

A background image of a sailing ship with three masts and white sails, set against a light blue sky and white water.

DUAL Ports LNG workshop II:
New and greener fuels in shipping and ports –
Opportunities and challenges.

Various ways of propulsion, multiple sources

Bart Kuipers
Erasmus Centre for Urban, Port and Transport Economics





Flettner rotor



Wing sails



DynaRig

ECOLINER, design Dykstra Naval Architects



Kites

Source:
DNV GL

Flying Fish


HYDROFOIL CONSULTANCY

- Integrated system design
- Hydrofoil control and simulation
- Engineering
- Modelling and optimisation with our flight simulator (HOST)





[Mission](#) [Vision](#) [Solution](#) [Insights](#)

A large cargo ship is shown from a side-on perspective, moving across a body of water. The ship's deck is filled with numerous intermodal containers. Several containers are blue and feature the "SKOON" logo in white. Other containers are red, green, and white. A blue container with the "DAMEN" logo is also visible. The ship has a white superstructure with a bridge. In the background, a city skyline with various buildings and a bridge is visible under a clear sky.

Accelerating the Energy Transition Through Sharing Batteries

First Skoonbox introduced

Dutch shippers start large biofuel test with Maersk

SUSTAINABILITY

A group of large Dutch multinationals and Maersk have started a large biofuel test in container shipping. Maersk will ship a Triple-E container ship from Rotterdam to Shanghai and back on a sustainable biofuel. This saves 1.5 million kilos of CO2 and 20,000 kilos of sulfur during that journey.



CMA CGM conducts first test with biofuels

SULPHUR CAP

This month, the CMA CGM shipping company is conducting an initial test with a container ship that is partly powered by bio-fuel. According to the company, the test in collaboration with Ikea is an important step towards making the polluting shipping sector more sustainable



CMA CGM orders more LNG containerships

CLEANER SHIPPING

The French shipping company CMA CGM has placed a new order for LNG-powered container ships. To this end, the company signed an agreement with Chairman Lei Fanpei of China State Shipbuilding Corporation, who is visiting France this week with Chinese President Xi Jinping.



Tobias Peiffers, March 26, 2019

Qatar focusus on armada of more than 100 LNG tankers

MEGAPROJECT

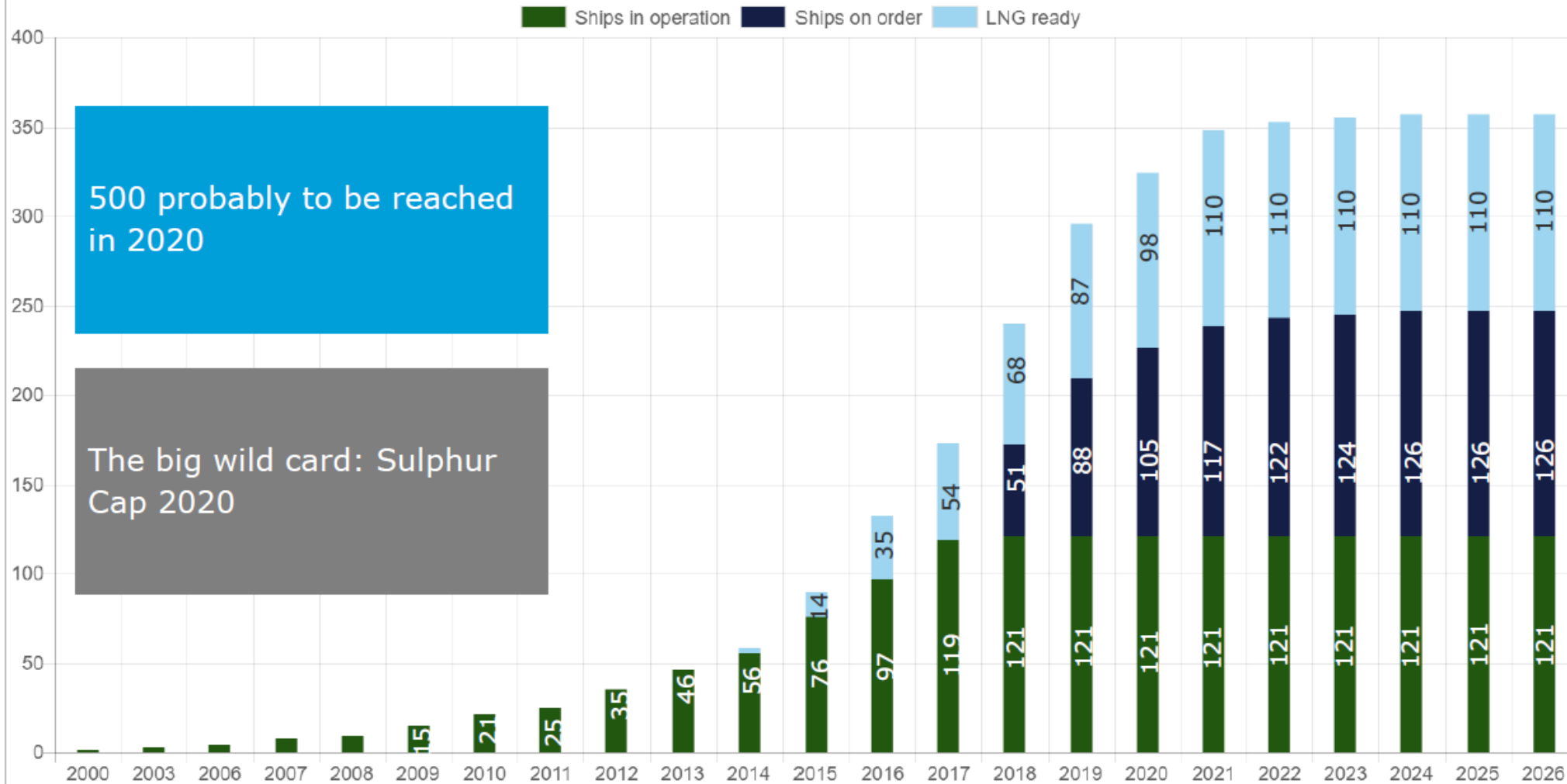
In the coming years, Qatar wants to have at least sixty and possibly more than a hundred new LNG tankers built in order to be able to significantly increase the export of liquefied natural gas.



Rob Mackor, April 23, 2019

There are currently 247 confirmed LNG fuelled ships, and 110 additional LNG ready ships

Yearly development of fleet



Updated 1 April 2018
Excluding LNG carriers and inland waterway vessels

2014 STATUS FOR LNG AS SHIP FUEL

DNV GL takes LNG ship fuel global



2018
Matson's 2 LNG fuelled container vessel will enter into operation.



2017
Crowley's 2 ConRo vessels will join TOTE's container vessels on the U.S. - Puerto Rico trade.



2013
Port of Antwerp contracts DNV GL to develop bunkering procedures, to ensure safe and efficient bunkering of LNG.



2011
Bit Viking is the first vessel to be converted to LNG fuel.



2013
The world's first bunker vessel SeaGas enters into operation fuelling the RoPax Viking Grace.



2013
Fjordline takes delivery of Stavangerfjord, the world's first ship with pure gas engines not deployed in domestic trade.



