



MARITIME

# The Future of Shipping

## Shippingforum

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8 May 2014

# Unique industry consolidation – celebrating 150 years in 2014



# DNV-GL



# **Sustainability**

**- a game changer for shipping**




## Sustainability will be a requirement in the future

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9 billion people,  
6 of them urban



Digitalisation and  
transparency



Resource  
constraints



80 % more  
energy

# Shipping has an impact on the society, economy and environment

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## Lives lost at sea



**900**

ship accident  
fatalities per year  
Average 2003-2012

## Freight cost



**7-11%**

of cargo value

## Insurance claim cost



**0.23%**

of insured value  
Average 2010-2012

## Recycling



**90%**

of the ship recycled

## Introduction of invasive species



**20 000**

marine organisms  
introduced per day

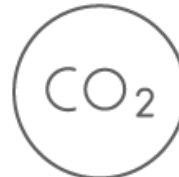
## Accidental oil spills



**5000**

tonnes per year  
Average 2010-2012

## CO<sub>2</sub> emissions



**900**

million tonnes  
per year

## NO<sub>x</sub> emissions



**22**

million tonnes  
per year

## SO<sub>x</sub> emissions



**12**

million tonnes  
per year

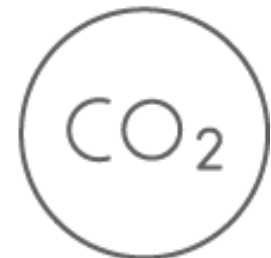
## Ambitions for sustainable shipping

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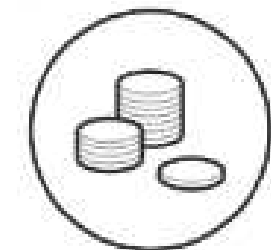
**90 % reduction in fatalities**



