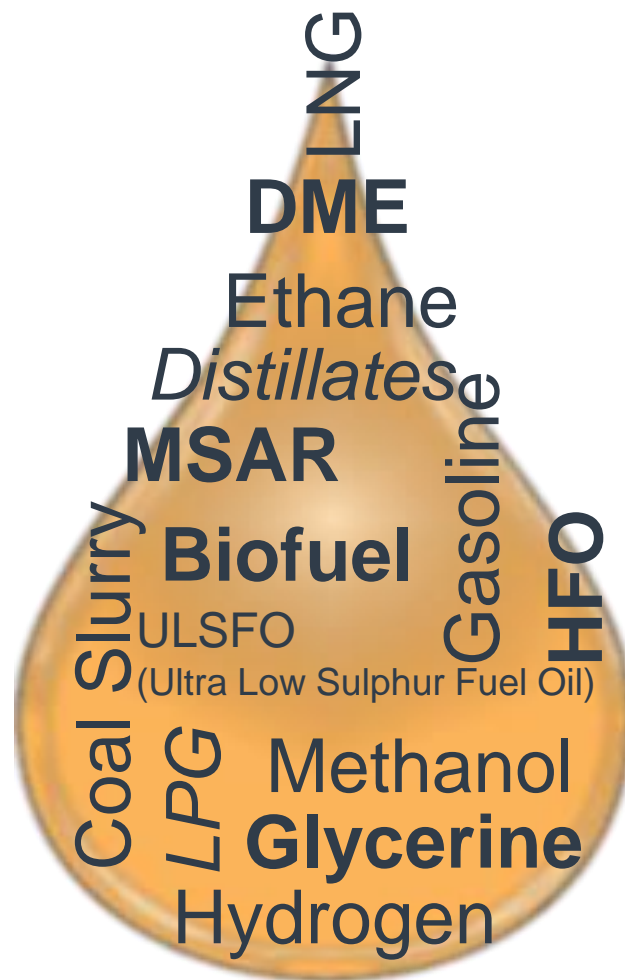




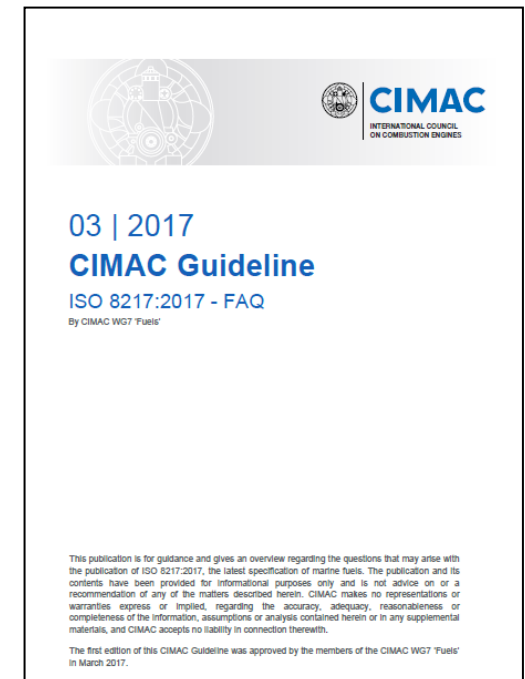
Marine market: Future Fuels 2020 and Beyond



Kjeld Aabo  
Customer support  
MAN Diesel & Turbo  
Copenhagen, Den

## Report of WG7 'Fuels'

- 35 members
  - 9 on waiting list
- Represented stakeholders
  - Refiners, Suppliers, OEMs, Ship Operators, Fuel Testing Labs, Classification Societies and others
- Co-operation with
  - All CIMAC WGs in case of common topics
  - ISO8217 fuels group (very close relationship)
- Latest Publications
  - Guideline providing answers to FAQ from ISO 8217:2017 (Mar 2017)
  - Guideline on the Interpretation of Marine Fuel Analysis Test Results (Feb 2016)
  - Guideline on Filter Treatment of Residual Fuel oil (Dec 2015)
  - Position paper: New 0.10% sulphur marine (ECA) fuels (June 2015)
  - Guideline: Cold flow properties of marine fuel oils (Jan 2015)