2014
Searoad orders a LNG-fuelled RoRo vessel, becoming the first ship to operate with LNG in Australia in 2016.



2013
López Mena is the first LNG-fuelled vessel deployed outside Norway, and set a world speed record with 58 knots.



2013
UASC demonstrates that LNG fuel is also an option for mega container vessels and orders 17 LNG Ready vessels to DNV GL class.

LNG-FUELLED SHIPS IN OPERATION

AIS plot of operation January to April 2014.

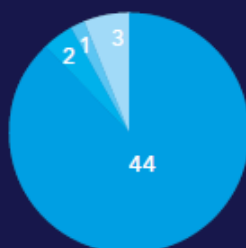


LNG-fuelled ships

1000
LNG-ships

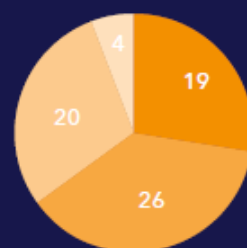
50 LNG-fuelled ships in operation

■ Norway
■ Europe
■ America
■ Asia & Pacific



69 LNG-fuelled ships on order

■ Norway
■ Europe
■ America
■ Asia & Pacific



Per 01.09.2014

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2020

LNG Ready ships

Ships on order

Ships in operation

2014 STATUS FOR LNG AS SHIP FUEL

DNV GL takes LNG ship fuel global



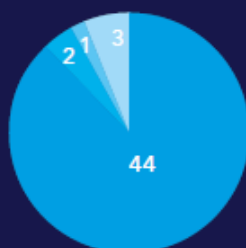
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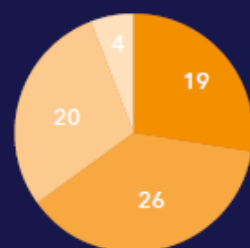
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AIS plot of operation January to April 2014.



LNG-fuelled ships



1000 LNG-ships

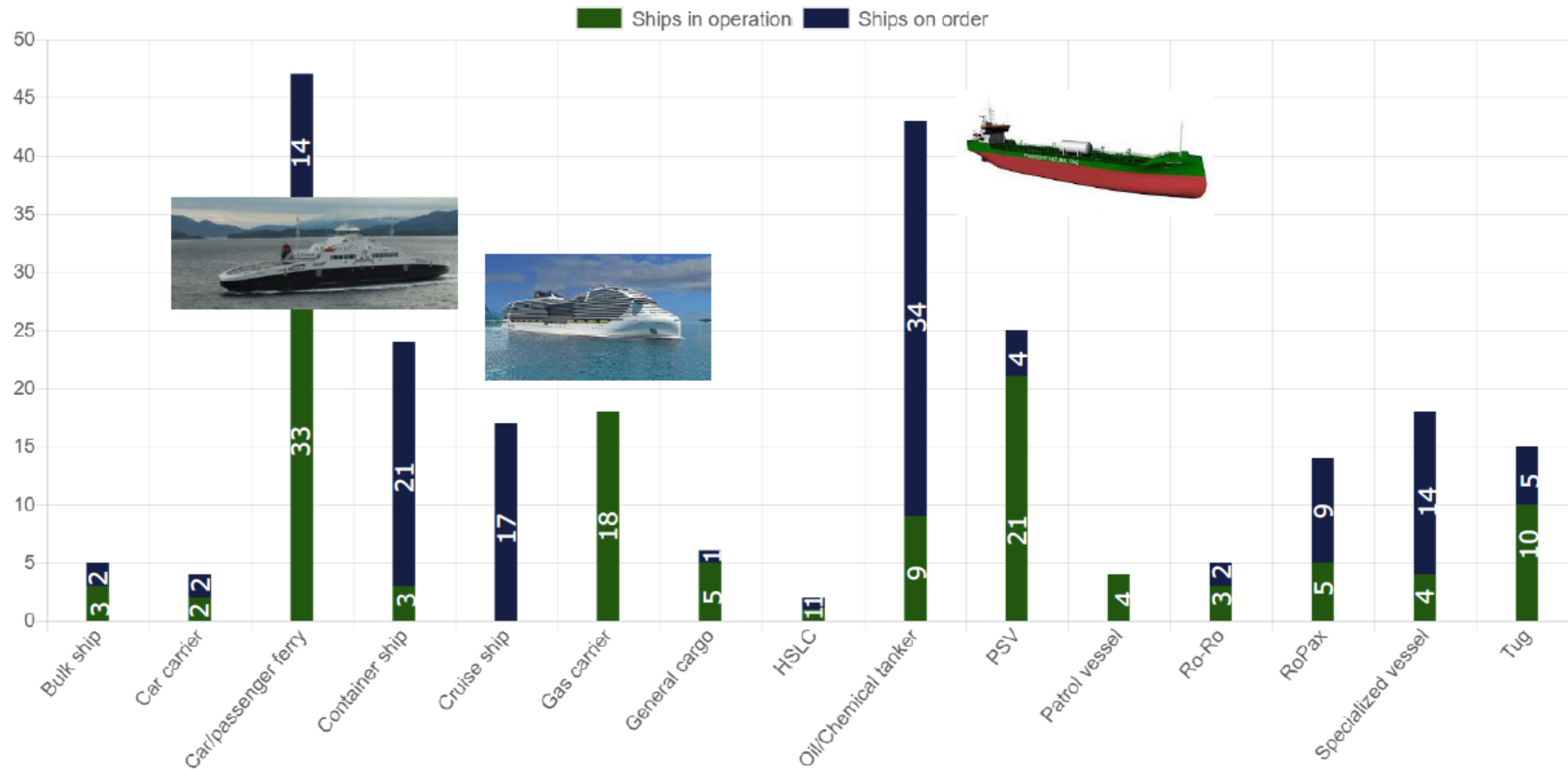
On order/
construction

In operation

Source:
Le Fevre,
2018

LNG uptake by vessel segment

Fleet by vessel type



Updated 1 April 2018
Excluding LNG carriers and inland waterway vessels

PARIS

2015

A silhouette of a person with their arms raised in a celebratory gesture, standing between the large numbers '0' and '1' of the year '2015'. The person is positioned in front of a bright sunset or sunrise, which creates a strong backlighting effect. The background is a clear blue sky with some light clouds near the horizon.