**60 % reduction in CO<sub>2</sub> emissions**



**Maintain or reduce present freight cost levels**







**Reaching the ambitions require new technologies,  
systems and practices**

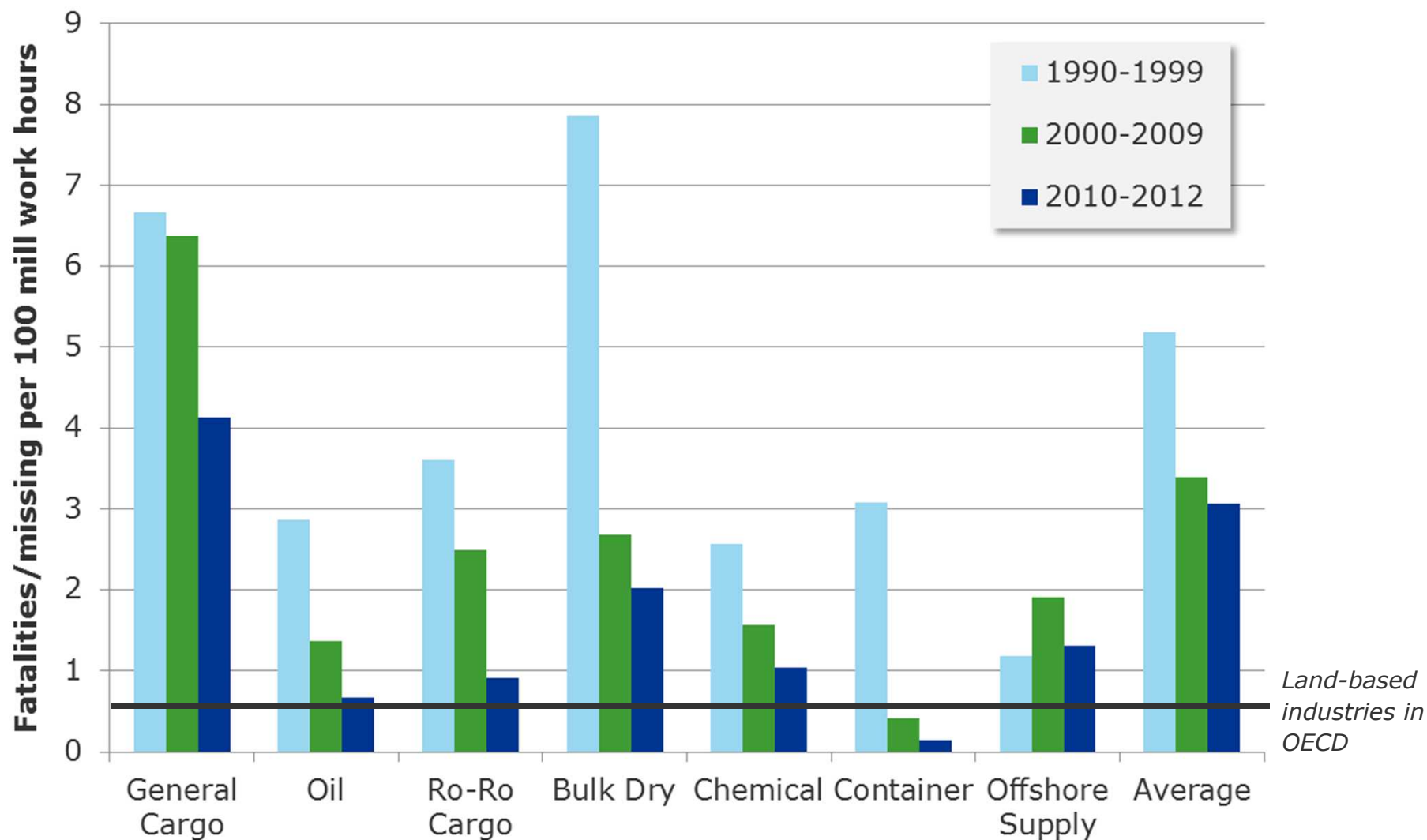


A dramatic, dark, and stormy sea under a heavy, cloudy sky. The text "A whole new safety mind-set" is overlaid in white.

# A whole new safety mind-set



## Ship accident fatalities in shipping



Source: IHS Fairplay, OECD



**Major accidents are not of the past**





**We design systems and procedures for perfect human behavior – but can we expect perfect behavior?