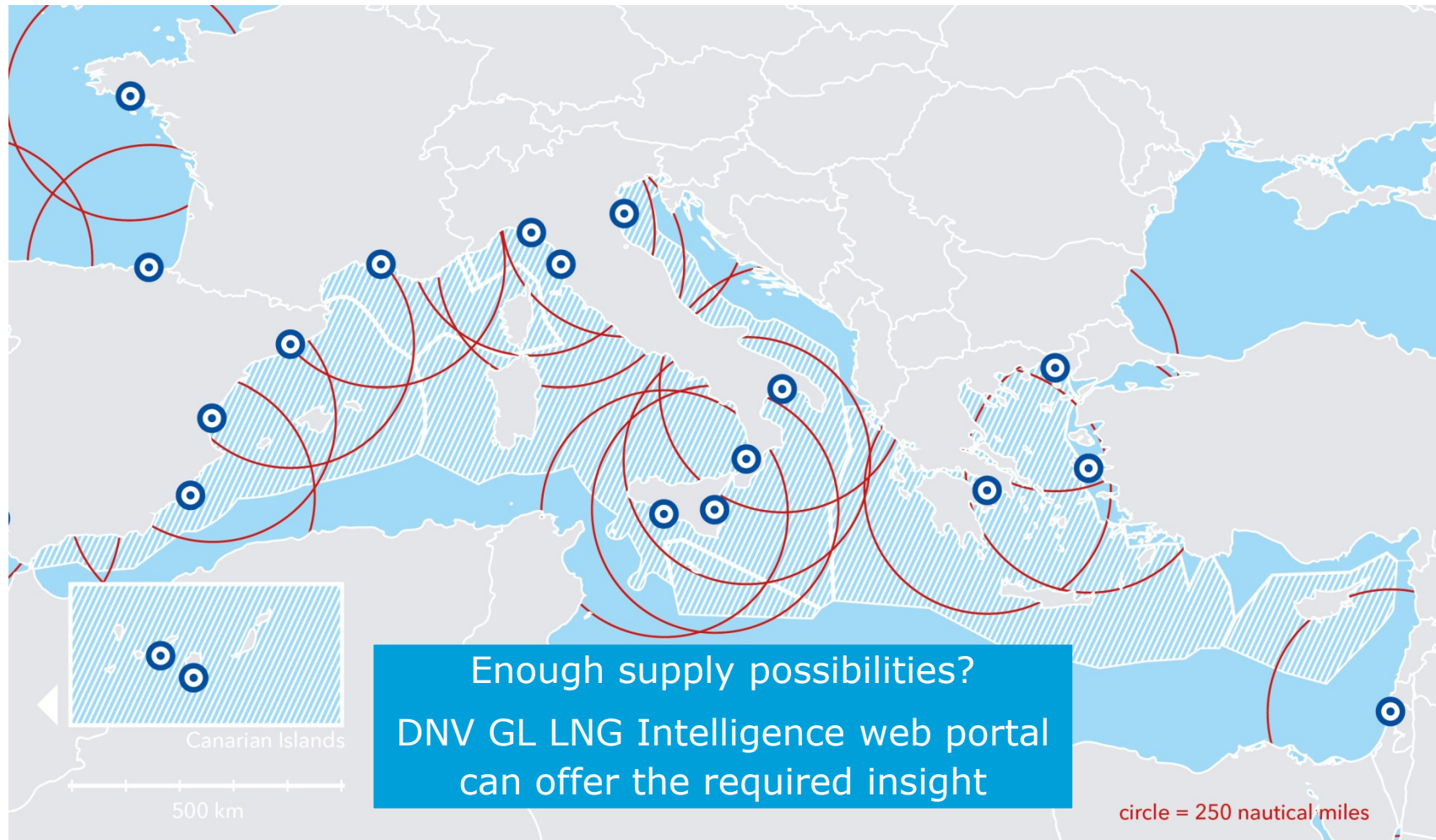
LNG supply development

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LNG supply for ships – some reflections

- The chicken and egg debate is finally almost over
- Bunker ships become available in 2016/2017
- Import terminals can supply bunker ships (size will be between 1,000 to 8,000 m³ LNG)
- For sustainable business, a bunker supplier has to sell LNG with a competitive supply surcharge
 - 2 \$/mmBTU and below seem to be possible (6,000 to 8,000 m³ bunker sold per week)
- A bunker ship may operate 200 to 250 nm around a supply terminal offering the required supply flexibility