## Report of WG7 'Fuels' – page 2

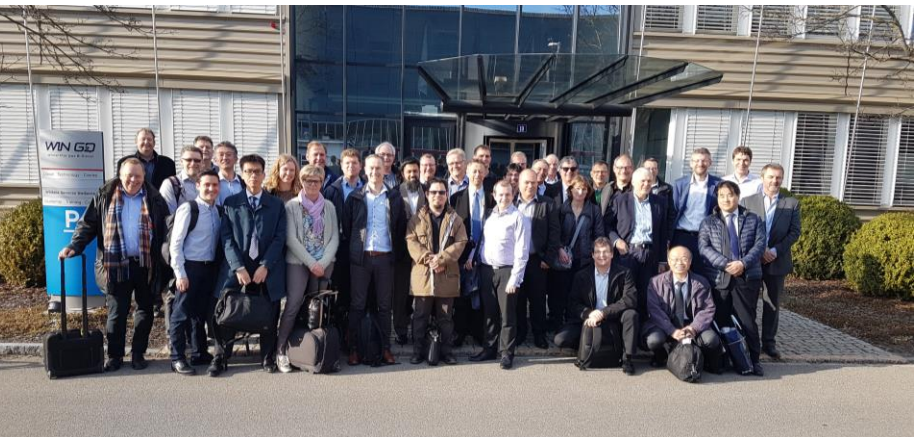
### Recent and upcoming meetings

- No 73: October 2015, France
- No 74: April 2016, Germany
- No 75: September 2016, NL
- No 76: March 2017, Switzerland

### Current activities, subgroups

#### High priority SGs

- SG 1-1 CFR (centrifuges and efficiency)
- SG 5 LNG quality
- SG 7 Emulsion fuels
- SG9 Fuel grade framework