FIGURE 1: SHIPPING BECOMES GREENER AND MORE COMPLEX

Selected items from regulatory timeline towards 2030

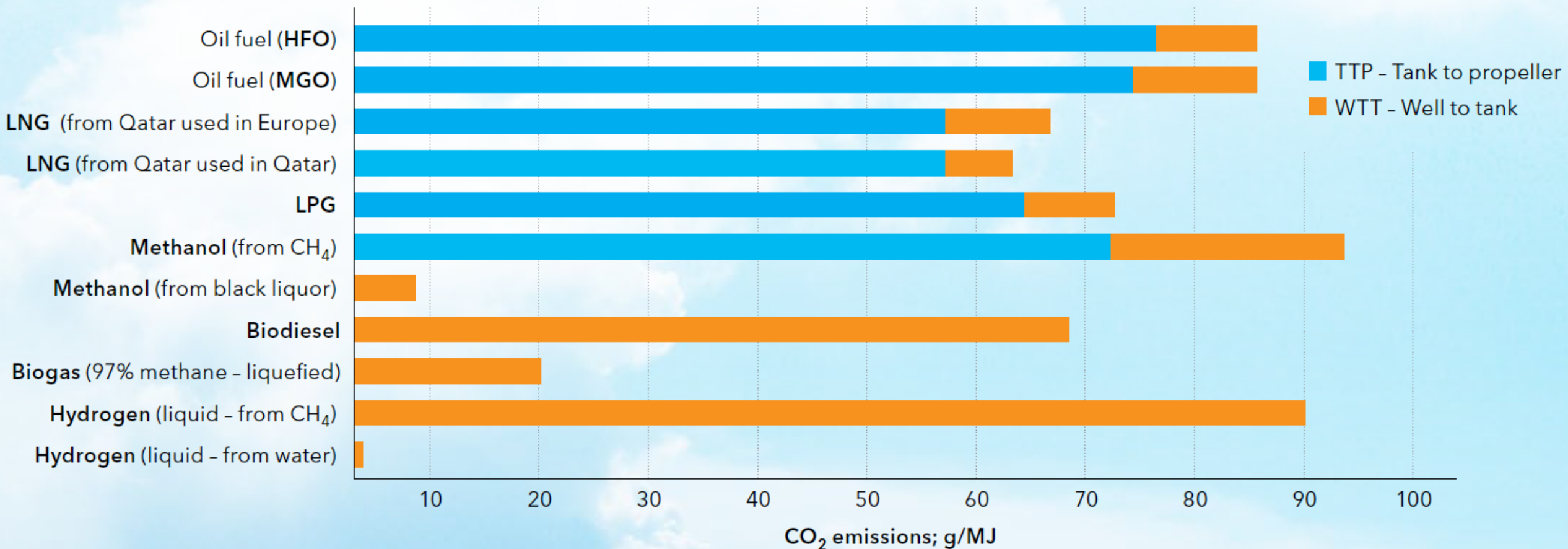


| FUEL OPTION | GHG EMISSIONS CHANGE (RELATIVE TO BASELINE) | ENERGY EFFICIENCY | FUEL SAVINGS (DEPENDING ON SHIP TYPE AND SIZE) | |
|---------------------------------|---|--------------------------------|---|-------------|
| | | | MAIN ENGINE | AUXILIARIES |
| Baseline: Switch to Low S Fuels | - | Hull Form – New buildings | 12-17% | - |
| HFO with scrubbers | +5% | Hydrodynamics – Retrofit | 13-20% | - |
| LNG | -20% | Machinery improvements | 4-8% | 12-23% |
| LPG | -17% | Waste Heat Recovery | 0-8% | - |
| Methanol (from Natural Gas) | +5% | Hybridization | 3-15% | |
| Biodiesel | -50% | Operational measures | 3-11% | - |
| Biomethanol | -50% | Cold Ironing | - | 30-70% |
| LBG (Liquefied Biogas) | -90% | Renewable Energy (Solar, Wind) | 0-10% | 0-2% |
| Electricity from renewables | -50% to -20% | Air Lubrication | 3-5% | - |
| Hydrogen | Depending on H ₂ production | CUMULATIVE PER VESSEL | 21-37% | |
| Nuclear | -99% | Speed reduction | Fuel savings depend on % of speed reduction. New vessels may have to be used to cover transport demand, therefore reducing the overall savings. | |

Table 2: List of Alternative Fuels and Energy Efficiency Measures and their expected impact.

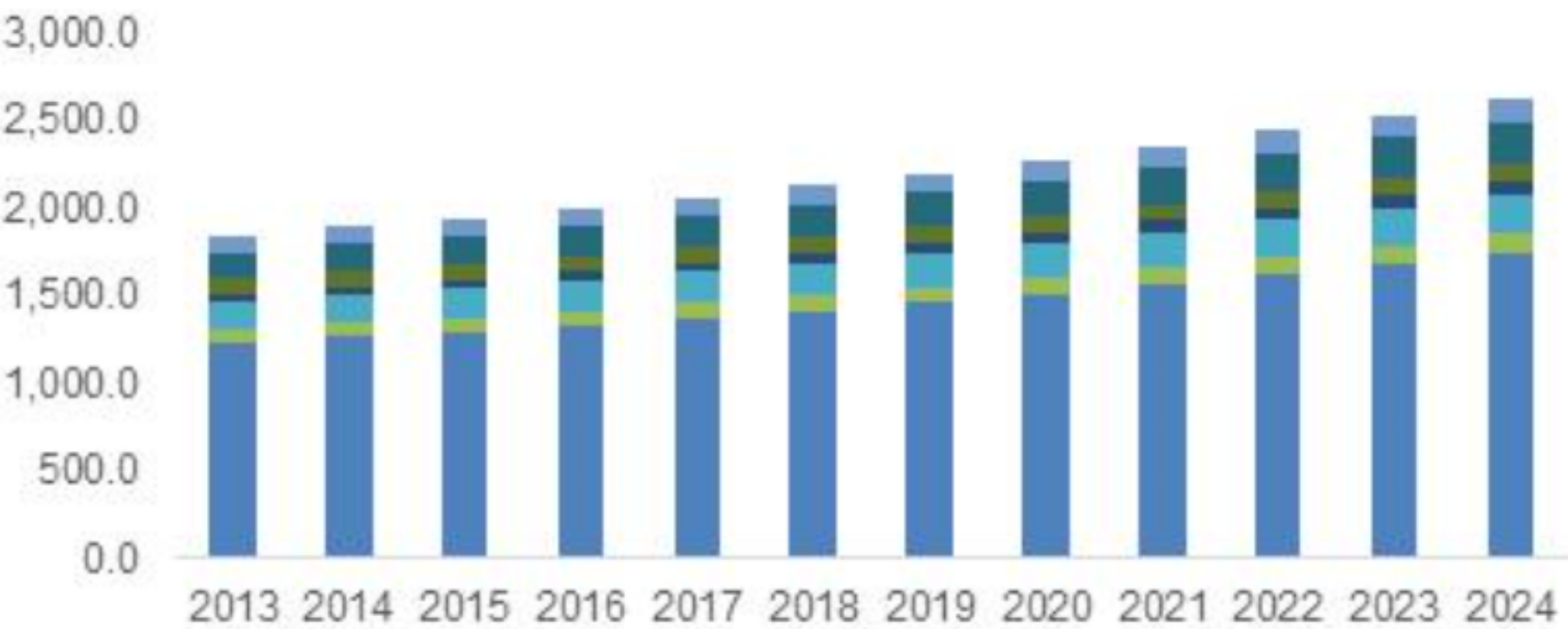
Source: DNV GL

FIGURE 3: CO₂ EMISSIONS OF FUEL ALTERNATIVES IN SHIPPING



Source: DNV GL calculations

Europe Marine Propulsion Engine Market size, by product, 2013-2024 (USD Million)