LNG supply for ships is possible from LNG import terminals



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LNGi – Your LNG intelligence portal

For more information please visit:

<https://lngi.dnvgl.com/sitepages/Homepage.aspx>

LNG Intelligence provides all needed information to keep you on top of LNG bunkering for ships

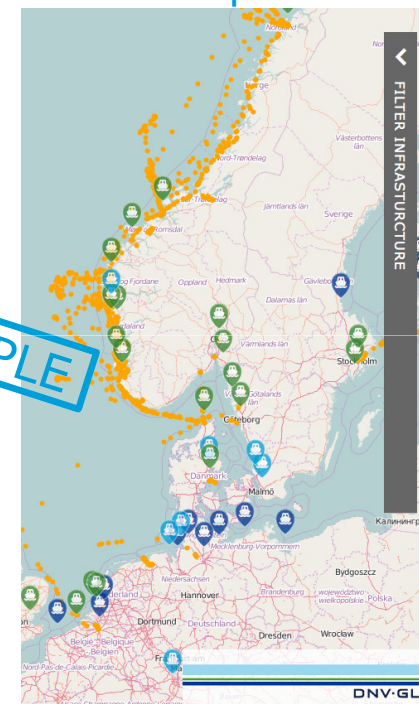
LNG INTELLIGENCE

- ✓ **Map** of LNG bunkering infrastructure with **detailed** project data
- ✓ Heat map and vessel positions of LNG fuelled fleet operating area using **AIS**
- ✓ Detailed **statistics** of LNG fuelled **fleet** development
- ✓ Scrubber + alternative fuels overview
- ✓ LNG related studies and publications

Heat map



Vessel positions



The heat map and vessel positions are based on AIS data from 01.01.2016-11.01.2016

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Shapshots of LNG Intelligence

LNG Interactive map: World map



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Shapshots of LNG Intelligence