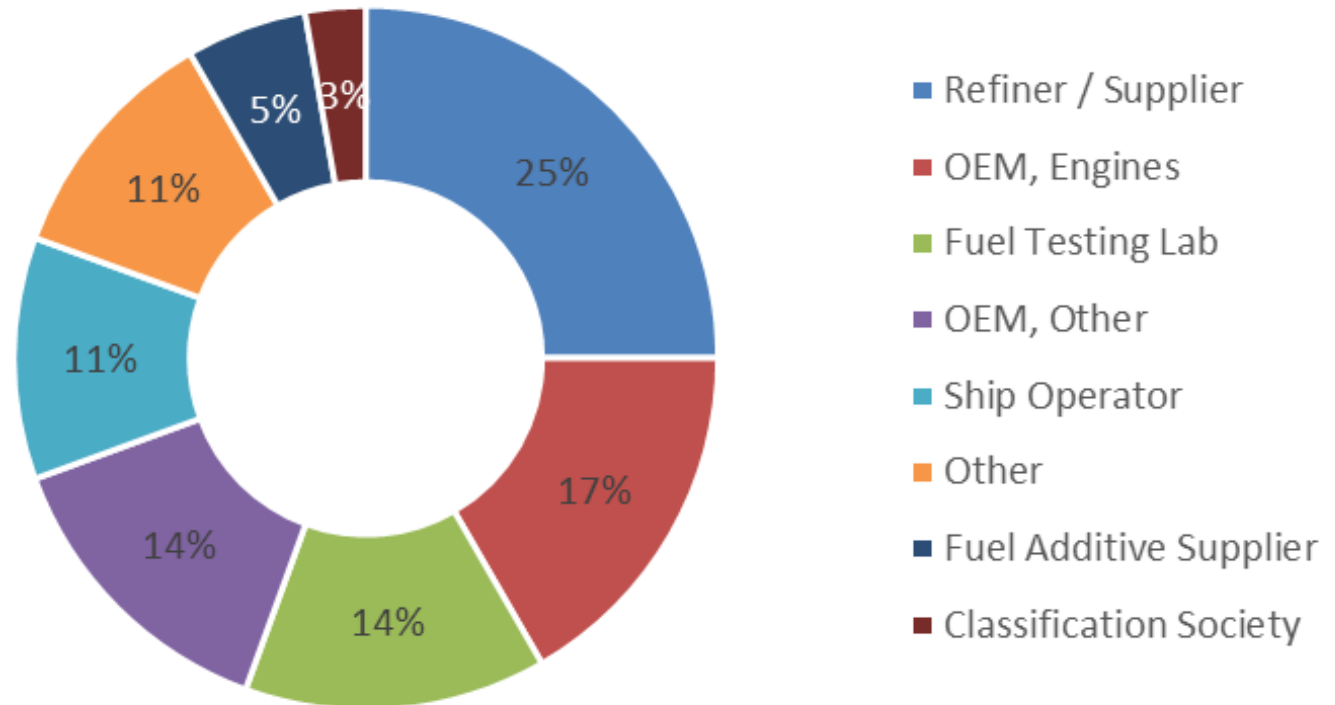


#### Low priority SGs

- SG 1-2 Separators
- SG 6-1 Sampling of marine fuels
- SG10 Niche fuels

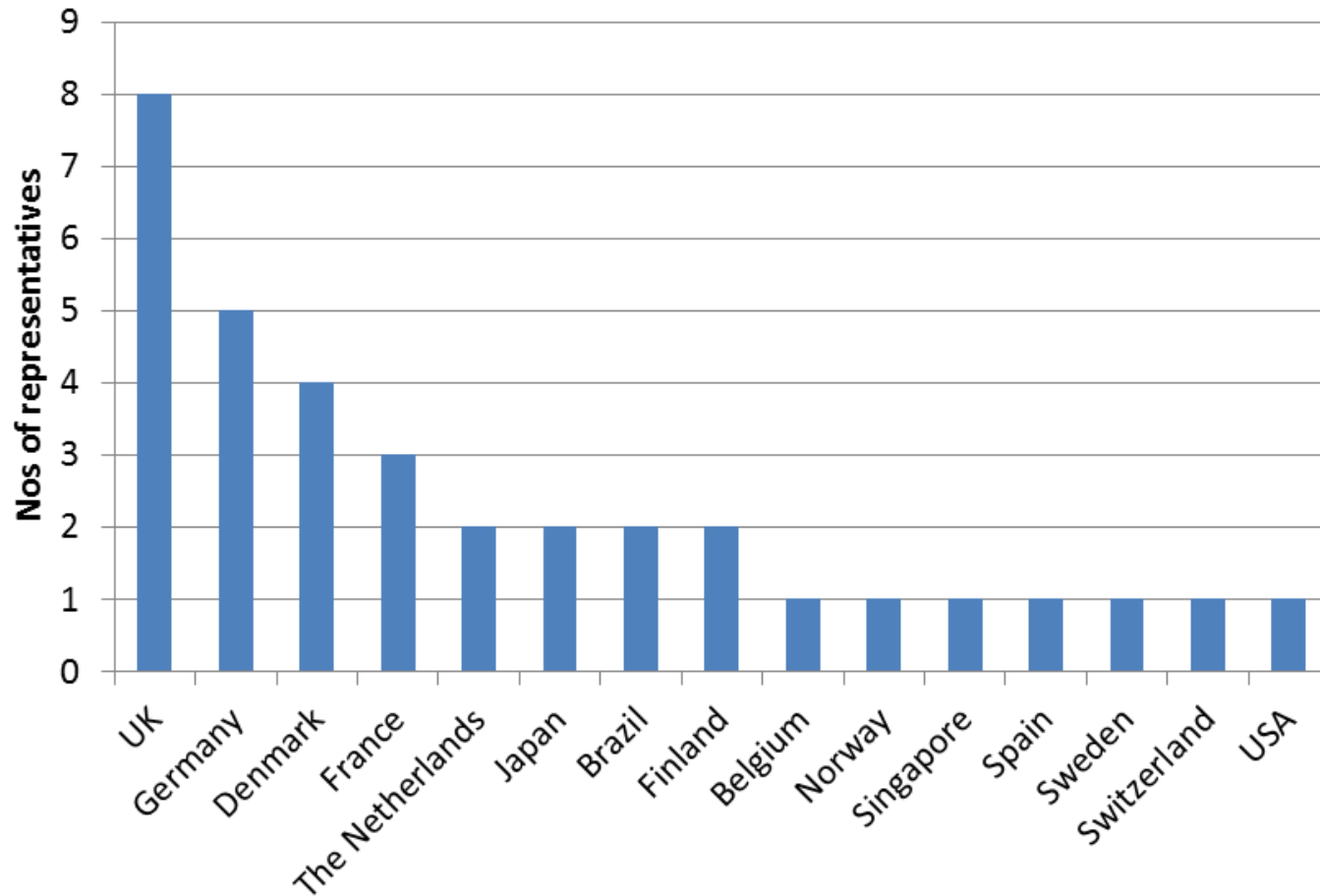


## Representation in WG7 by sector



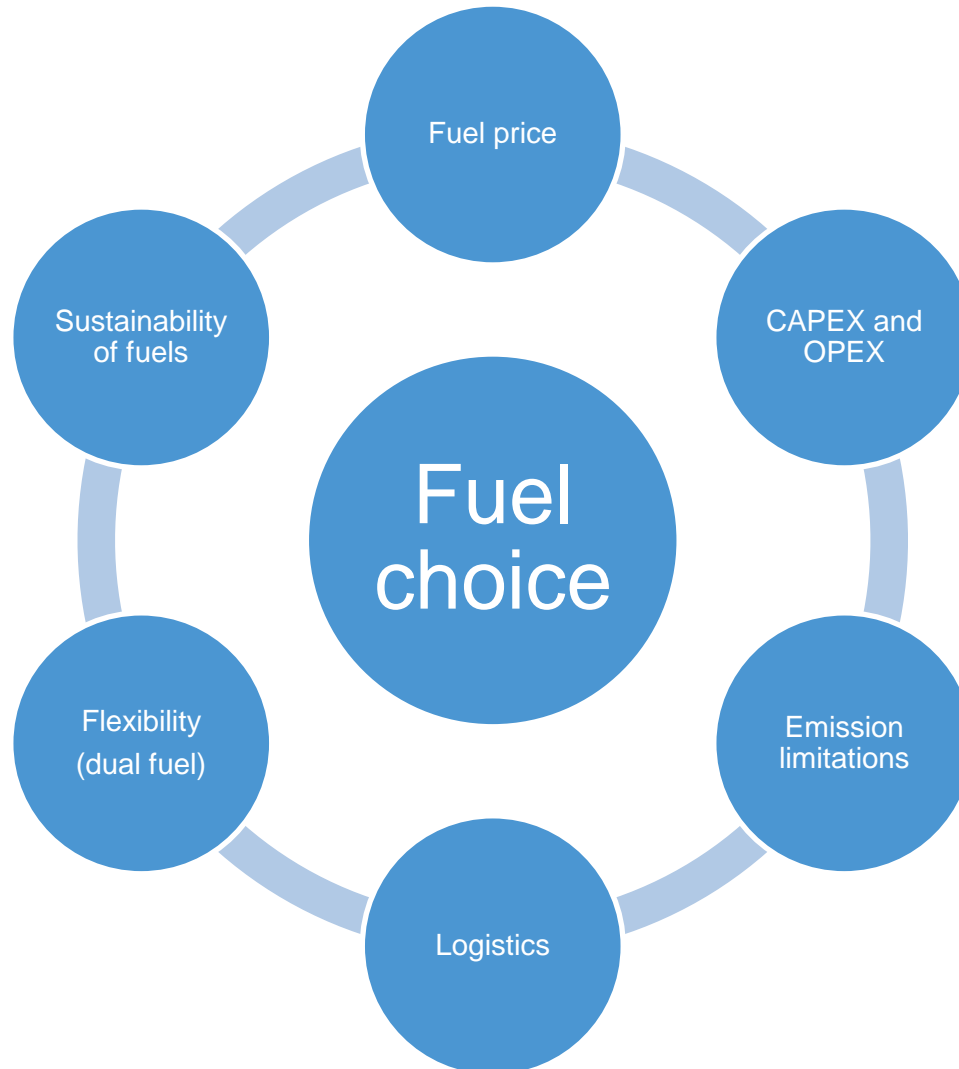


## Representation in WG7 by country



- **Mega CV, VLCC, VLOC, VLGC vs smaller vessels ?**
- **Hull Line Optimising vs Propeller Speed Optimising ?**
- **Global Sulphur Cap - Gas, High S or Low S Fuel ?**
- **With or Without TIII Equipment ?**
- **Digitalisation on the way**
- **Better Efficiency and Lower Cost is called for.**

# Influencing Factors on Fuel Choice



# Fuel Types



Residual



Distillates



ULSFO



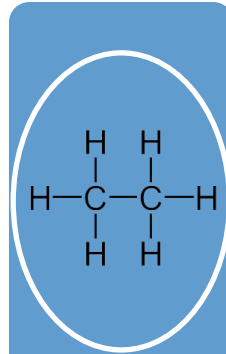
Methane



Methanol



LPG



Ethane



Biofuel  
(2<sup>nd</sup>+3<sup>rd</sup>  
gen.)

