

LNG AS A MARINE FUEL

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Shell
LNG
FUELLING THE FUTURE

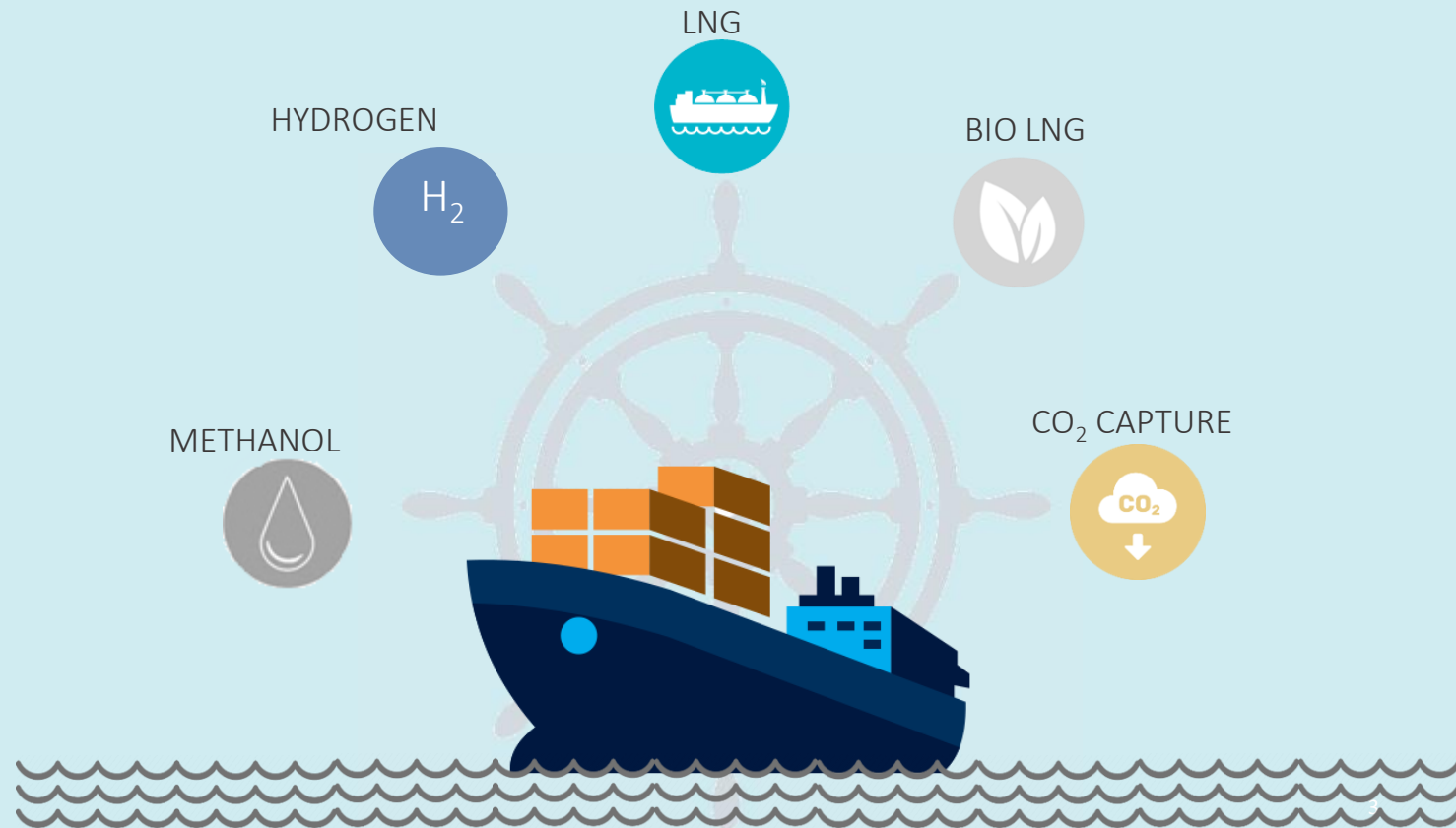
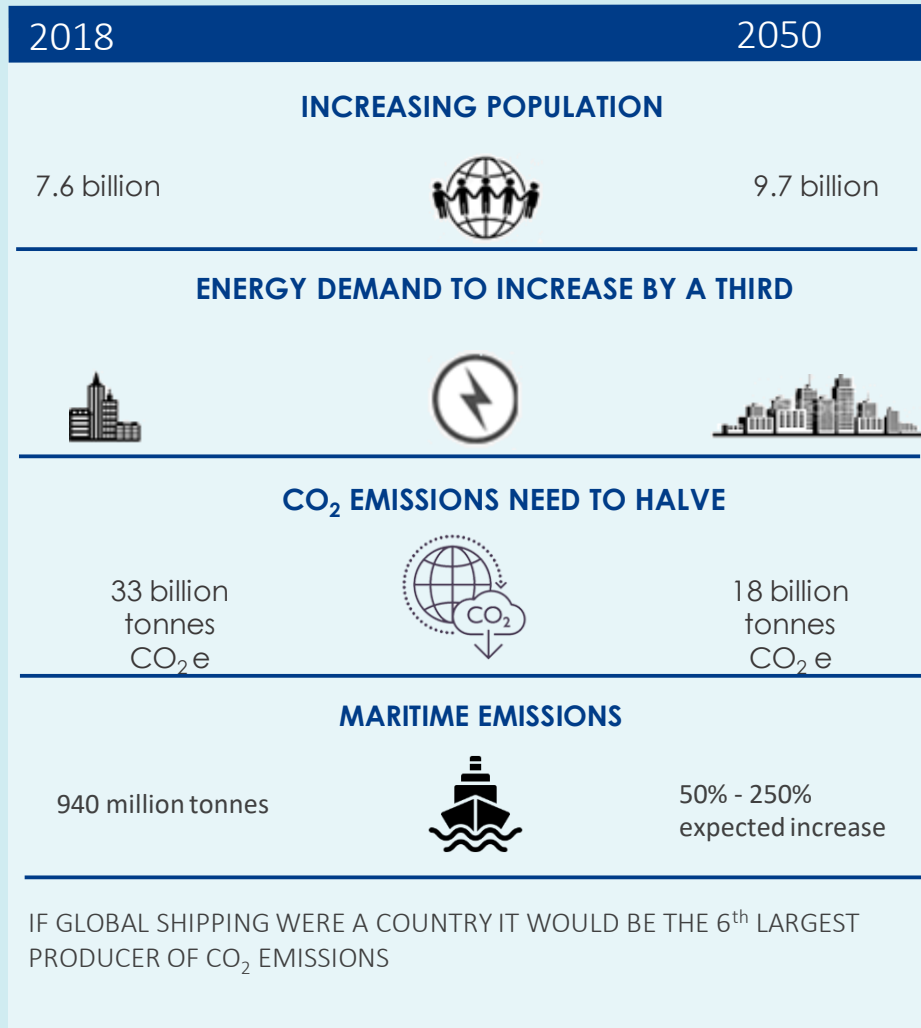