LNG Interactive map: AIS data shows vessel positions of LNG fuelled vessels

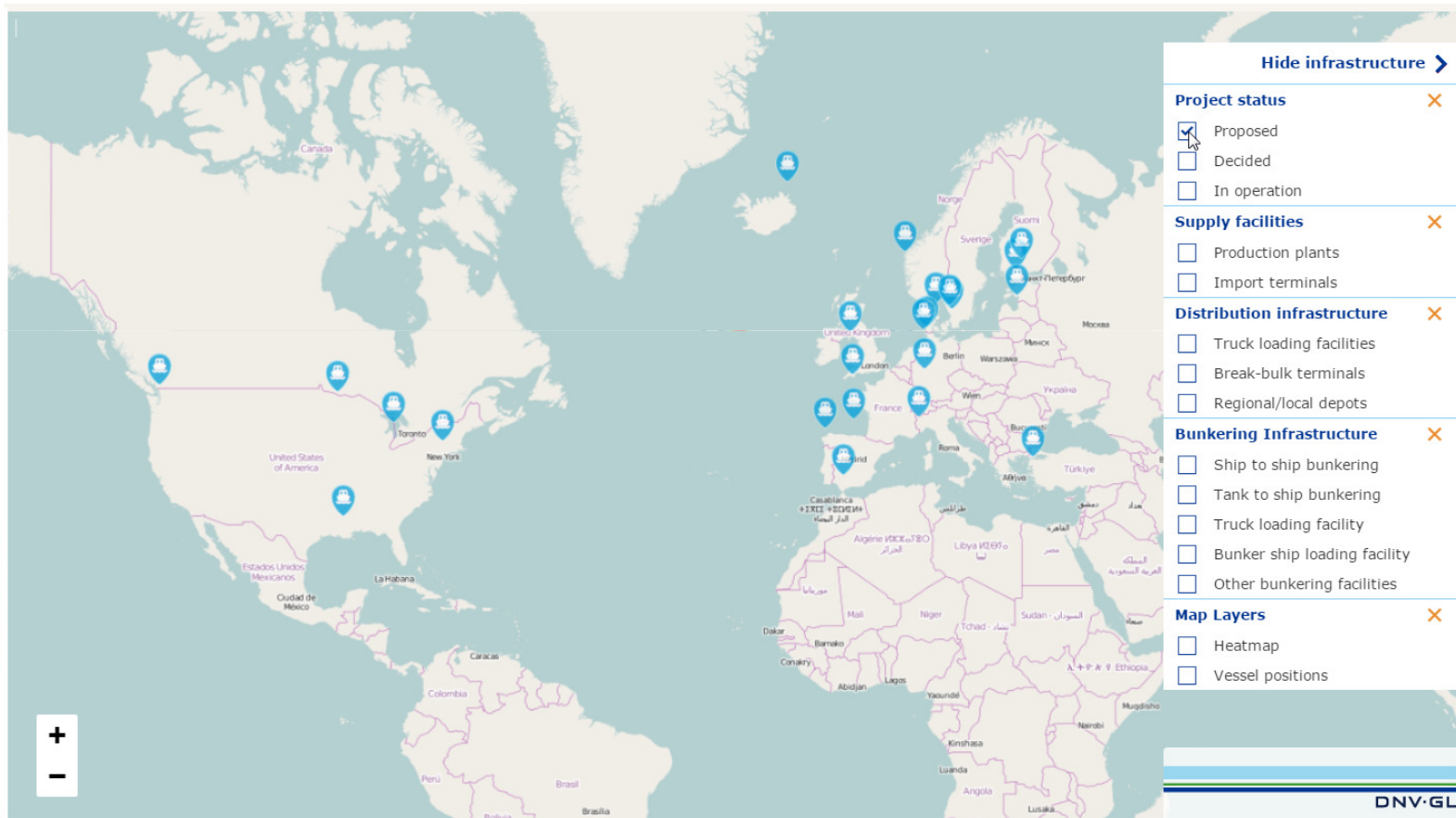


* The heat map and vessel positions are based on AIS data from 01.01.2016-11.01.2016

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Shapshots of LNG Intelligence

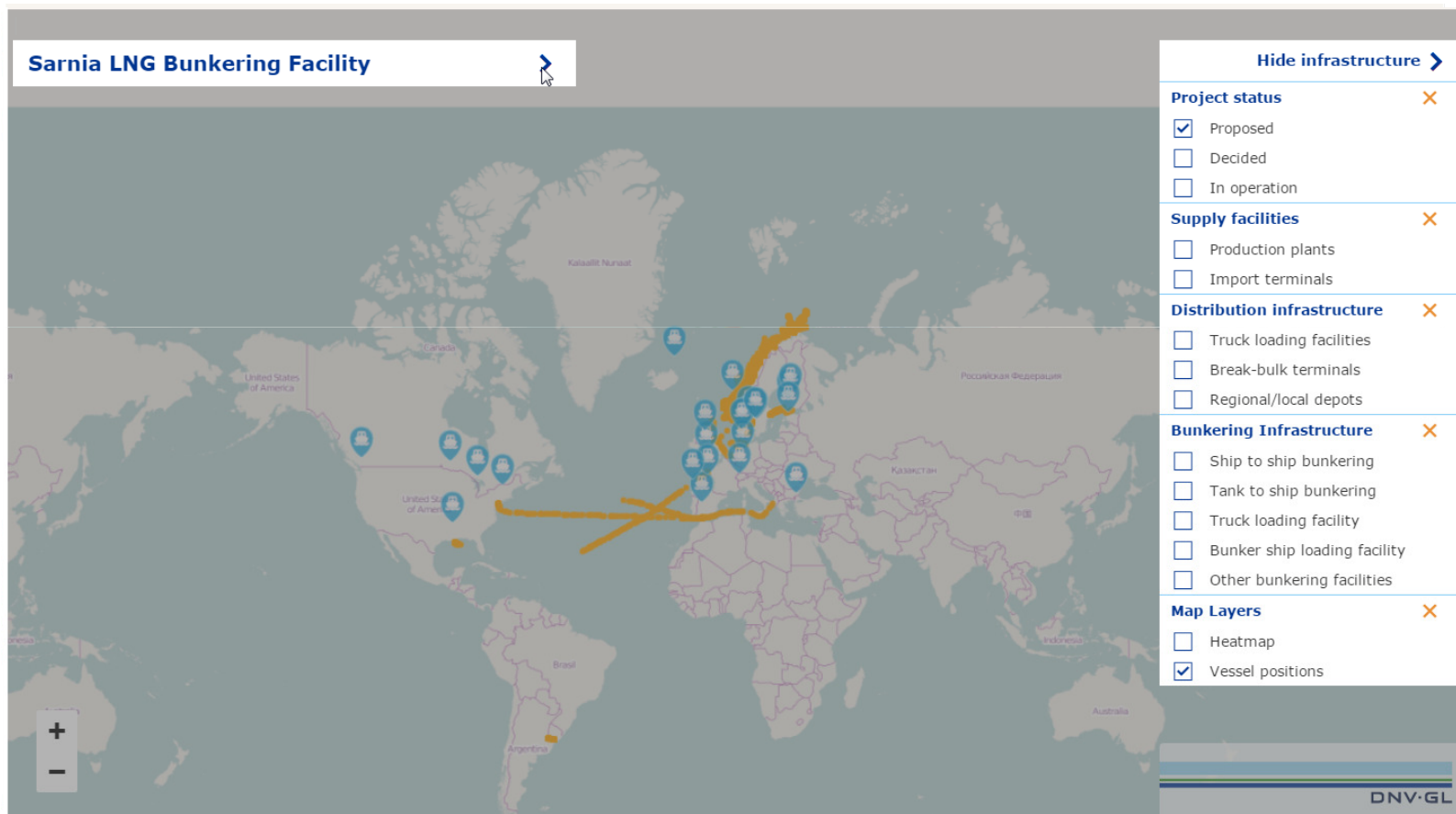
LNG Interactive map: Only proposed projects are shown by use of filter