- Diesel Propulsion
- Gas Turbine Propulsion
- Steam Turbine Propulsion
- Wind & Solar Propulsion
- Fuel Cell Propulsion
- Natural Gas
- Others

Source: Global Market Insight

Fig. 15 Fuel mix for containership, bulk carrier/general cargo, tanker (crude) and tanker (product/chemical) fleet (%)

Source: LR / UCL

■ HFO
 ■ MDO/MGO
 ■ LSHFO
 ■ LNG
 ■ Hydrogen
 ■ Methanol

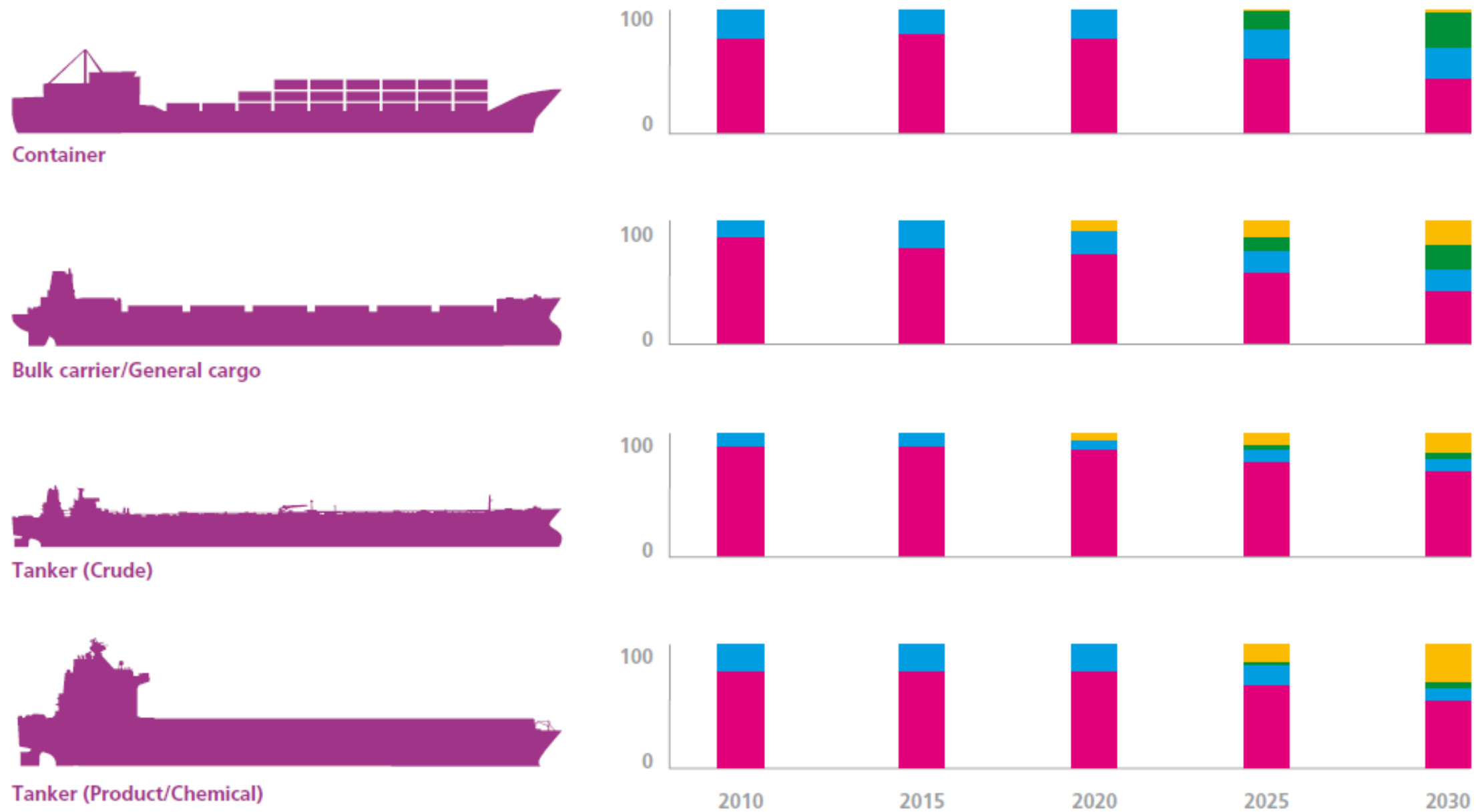
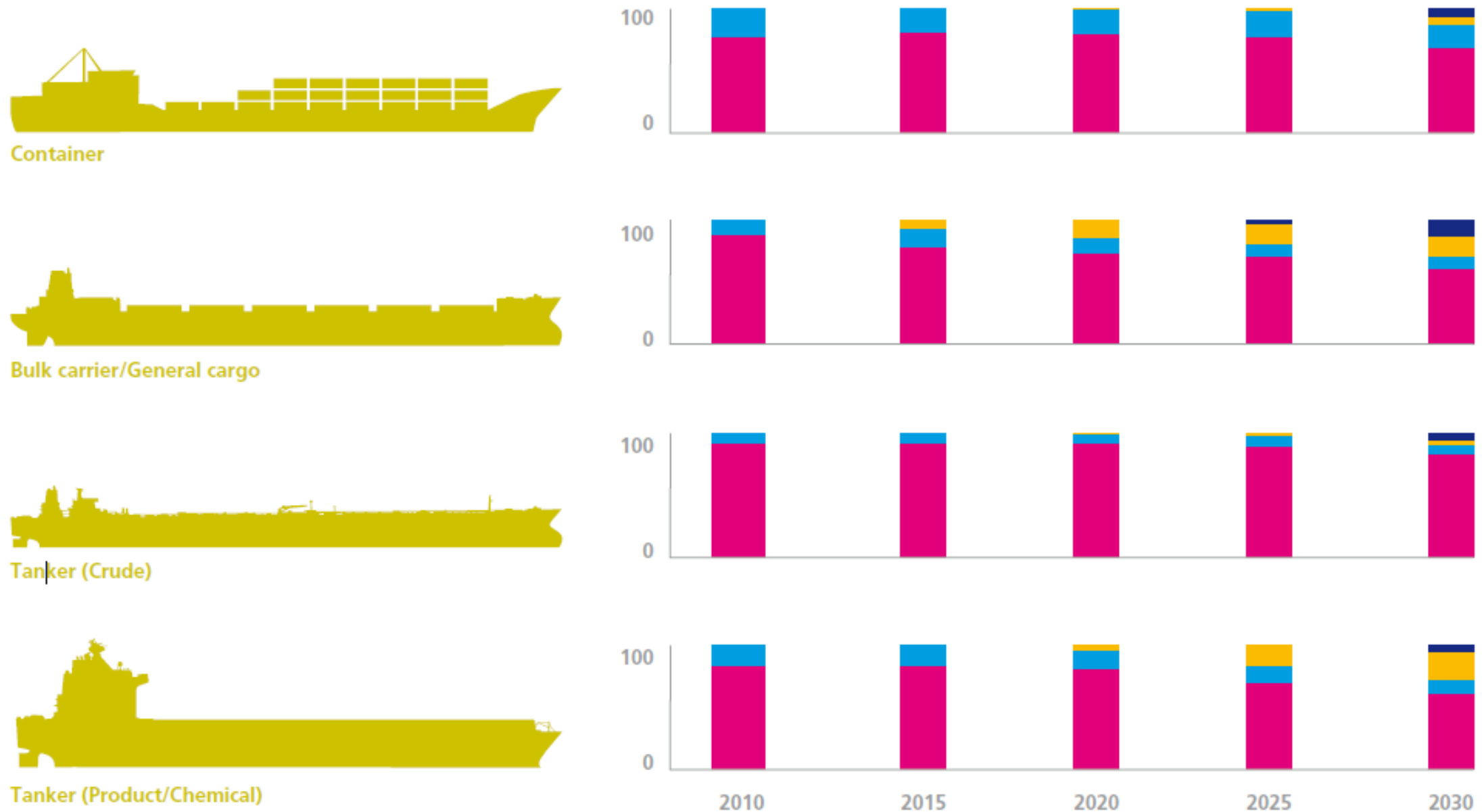