**





**Technologies and systems can either support, replace or train us humans**

A detailed illustration of a satellite in orbit above Earth. The satellite features a complex structure with multiple solar panel arrays extended from its central body. A bright, intense blue light source, possibly the sun, is visible in the upper left, creating a strong lens flare effect across the scene. The Earth's surface, covered in white clouds, is visible below the satellite.

# **Digital technologies**

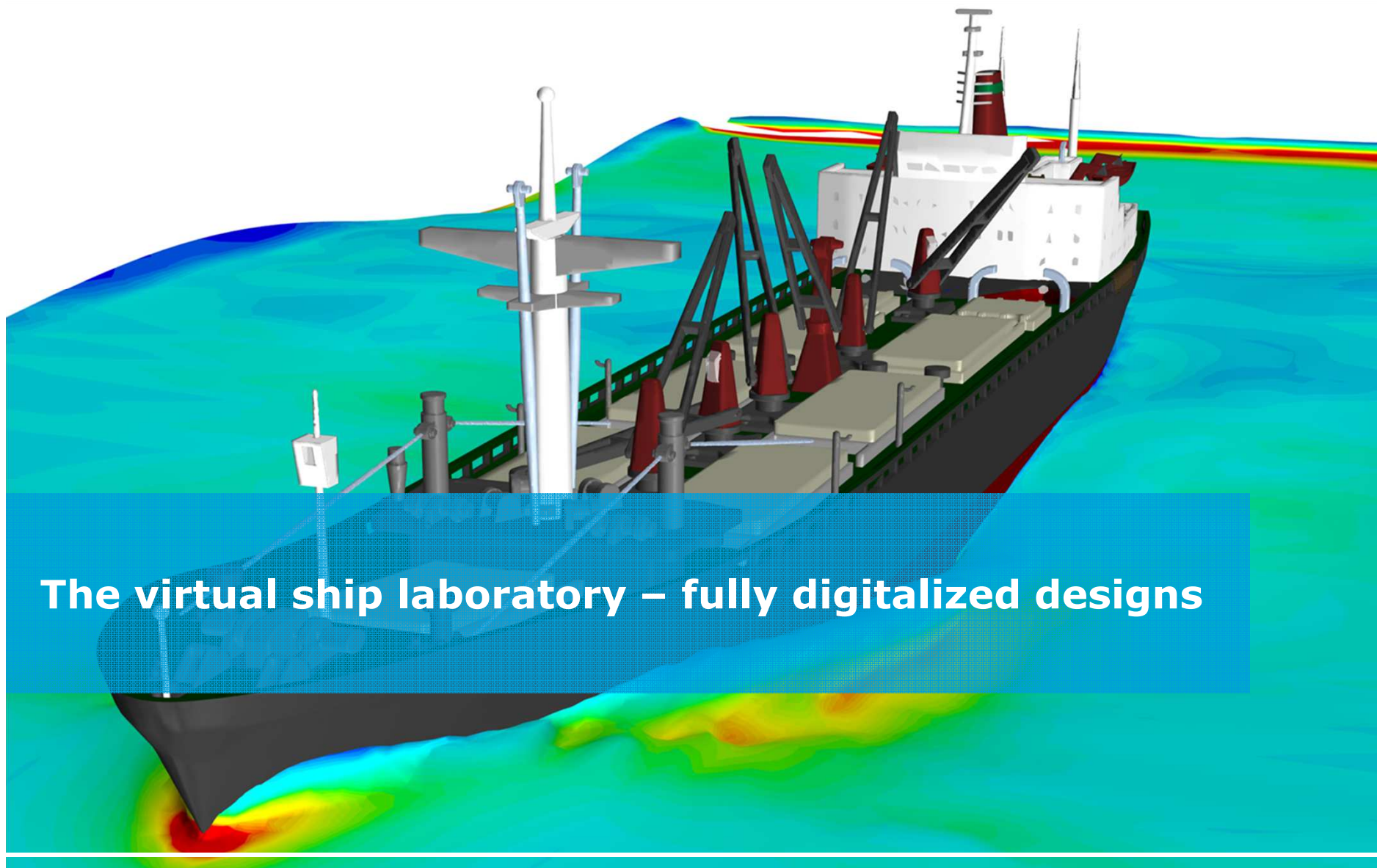
## **- a catalyst for smarter shipping**