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Shapshots of LNG Intelligence

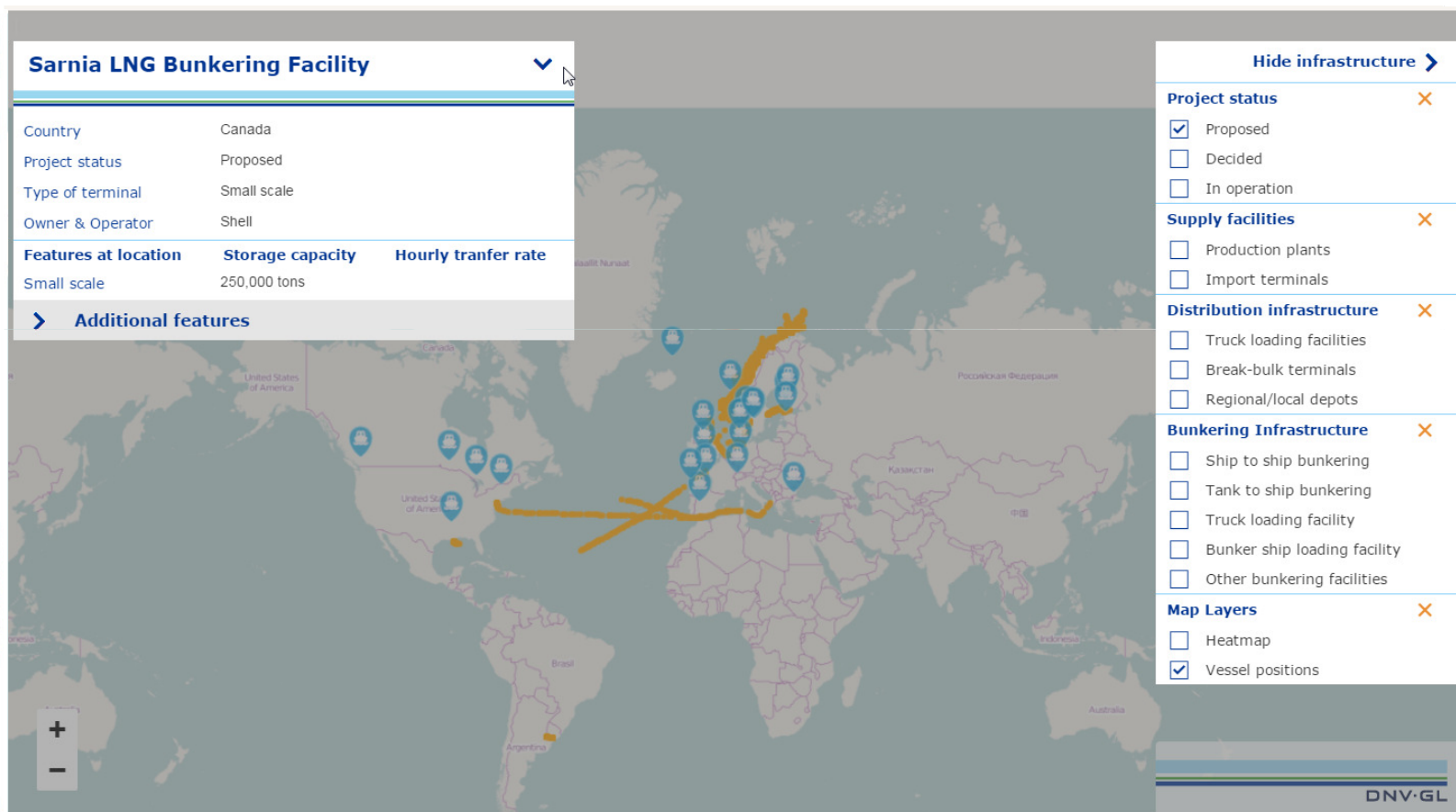
LNG Interactive map: By clicking the port icons, the name of the port is shown