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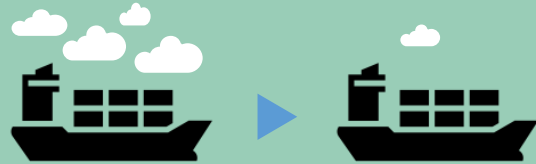
Need for multiple solutions

Scale and complexity of the energy challenge requires a variety of cleaner energy solutions



LNG - A cleaner option vs conventional fuels

▼ 90%



Emissions of particulates from natural gas combustion are 90% lower



Natural gas emits virtually no sulfur dioxide, so using more natural gas as fuel could emit less pollutants

▼ 28%



LNG fueled vessels can reduce Greenhouse Gas (GHG) emission up to 28% (tank to wake)

LNG for Tractor



LNG for Marine



LNG for Industry



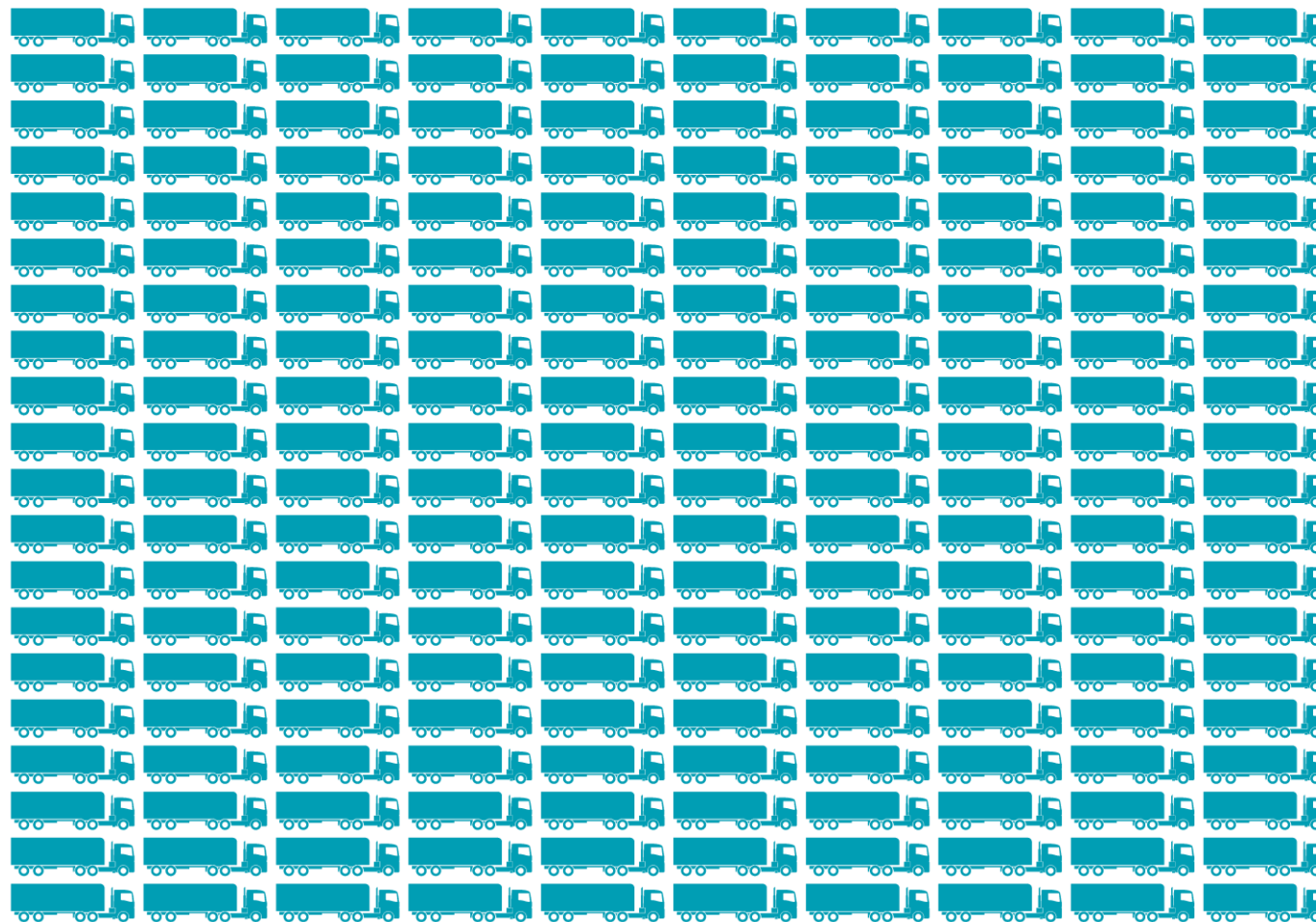
LNG for HWM



LNG for Railway



HOW LNG FUEL CAN REDUCE EMISSIONS IN SHIPPING

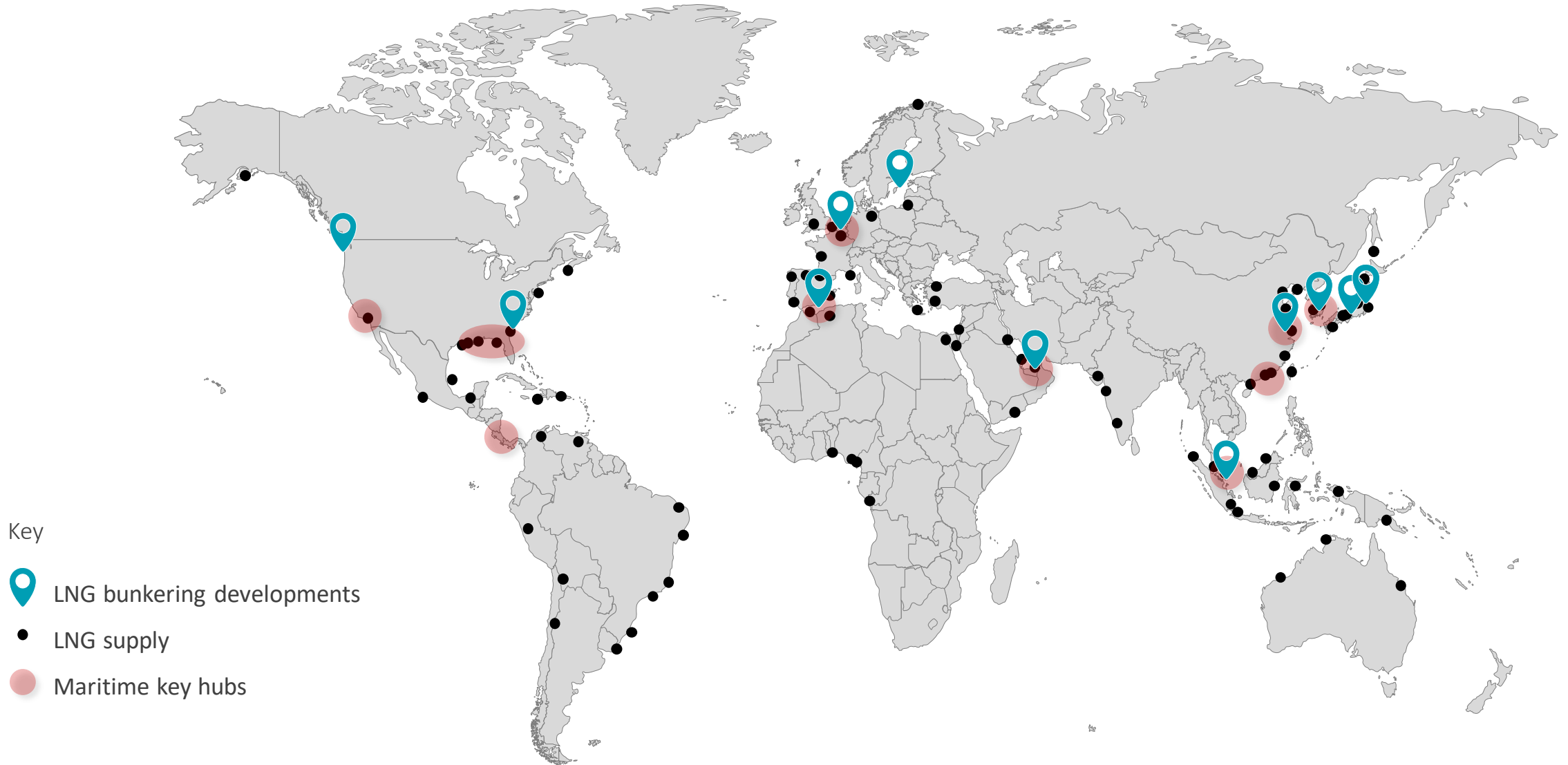


Equivalent to **200 trucks** removed from the road for a single ship

*One example of emissions reduction using one supply chain scenario and one medium-large engine, >1 MW. Higher or lower engine efficiency and supply chain emissions impact WtW savings proportionally. Unburned methane in the exhaust (methane slip) has higher GHG impact than fuel completely combusted to CO₂.