**ICT can remove many inefficiencies in shipping**





## The virtual ship laboratory – fully digitalized designs



## Translate

English

Spanish

French

English - detected



English

German

Norwegian



Translate

Smart maintenance



Smart vedlikehold





**Remote operation already in subsea operations – can we expect fully autonomous ships?**





**We will see more cooperation and efficient supply chains in the future**

# Enabling carbon-neutral shipping







**Better hull shapes, efficient machinery and energy harvesting**





**New materials: lightweight, intelligent and powerful**





**The future fuel mix will be more diverse**



# Future Greenhouse Gas Emissions from Shipping

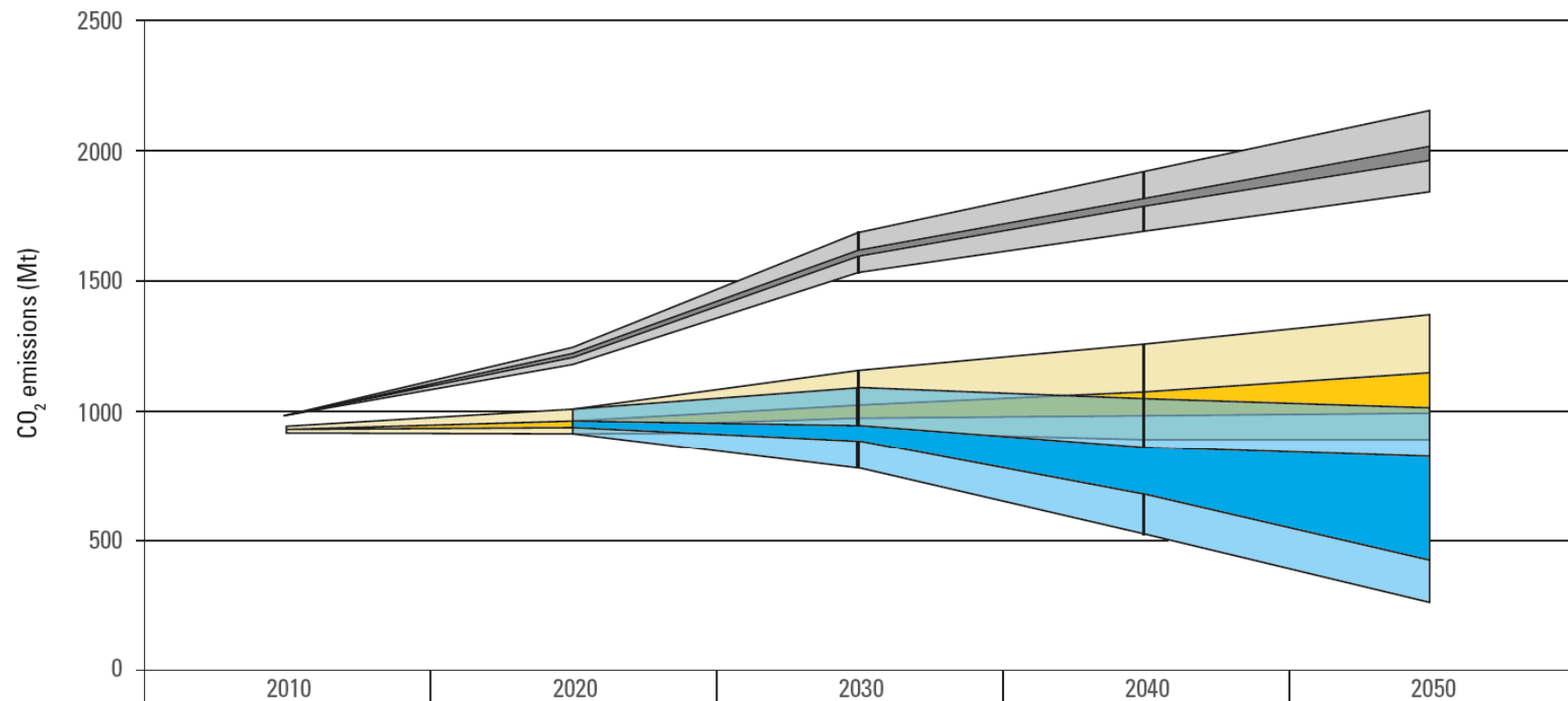
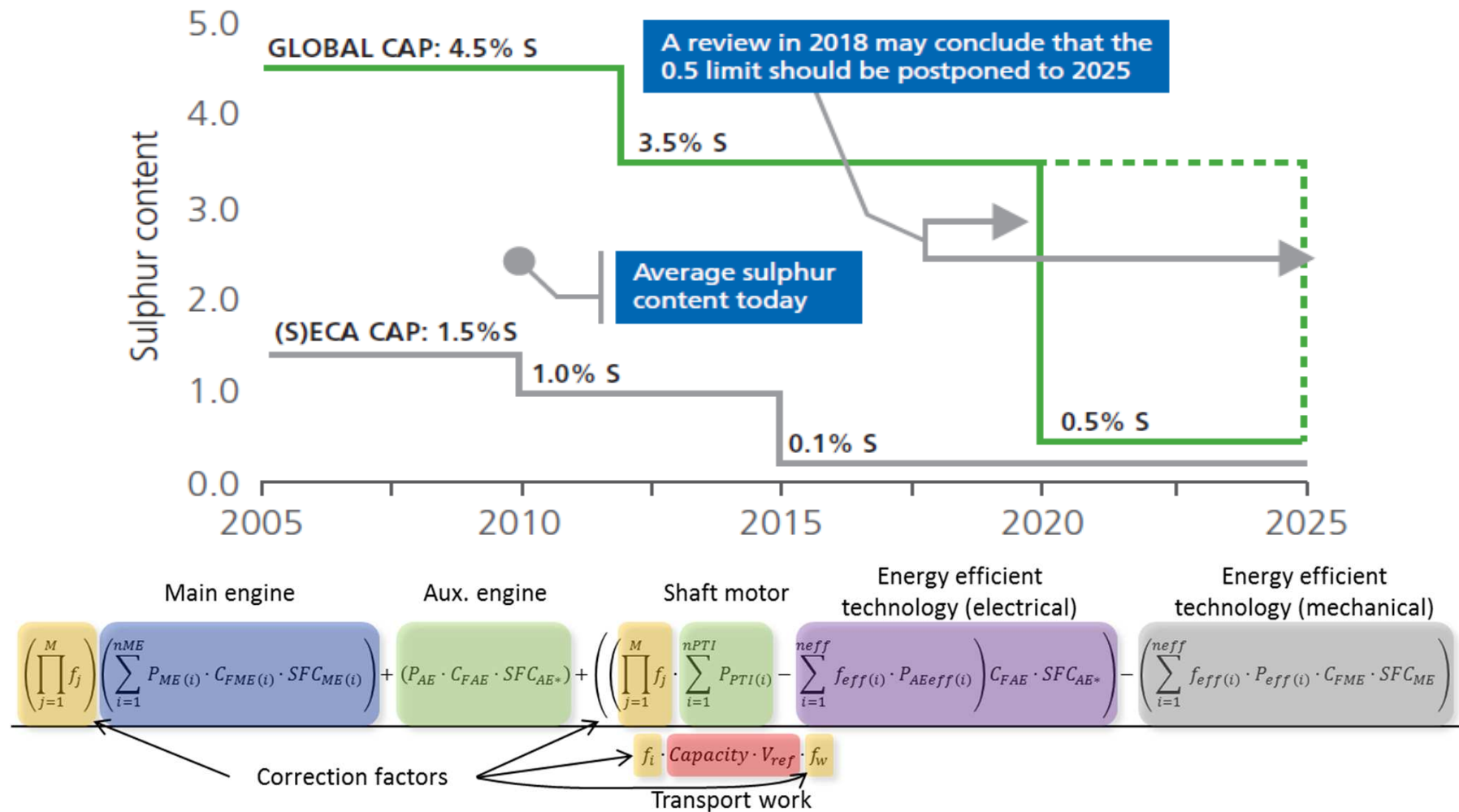


Figure 1: Baseline emissions (grey) vs. emissions including cost-effective uptake of alternative fuels. Blue sector shows potentials including uptake of nuclear, biofuel and LNG, as well as technical and operational measures. The yellow sector shows the same potential, but excludes nuclear. The achievable emission levels are illustrated, displaying the maximum, minimum, 25% and 75% percentiles of 200 model realizations; the dark shaded area covers the central 50% of the model runs.