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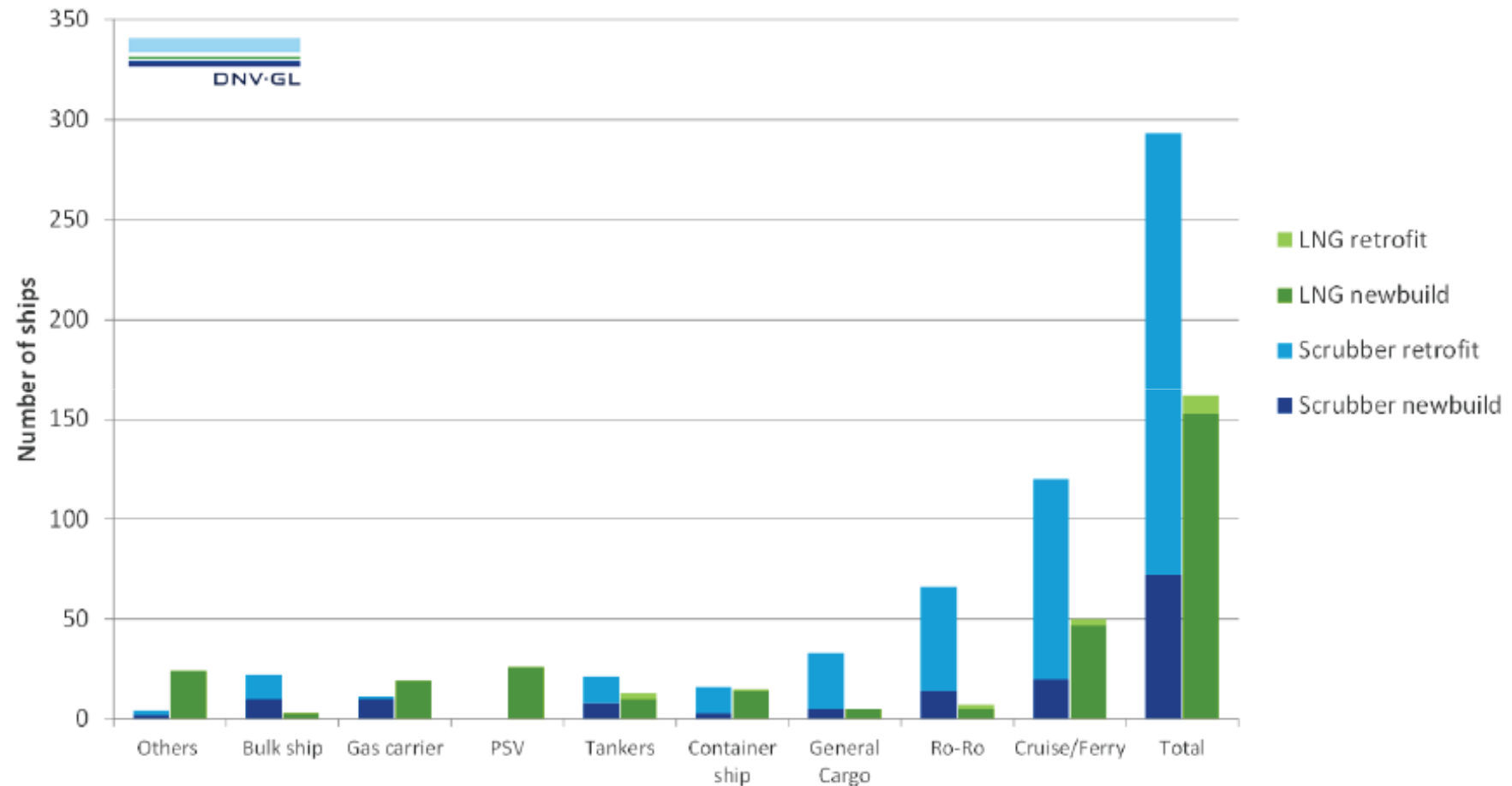
Shapshots of LNG Intelligence