Fig. 17 Fuel mix for containership, bulk carrier/general cargo, tanker (crude) and tanker (product/chemical) fleet (%) **GLOBAL COMMONS**

Source: LR / UCL

HFO MDO/MGO LSHFO LNG Hydrogen Methanol

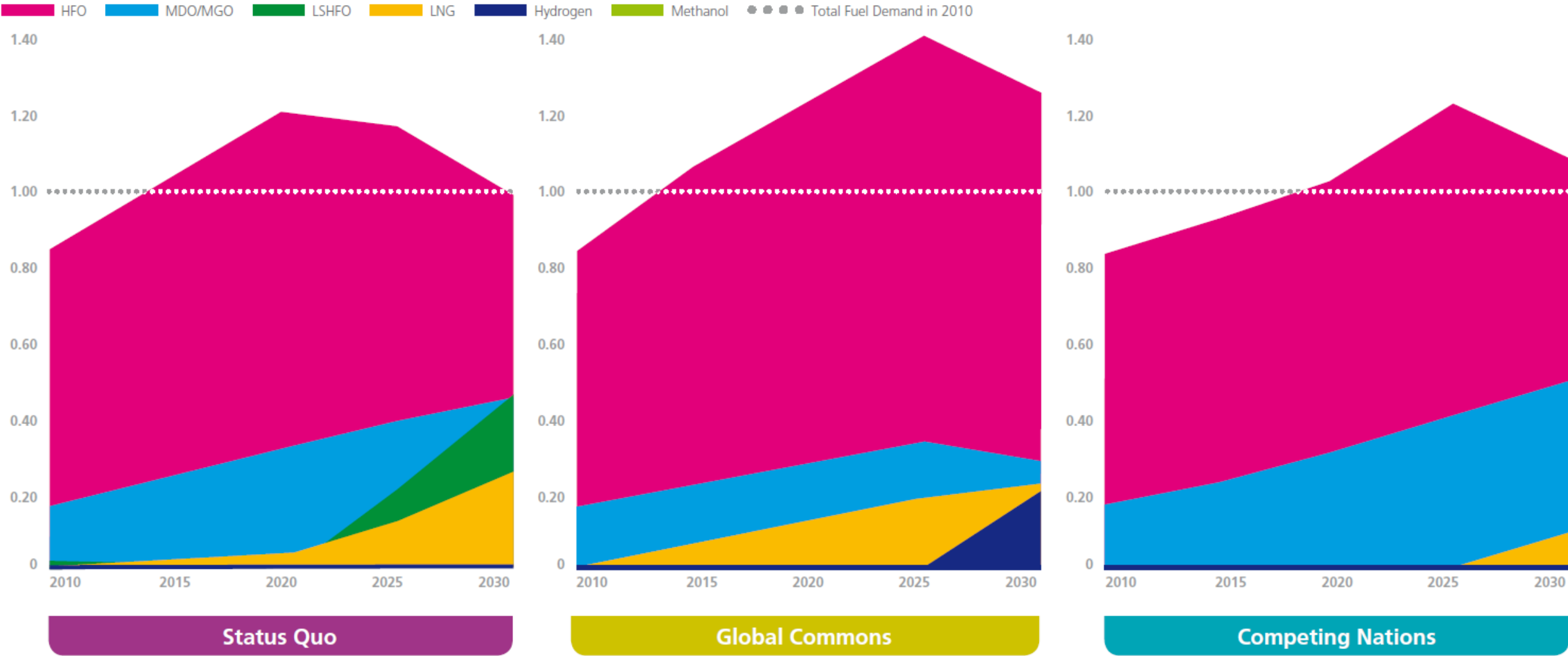


Tanker (Product/Chemical)

Source:
Lloyds

Fig. 24 Evolution of marine fuel demand, relative to the 2010 baseline for each fuel

Source: LR / UCL



Case study: scenarios for the use of LNG in inland shipping



Question:
Will LNG become the dominant fuel in the
Dutch inland shipping market in 2030?