# Drivers for Alternative Fuels in Shipping

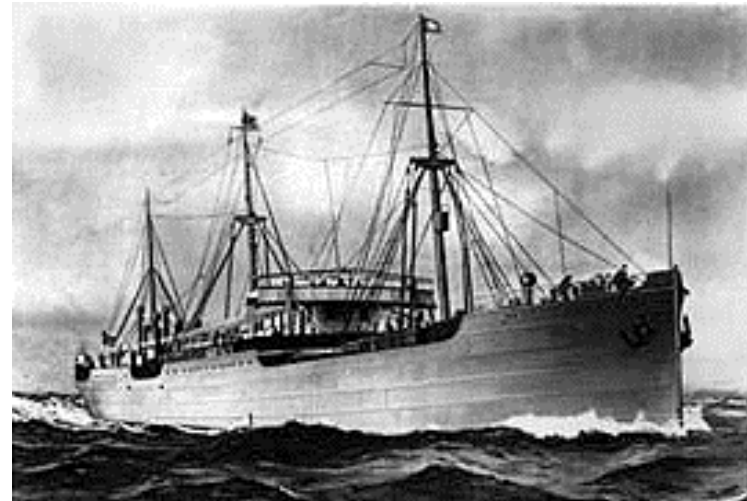




## Lessons from history: fuel shift

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- 1892: Diesel engine patented
- 1903: First diesel powered vessels were launched
- 1912: First ocean-going diesel powered vessel launched: MS Selandia
- 1945: 60% of new ships are diesel powered
- 1960: Most new ships are diesel powered
  
- 2000: First LNG powered ferry: MF Glutra
- 2014: 50 LNG powered ship scheduled for delivery



## Low carbon energy

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A large liquefied natural gas (LNG) carrier ship is shown at sea under a cloudy sky. The ship is white with a dark hull and has a crane visible on its deck.

LNG

Foto: Speziellise Foto & Design

A white electric car is parked on a paved surface next to a body of water. The car has "NORLEDGE" written on its side. The background shows a blue sky with some clouds.

Electrification  
and renewables

A close-up view of industrial equipment, likely part of a carbon capture system, showing large pipes and structural elements. The text "CO<sub>2</sub>" is visible in the background.

Carbon capture  
and storage

A wide shot of a lush green field, possibly a biofuel crop field, under a blue sky with scattered clouds. A single tree is visible in the distance.