LNG Interactive map: Port details in pop-up



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LNG fuelled vessels VS scrubber installations – development

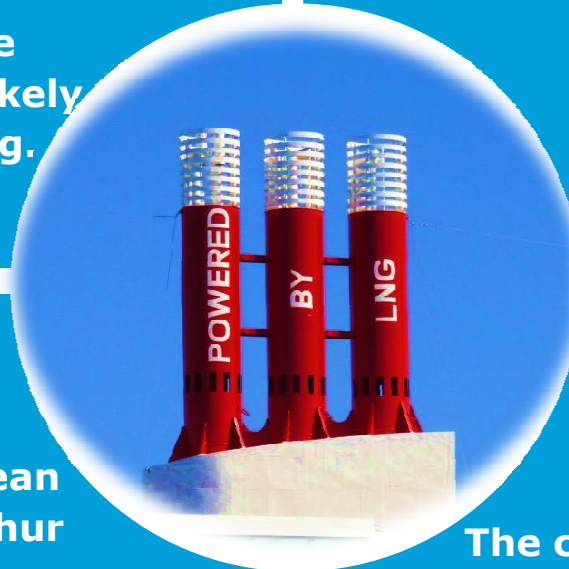


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Key takeaways - The perspective for LNG as a fuel still stays positive

- Increase in LNG production within next 5 years by approx. 40% (US and Australia coming online)
- This will keep the LNG price under pressure and most likely in world wide price levelling.

- The low oil price is delaying the market development
 - Bunker ships and first cargo vessels in Europe and US become available in 2016/2017. This will motivate followers



All projects for US and European market have to consider Sulphur reduction:

This creates interest in the Mediterranean and additional interest for round Europe trade

IMO IGF Code is in place reducing significantly any potential risk

The complete technology chain including 2-stroke engines from both large makers are now available come into operation. This will also motivate followers

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Thank you very much for your attention!

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SAFER, SMARTER, GREENER

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Interesting new vessel: Nor Lines 2 x Combined cargo vessels, mono fuel LNG