Source: Shell SR.13.11731. Truck comparison calculation based on data from EIA for CO₂ values for diesel and from information from American Clean Skies, MJ Bradley relating to fuel consumption for trucks and ships.

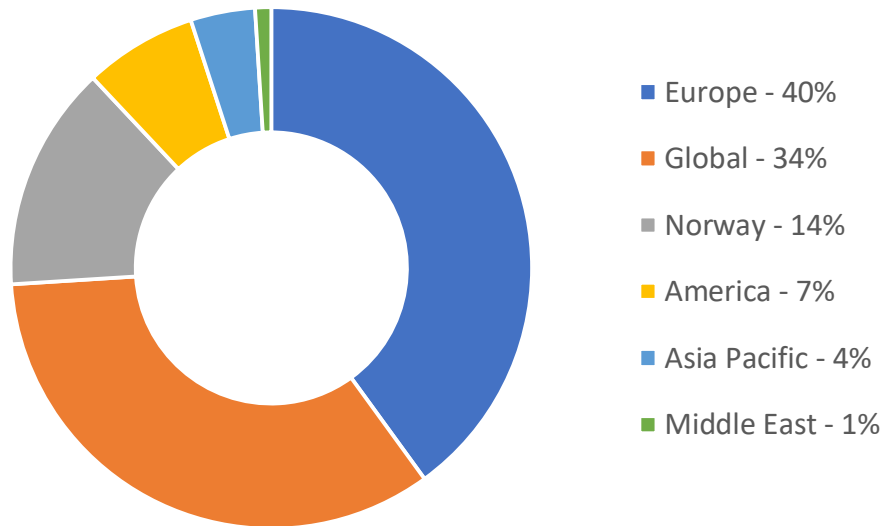
LNG fuel is available in 150 global locations and overlapping with key maritime hubs



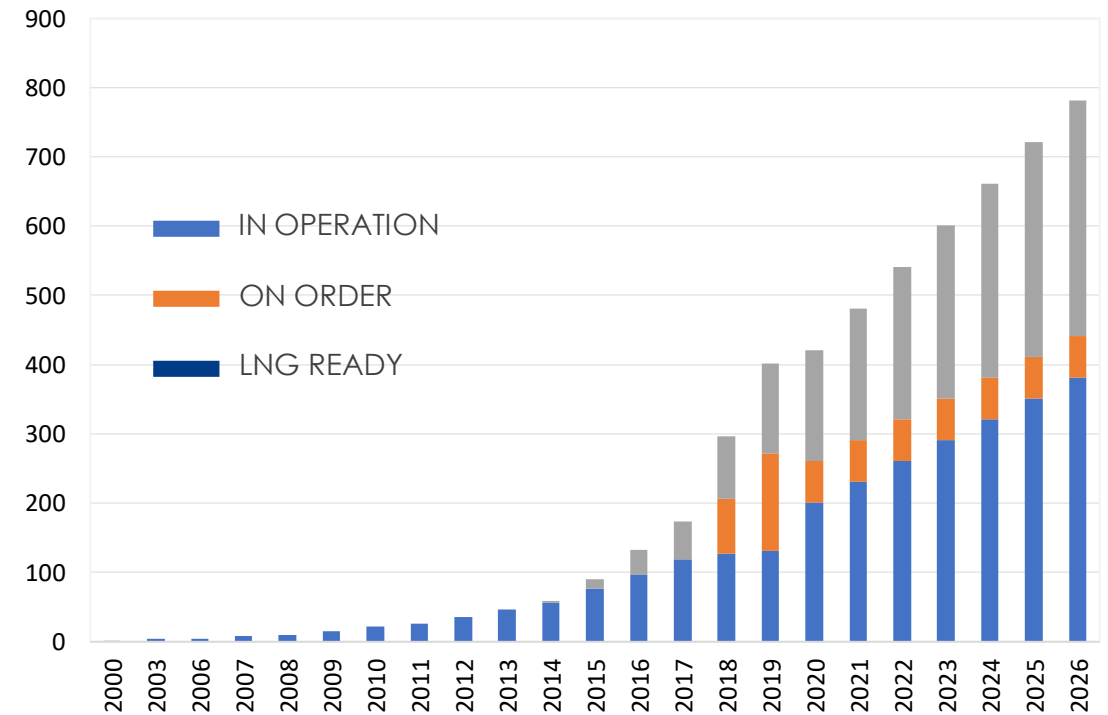
Take up of LNG vessels is growing - the IMO 2020 transition provides opportunities for future growth