Biofuels



## Liquefied Natural Gas (LNG)

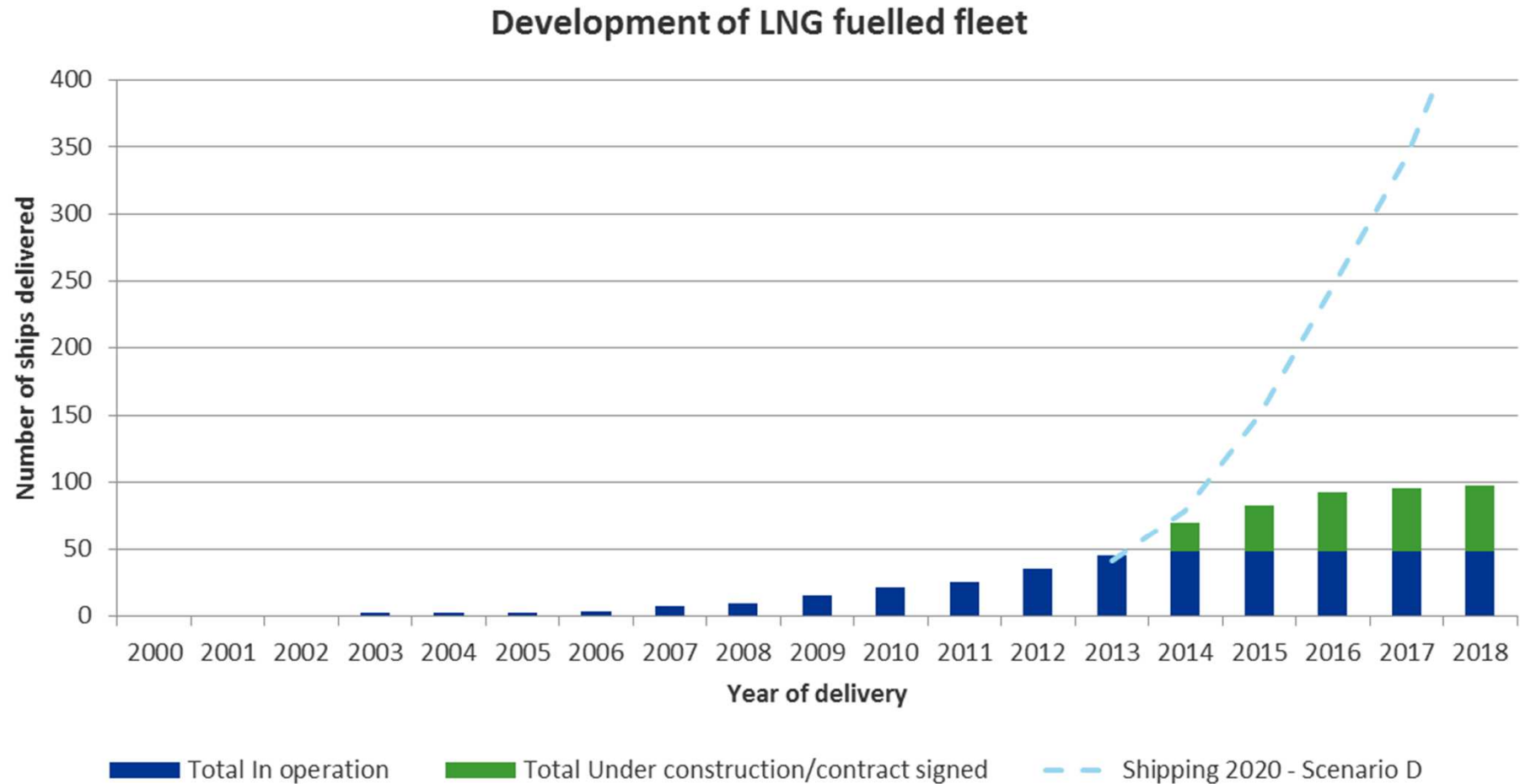


Gas Engines, Dual-Fuel Engines

More than 50 ships in operation

Main Issue:  
Bunkering infrastructure

## The number of LNG fuelled ships is expected to grow



**Updated 10.02.2014**  
**Excluding LNG carriers and inland waterway vessels**



## Ship Electrification and Renewables



Hybrid ships

Pure electric  
ships

Cold ironing

Renewables for  
power  
production

# Biofuels



Three sources:  
edible crops; non-  
edible crops and algae

Production capacity  
increasing

Main challenges:  
Land area required  
Long term storage



## Other Gaseous or Liquid Fuel Options



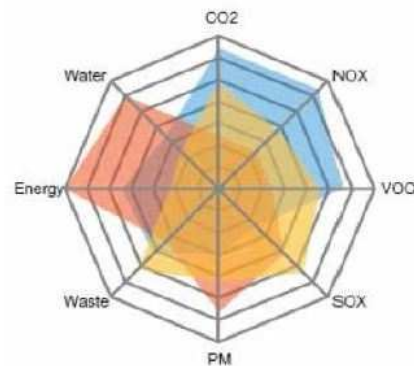
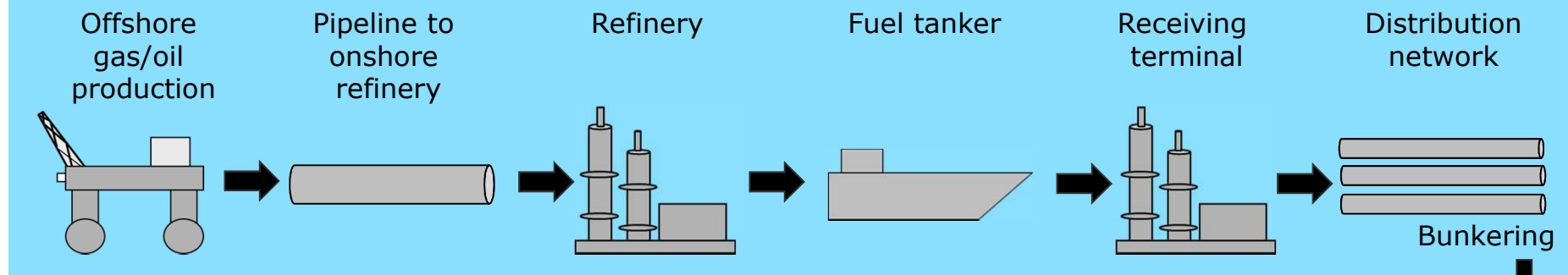
LPG: Liquefied  
Petroleum Gas