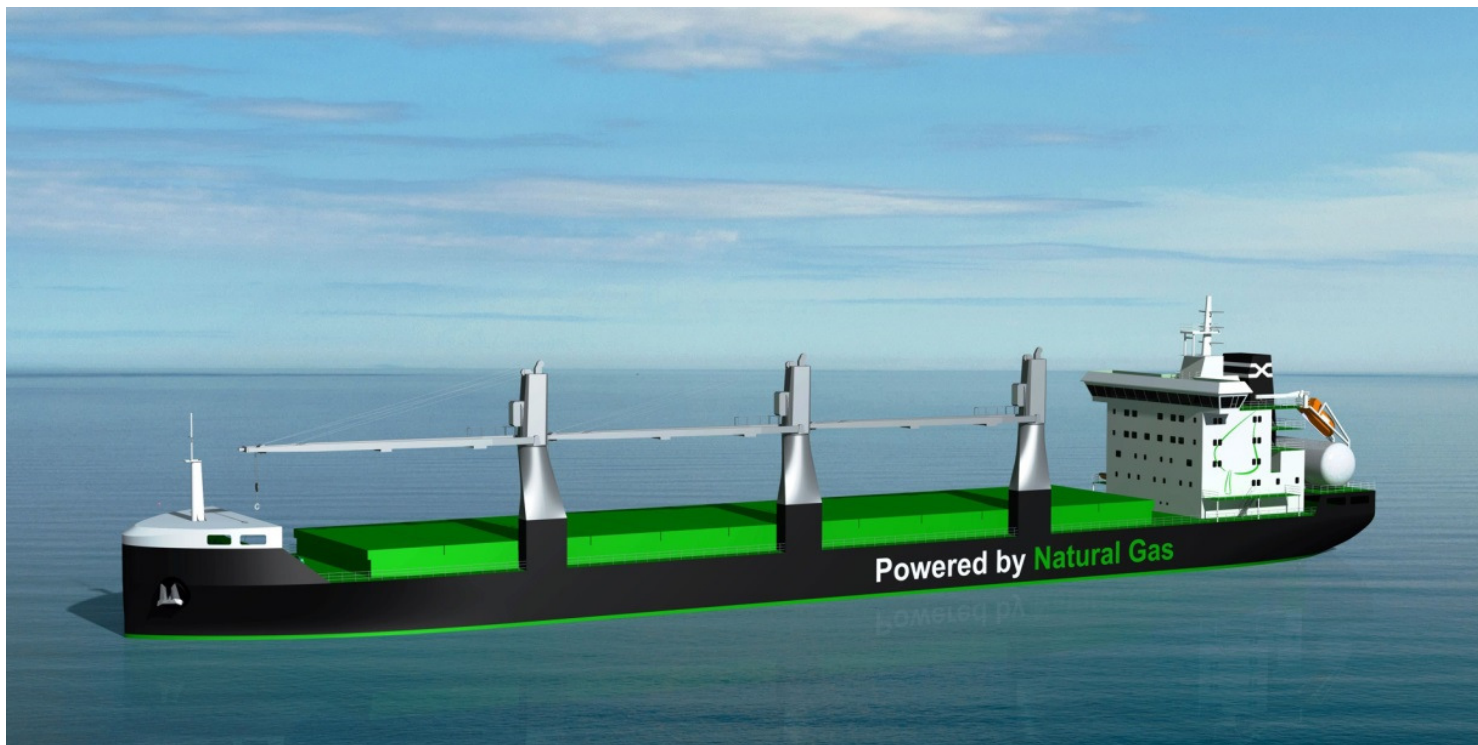
- First ship «Kvitbjørn» underway from Tsuji Yard in China to Norway (North Sea trade). Second ship launched in June
- Rolls Royce LNG engines and design, DNVGL Class
- Specially designed for coastal/short sea traffic, competing with trucks «Green Corridors»
- **Refuelled in India on her way to Europe (Kochi LNG terminal)**



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The world's first LNG Handysize bulk carriers

The two B.Delta26LNG vessels will be constructed for the Finnish shipowner ESL Shipping Ltd by the Chinese Qingshan Shipyard of Sinotrans & CSC SBICO.



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First LNG Powered Cruise Ships

6,600 Passengers – Carnival Orders Record Setting LNG-Powered Cruise Ships



File photo: [Shutterstock/Leonard Zhukovsky](#)

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LNG Fuelled Kamsarmax Bulk Carrier (Oshima & DNV GL)



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The innovative Oshima solution – vessel design

Key challenges:

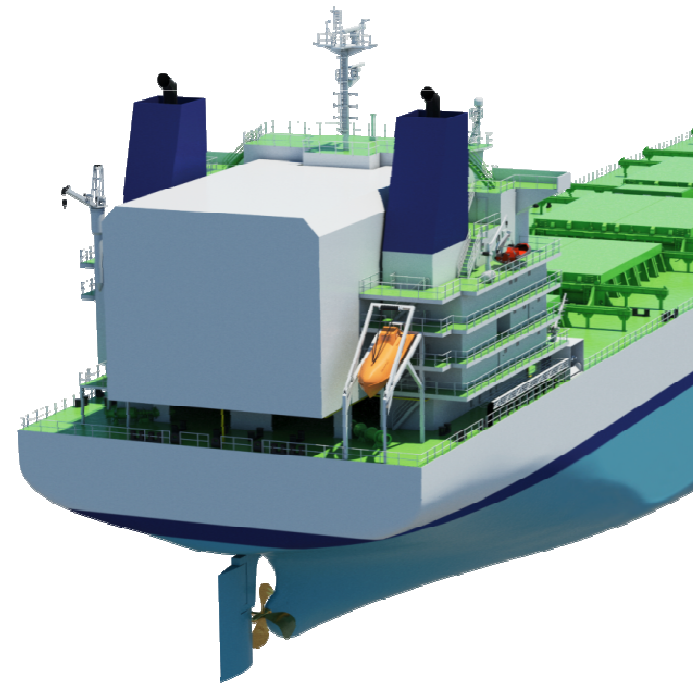
- Keep the same cargo capacity
- Limited space on deck
- Accommodate up to 3,000m³ of LNG