- Operating area of vessels on order

- Currently 131 LNG-fuelled vessels operating globally, with 140 more in the order book
- Over 131 'LNG Ready' vessels either on the water or on order

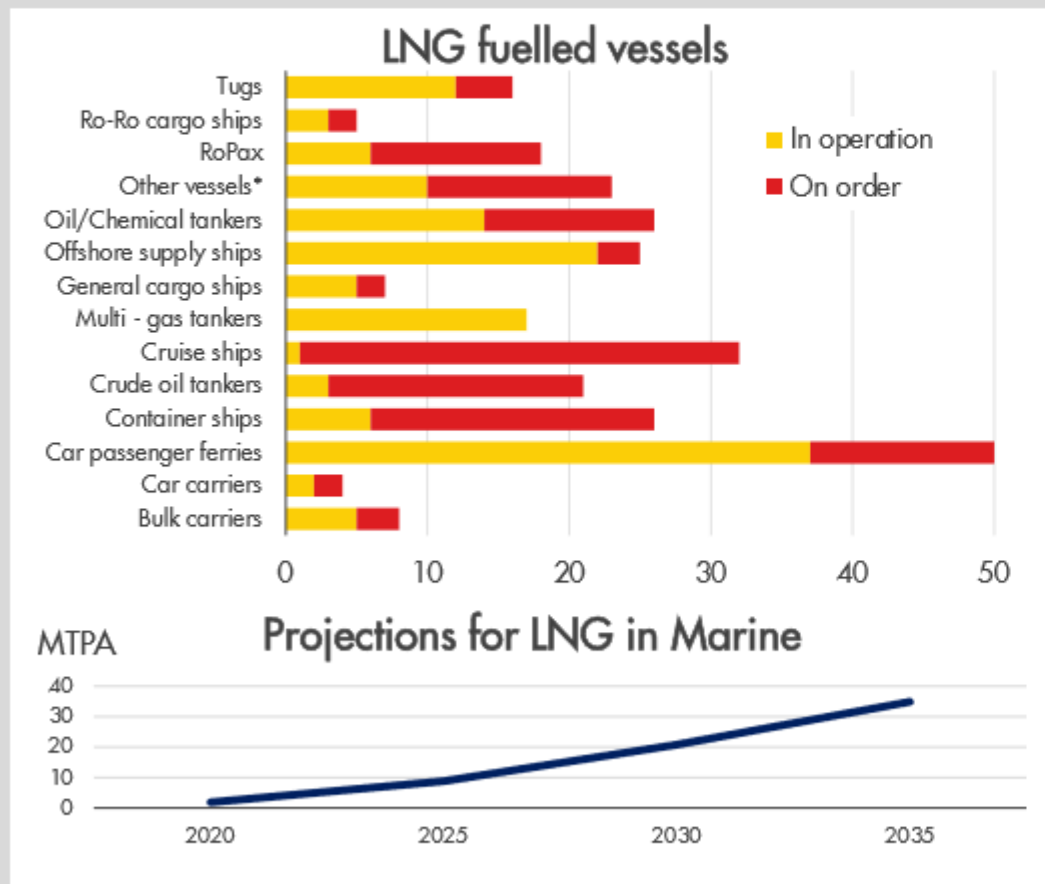


of Vessels



Source: DNV GL, 2018

Marine LNG poised for growth



Source: Shell interpretation of DNV-GL & Woodmac *Other vessels includes fishing vessels, dredgers, etc.