Methanol

DME: Di-Methyl  
Ether

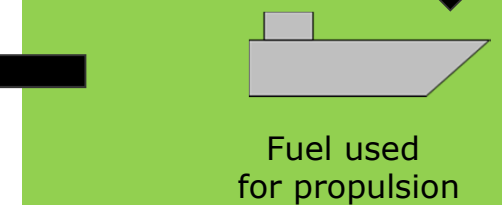
# Life Cycle Assessment of Fuels

## Well-to-Tank



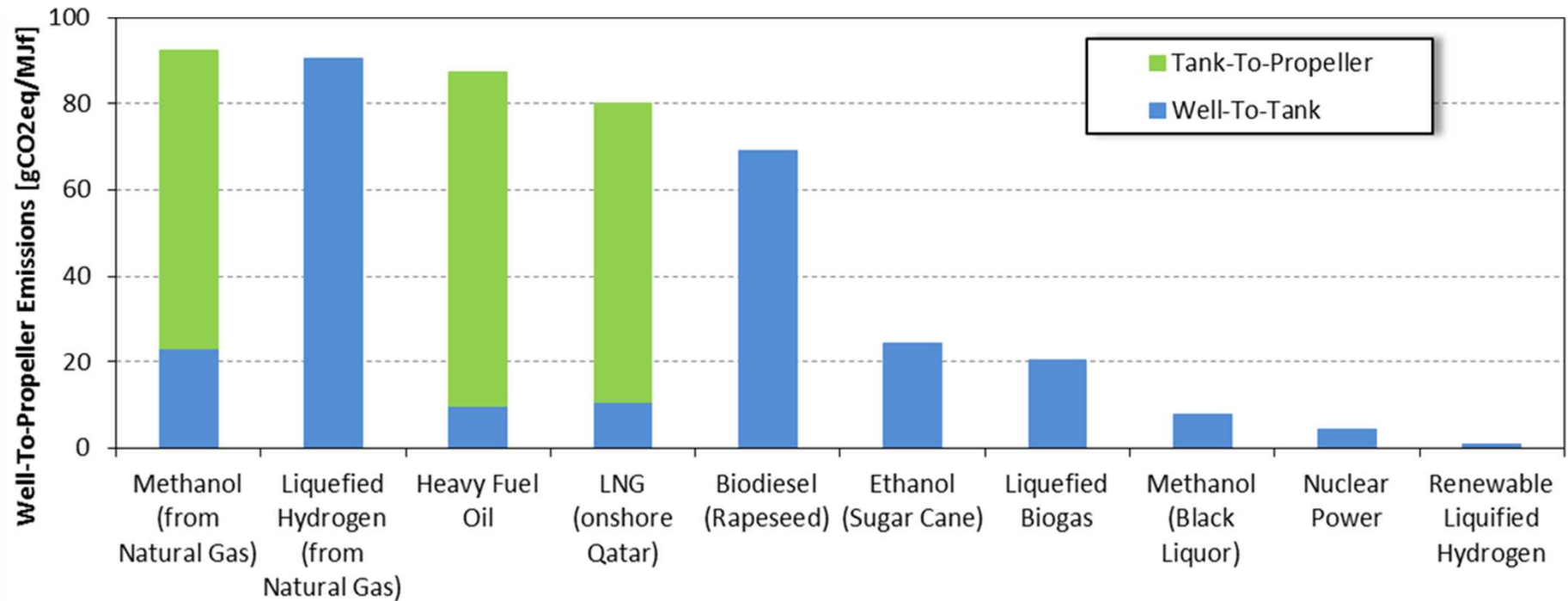
- Emissions to Air?
- Environmental Footprint?

## Tank-to-Propeller





# Environmental Footprint of Alternative Fuels



Tank-to-Propeller (combustion) emissions assumed to be equal to CO<sub>2</sub> absorbed by the plant during its lifetime