Solution:

- Unique U-shaped superstructure
- LNG tank protected by a steel cover forming a box which is part of the hull structure and provides additional safety

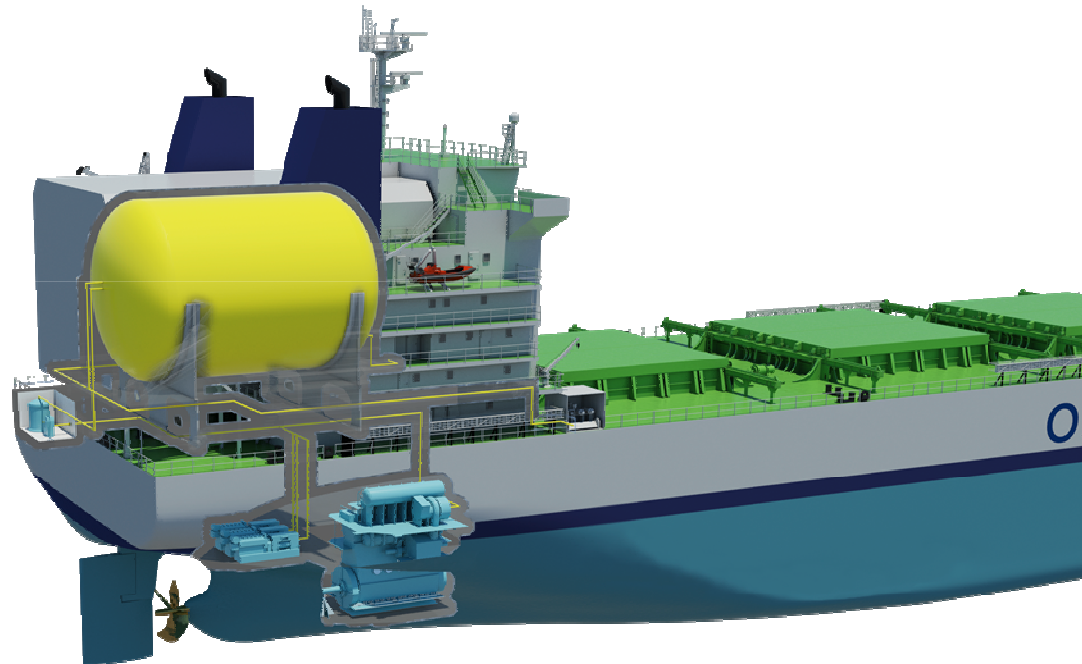


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LNG system installation on board

- Both LNG tank type C and type B can be installed in the same dedicated space
- Can accommodate any LNG volume requirement up to about 3,000 m³ by type-B tank installation
- Also the arrangement is suitable design for retro-fit after the delivery.
- Requesting patent application



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Brodosplit builds four LNG-fuelled container ships with DNV GL class



Croatian shipbuilder Brodosplit has committed to build four LNG-powered container vessels to DNV GL class. The 2,000 TEU vessels were ordered by Brodosplit Shipping Company and are planned to be used for long-term charter. The steel cutting ceremony was celebrated in Split recently and the first of the four ships is scheduled for delivery in November 2017.

"By building these ships we enter a market niche that will enable sustainable business operation, bigger engagement of capacities and acquisition of references for building of ships that will be in higher demand in near future," says Tomislav Debeljak, CEO of Brodosplit and owner of Brodosplit Shipping Company.



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