Case study: scenarios for the use of LNG in inland shipping in the Netherlands in 2030

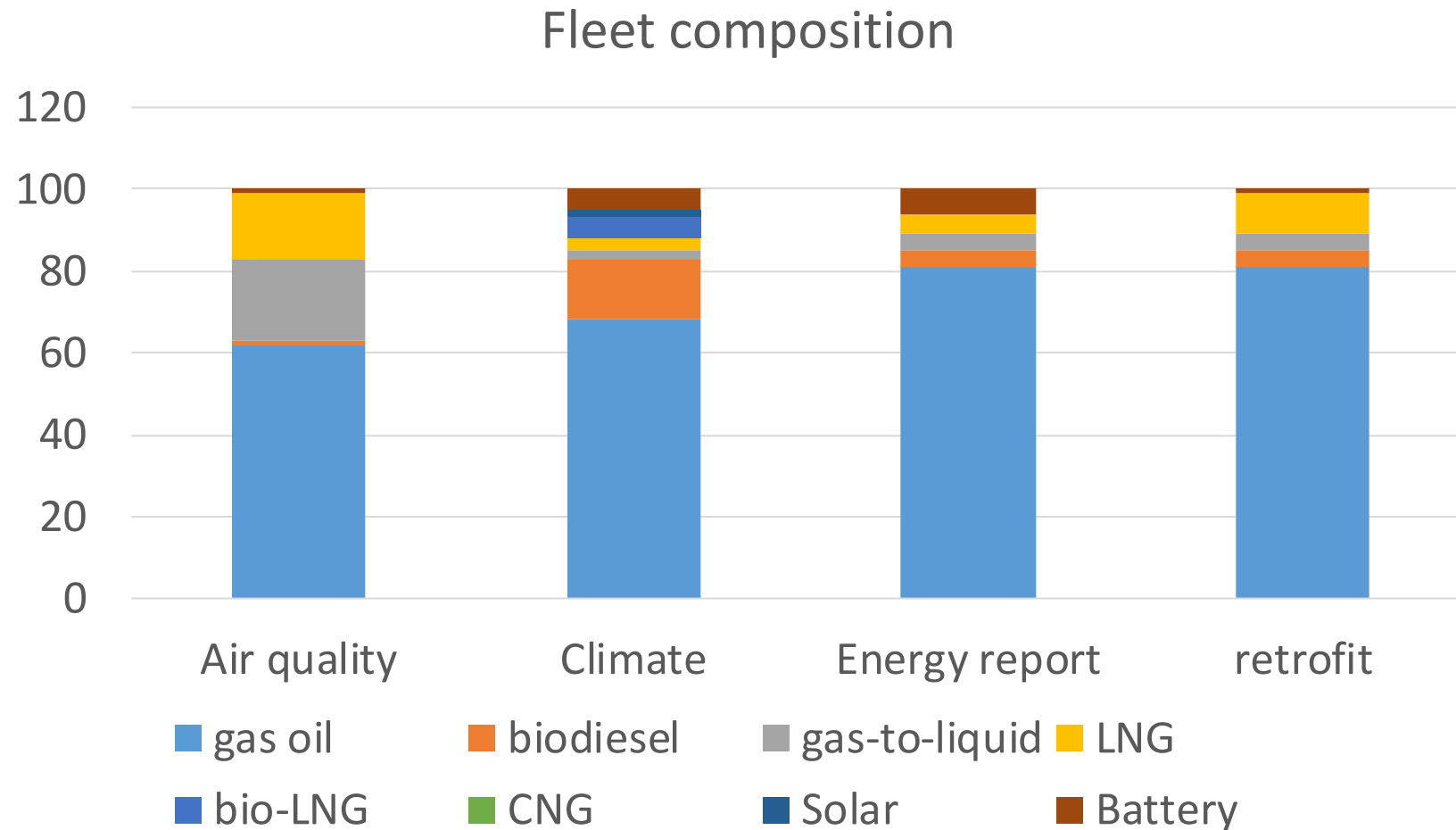
Policy driven scenarios:

- *Air quality* is leading: growth of LNG expected
- *Climate goals* are leading: share biofuels is growing
- *“Energy report”*: industry demand is leading: BAU
- *Retrofit*: inland shipping sector leading: low share of new ships being constructed: high share retrofit (subsidies)

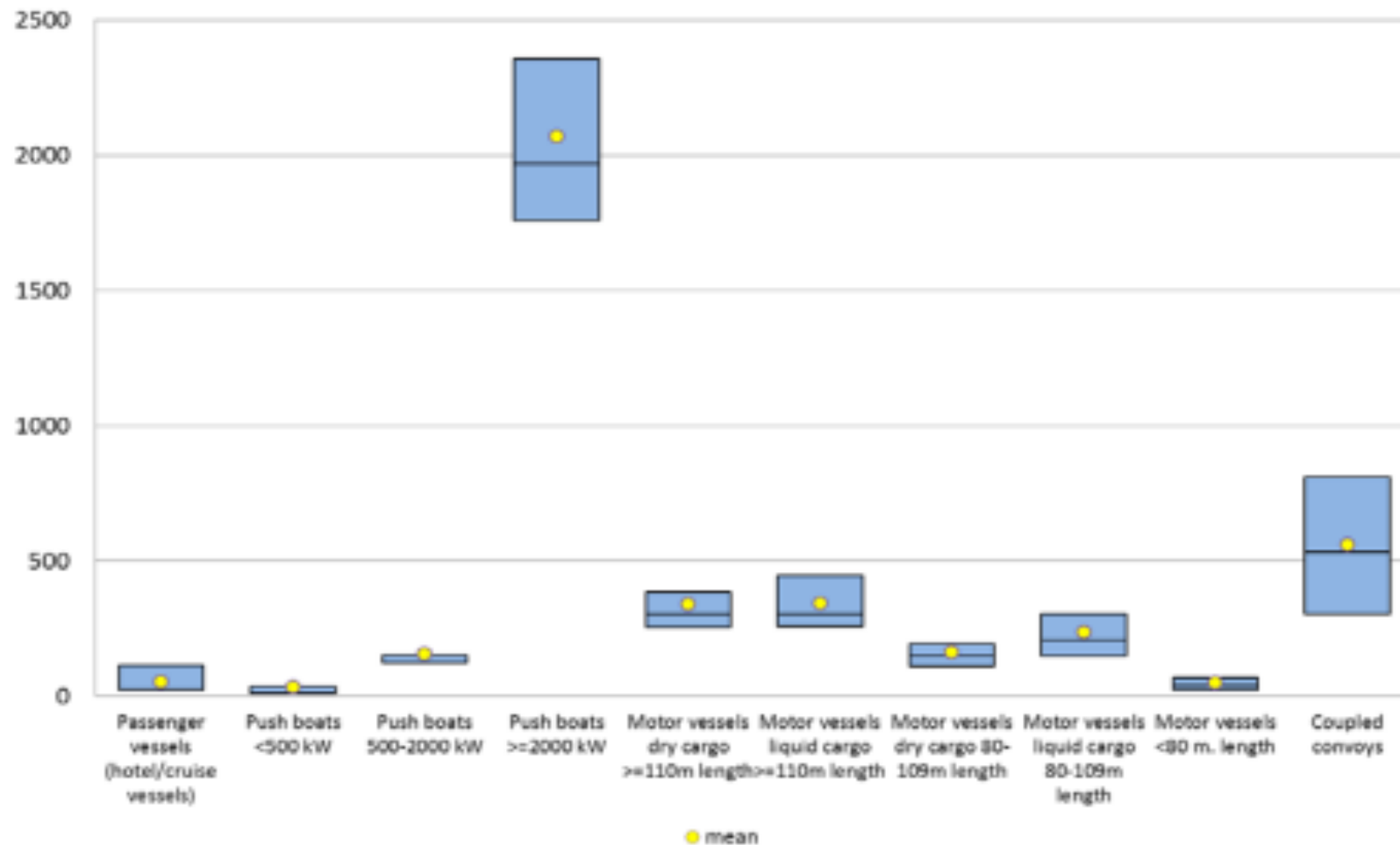
Alternative sources of propulsion:

- Gas oil
- Biodiesel
- Gas-to-liquid
- LNG
- Bio-LNG
- Compressed natural gas (CNG)
- Solar
- Battery

Case study: scenarios for the use of LNG in inland shipping in the Netherlands in 2030: fleet 5800 ships

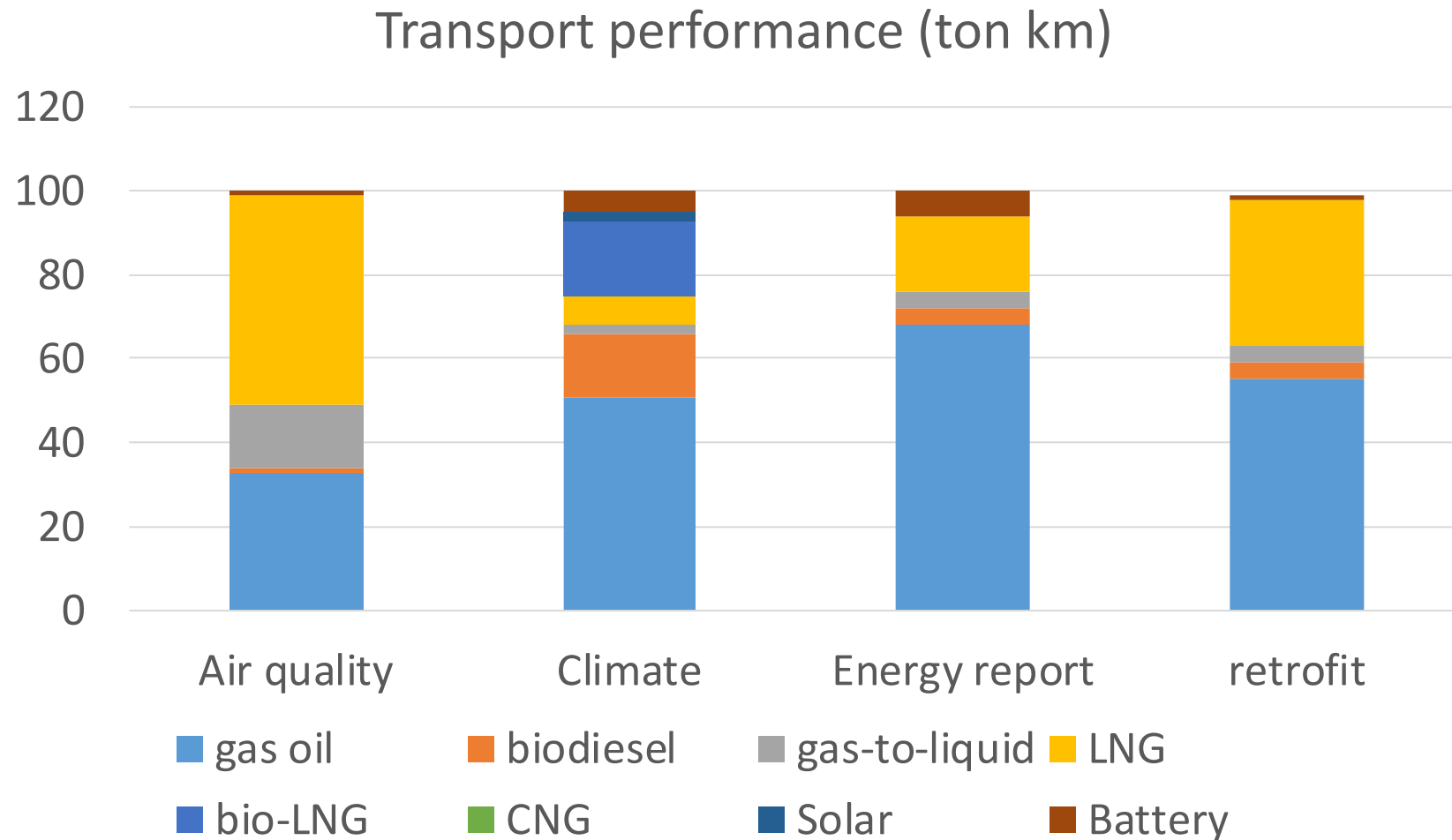


Power consumption (m3) for different types of ships



Source: SPB (2015)

Case study: scenarios for the use of LNG in inland shipping in the Netherlands in 2030