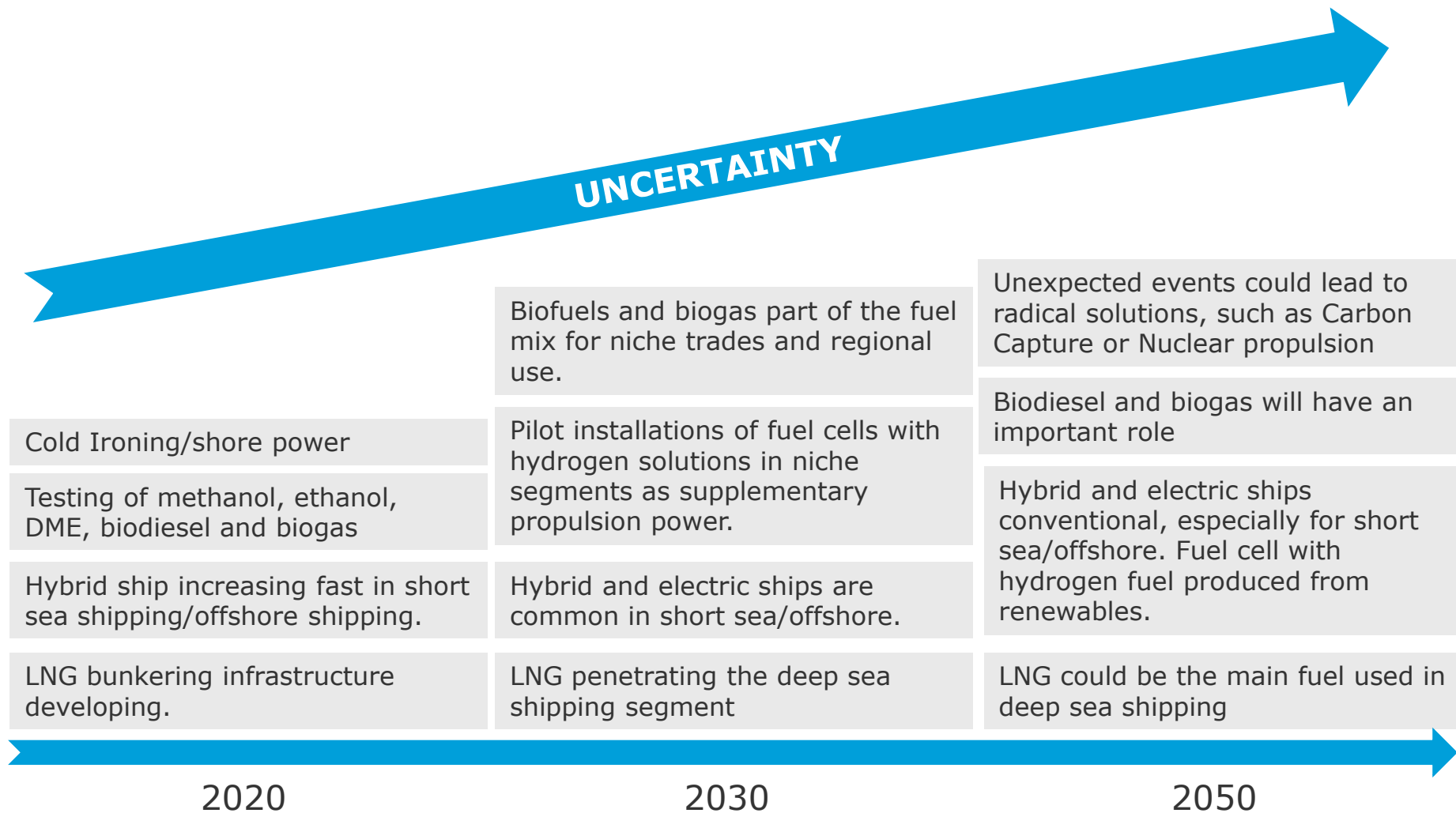
## Availability of Alternative Fuels

Fuel	2010 Total consumption (million TOE/year)
Oil-based	4,028*
Natural Gas	2,858 (LNG: 250-300)
Biodiesel	18-20
LPG	275
Methanol	23
Ethanol	58
DME	3-5
Fischer-Tropsch	15
Biogas	Very low
Hydrogen	Very low

\* Approximately 7-8% for shipping



## Possible Future Scenarios



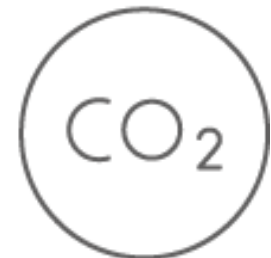
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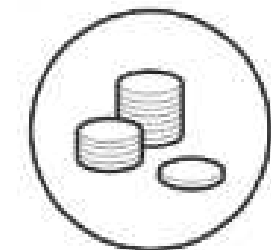
**A whole new safety mind-set**



**Enabling carbon-neutral shipping**



**Digital technology – a catalyst for smarter shipping**





Read more and download the report at:

**[futureshipping.dnvgl.com](http://futureshipping.dnvgl.com)**

**[www.dnvgl.com](http://www.dnvgl.com)**

**SAFER, SMARTER, GREENER**