2018

QUARTER 1

Mitsui OSK order LNG bunker barge to serve Total-CMA-CGM deal



World's first LNG-fuelled bulk carrier charter delivered



Carnival orders 9th LNG fuelled Cruise ship



QUARTER 2

Shell agrees to charter two LNG powered tankers from AET



MPA awards grants for two LNG bunker barges for Singapore



QUARTER 3

First Japanese LNG bunker vessel ordered



Hapag Lloyd announces it will convert a container vessel to operate on LNG



QUARTER 4

Crowley takes delivery of second LNG-powered container/roll on-roll off (ConRo) ship



Bunkering of the first LNG fuelled Aframax tanker by Shell Cardissa



H-Line Shipping ordered two LNG fuelled bulk carriers



World's first LNG powered cruise ship sets sail



Kairos, the 7,500 m³ bunker vessel started operations



Adnoc and Inpex sign agreement to explore LNG bunkering opportunities in UAE



Public Gas Corp of Greece signed a grant agreement with EU for construction of the first LNG bunkering vessel





Containerships London



1st LNG-powered oil tanker

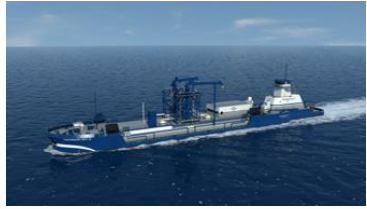


LNG Car Ferries



Bunkering to Cruise @Barcelona

Shell is investing in LNG bunkering infrastructure



- LNG Bunker Barge
- 4,000 m3



- Cardissa
- 6,500 m3



- LNG London
- 3,000 m3



- Coral Methane
- 7,500 m3



- Pioneer Knutsen
- 1,000 m3



- FueLNG (Shell/Keppel)
- 7,500 m3



“A historic moment for Shell”



Shell has [signed an agreement](#) with Qatar Petroleum to increase the availability of LNG as a marine fuel. The joint venture will develop LNG bunkering infrastructure in key ports worldwide covering high-traffic shipping lanes.

Bunkering Models from Gasnor (Norway)



Bunker from semitrailer



Ship to ship bunkering



Bunker from terminal

LNG is part of the pathway to cleaner shipping



LNG fuelled
engine

up to **28%**
GHG saving (tank to wake)