Case study: scenarios for the use of LNG in inland shipping: 2015-2030

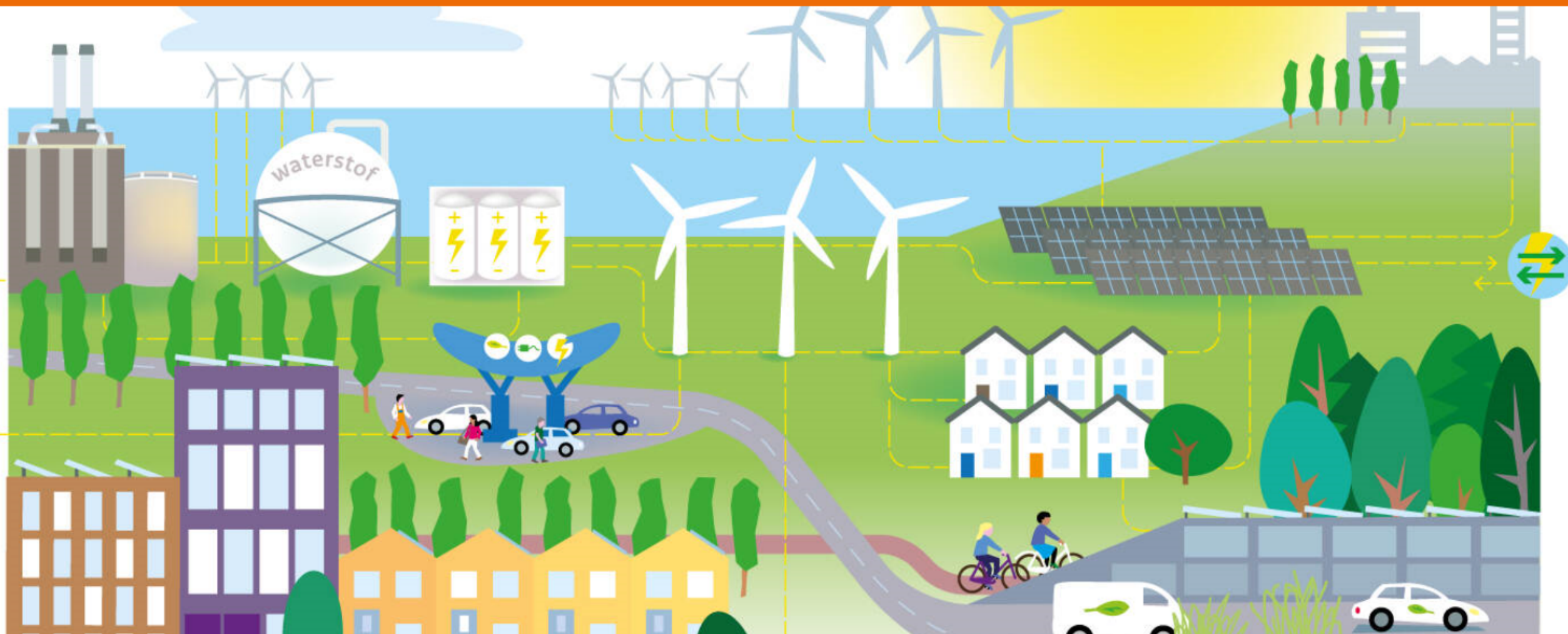
| SCENARIO | Air quality | Climate | Energy- report | Retrofit |
|--|----------------|------------------------|-------------------|----------|
| LNG-fleet inland shipping | 922 | 460 ^a | 300 | 600 |
| Share LNG in total fleet | 16% | 3% 5% ^b | 5% | 10% |
| Share LNG in transport performance (ton- kilometers) | 50% | 7% 18% ^b | 18% | 35% |
| New LNG-ships per year (2015-2030) | 60 | 30 ^a | 20 | 40 |
| Share new building | 80 | 80 | 80 | 20 |
| Share retrofit | 20 | 20 | 20 | 80 |

[a = inclusive bio-LNG, b = bio-LNG]

Is it possible to realise such a dramatic shift towards LNG in the Netherlands?

Lessons from history for a successful transition of a propulsion technique

- *100% commitment*: all key stakeholders need to be completely aligned, fully agreed, and 100% committed to the change.
- *Timing is key*: coordination between key players on the timing of introduction is critical. Investment by a key player too far ahead of introduction leads to capital inefficiency.
- *Don't forget the incumbent*: there needs to be a solution for the legacy fleet.
- *Information is king*: inform all stakeholders in advance of any introduction.



7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 1 – Fundamental market CONDITIONS (0/+)

- Technology available: supply structure in place (++)
- Technology superior to alternatives (0)
- Legislation (+/++)
- Sufficient scale to realise economies of scale in investment (–)
- Market pricing supports conversion to LNG (+)
- Product availability (++)
- *If the market conditions are right: other rules can be applied.*



HEINEKEN Nederland, Nedcargo and GoodFuels are going to transport beer with sustainable marine fuel

Inland navigation is going electric thanks to Bon Jovi

GROEN

Quirijn Visscher – 8:21, 8 september 2017

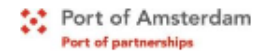


7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 2 – The Power to CONVENE (++)

- A visionary party is needed: a catalyser, independent intermediary with the vision to see the opportunity and the ability to convene sufficient players.
- A party with sufficient margin to support capital investment.





7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 3 – Promoting COLLABORATION (0/+)

- Early engagement and collaboration to build shared understanding.
- Building of trust between players and catalyser.
- No single player has the ability to exert preferential power over the others – which requires the catalyser to be independent from all of the players.

7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 4 – Understanding CHALLENGES (+)

- The ability to understand and to be ruthlessly focused on your own part of the market.
- It is critical to really understand the technical, financial, commercial, and operational challenges the *other* players face and their role in positively or negatively influencing this.
- For instance in inland shipping: understanding of the complex relationship between the barge owners, the barge operators and the operators of refuelling sites.

7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 5 – CONCEPTUALIZE the solution (++)

- Multiple players must execute interrelated activities:
- Establish the LNG supply chain
- Ships need to be available
- Customers need to be identified and demand created
- Refuelling infrastructure needs to be available in the right location
- The complete system needs to be conceptualized!

7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 6 – Developing the COMMERCIAL case (0)

- Inland shipping market not strong
- Funding is difficult
- Business case important bottleneck
- External funding needed – innovative financial construction/subsidy

Rule 7 – CONDUCTING the orchestra (0)

- Catalyser plays important role in conducting the process.
- Each player needs to remain confident in progress of other players.

7Cs of success: seven rules to establishing LNG as a fuel for inland shipping in the Netherlands

Rule 1 – Fundamental market CONDITIONS: 0/+

Rule 2 – The Power to CONVENE: ++

Rule 3 – Promoting COLLABORATION: 0/+

Rule 4 – Understanding CHALLENGES: +

Rule 5 – CONCEPTUALIZE the solution: ++

Rule 6 – Developing the COMMERCIAL case: 0

Rule 7 – CONDUCTING the orchestra: 0

In 2019 only 13 LNG fueled barges in the Netherlands (2016: 7) instead of 187: growth below lowest scenario for 2030: 2 new ships per year.

- Motortankschip Argonon
- Motortankschip Ecotanker II
- Motortankschip Ecotanker III
- Koppelverband Eiger-Nordwand
- Motortankschip Greenstream
- Motortankschip GreenRhine
- Motortankschip Sirocco
- Motortankschip Ecoliner
- Motortankschip Somtrans LNG
- Motortankschip RPG Stuttgart
- Motortankschip RPG Bristol
- Motortankschip RPG Stockholm
- Kraanschip De Werkendam

Conclusion

- LNG will not become the dominant fuel in the Dutch inland shipping market in 2030.
- Based on lessons learned from earlier propulsion transitions: total, 100% commitment is missing: serious point of attention.
- Based on 7 Cs of success for introduction LNG: fundamental market conditions still serious point of attention.
- Role of Dutch government crucial: allowing LNG as a transition fuel not yet clear in Dutch climate strategy.
- Impact competing technologies unclear: diesel electric at the moment strong.
- *I am looking very much forward to the sessions of today: change my conclusions?*
- *I thank you very much for your attention!*