↓ ~100% SO_x

↓ ~99% PM

↓ ~95% NO_x

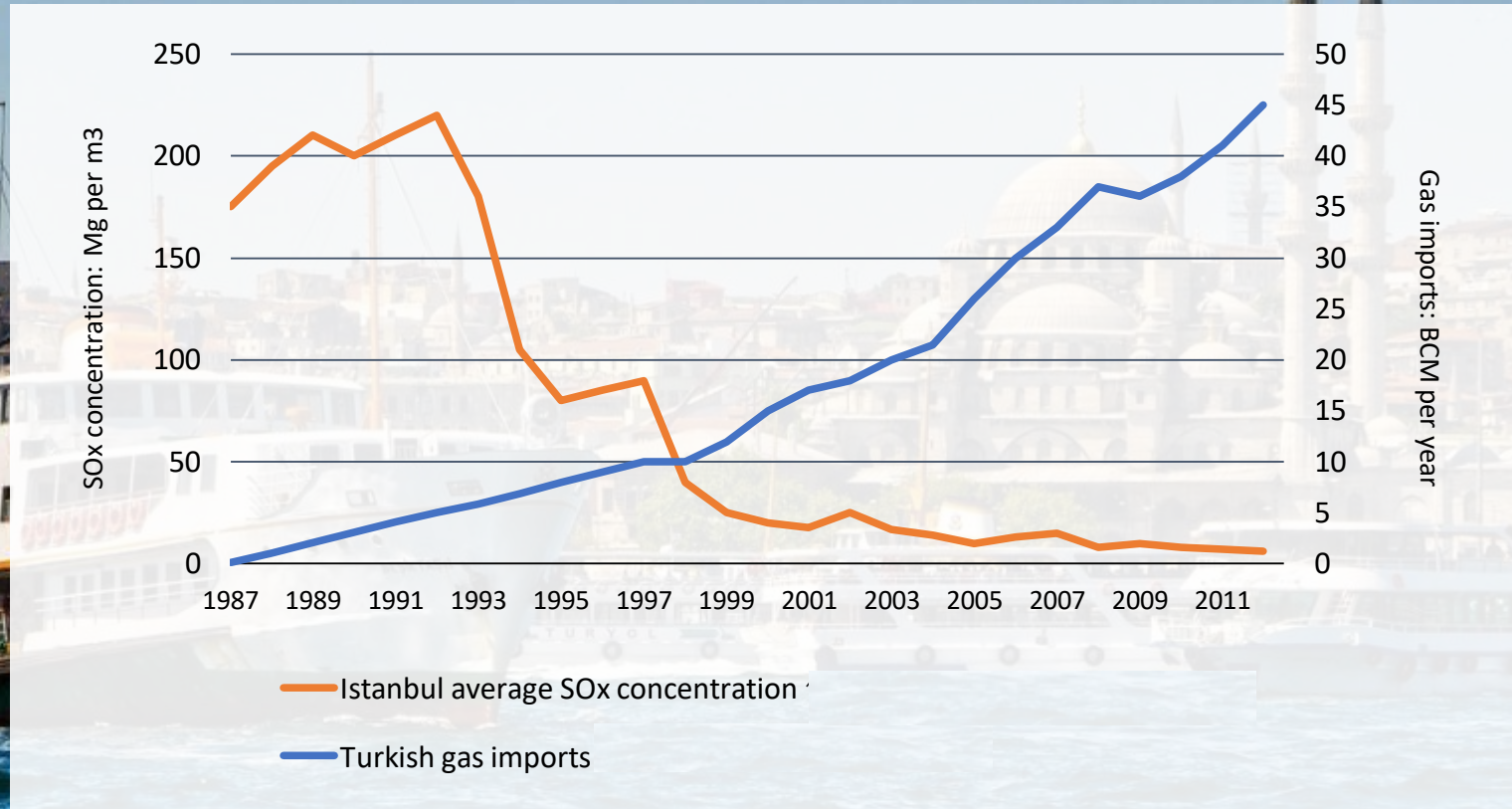
BioLNG

Blending just 20% =
41% GHG saving

- Leveraging existing infrastructure
- Worldwide availability
- No regret costs

Natural Gas can help improve air quality

Istanbul air quality and gas consumption



Source: International Gas Union case study, University of Oxford Turkish energy market study

LNG, Türkiye'de Denizcilik Sektörüne maliyet avantajı ve Hava Kalitesinin gelişimine de katkı sağlayacaktır

- Yeterli LNG ürün bulunurluğu (2 FSRU & 2 Kara Terminali)
- LNG ikmal ve dağıtım ağı ile 2.000'in üzerinde sanayi tesisinde kullanılması
- Tersanelerimiz'in Türkiye'de LNG ile çalışan gemi üretim tecrübeleri
- Yetersiz Talep (Yurtiçi ve Uluslararası müşteriler)
- Yurtiçi Kullanımı Geliştirecek Mevzuat (Yakıt Alım Defteri ile ÖTV muafiyeti)



THE GLOBAL MARITIME REGULATORY ENVIRONMENT IS CHANGING

EMISSION CONTROL AREAS ARE INCREASING IN NUMBER AND STRENUOUSNESS

- 
- 0.5% global limit (MARPOL, 2020)
 - 0.5% EU Sulphur Directive limit (2015)
 - 0.1% Emission control area limit (2020)
 - 0.5% local limit (Hong-Kong, China)*
- * Note that Hong-Kong, China can go down to 0.1% before 2020

In April 2018, IMO gave a clear signal of the industry's commitment to reduce GHG emissions from international shipping: GHG emissions to peak and decline asap and to **reduce** the total annual **GHG emissions** by at least **50% by 2050** compared to 2008 while pursuing efforts towards phasing them

Other regulations

- Neca zones and Nox Tier III regulations expected
- Open loop scrubber ban in Singapore, China (ECA) and Fujairah

Other countries with bans or restrictions: India, Belgium, Germany, Norway, Hawaii and California