MAN Diesel & Turbo supports all



# What other Fuels and Plants can be Relevant for Future Propulsion?



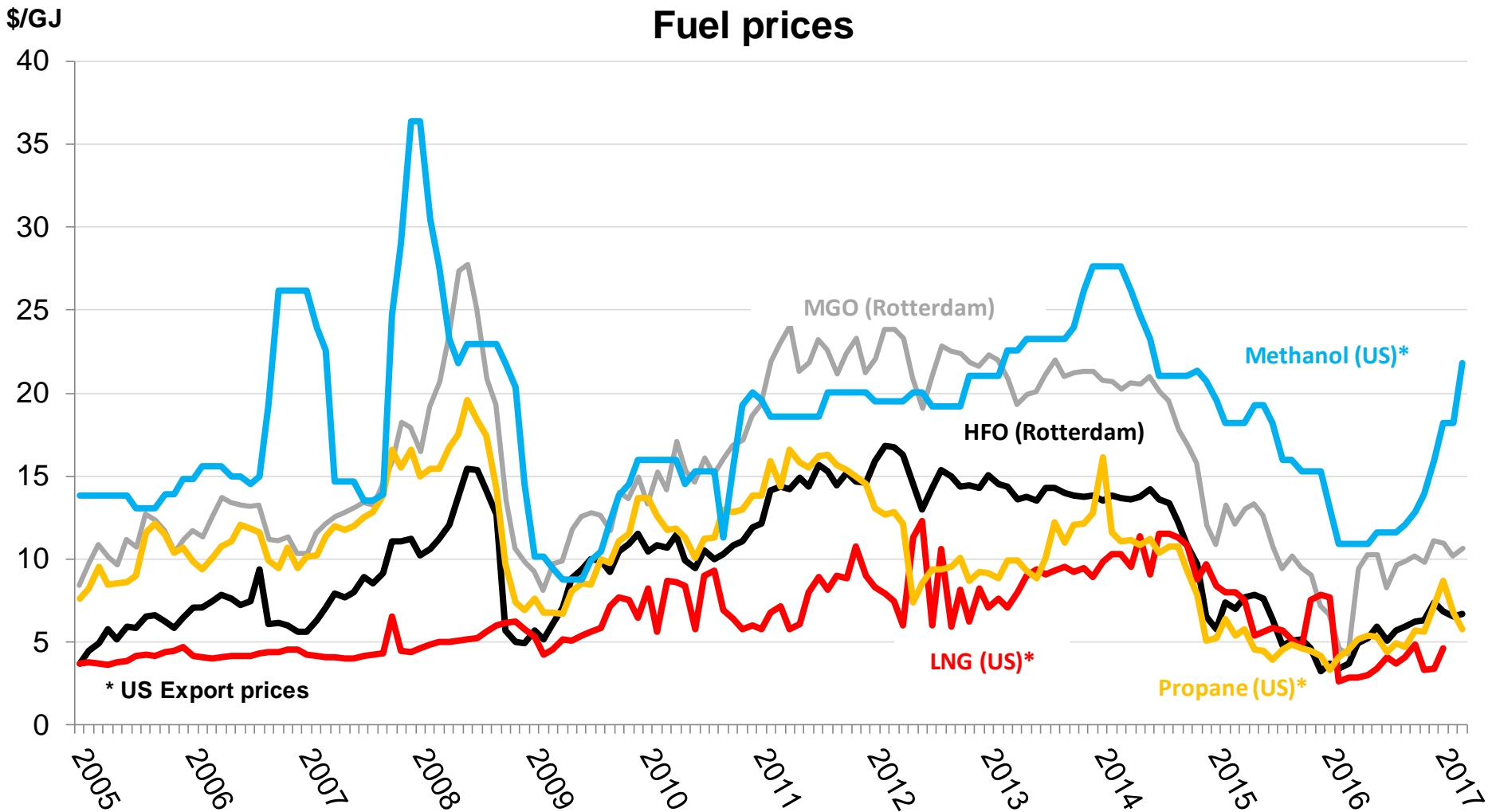
- Batteries instead of GenSets and power peak-shaving?
- Fuel cells?
- Use of hydrogen in a diesel engine?
- Nuclear power?
- Sails, kits and solar panels?
- Gas turbines ? ( Also MDT )



# Fuel price development



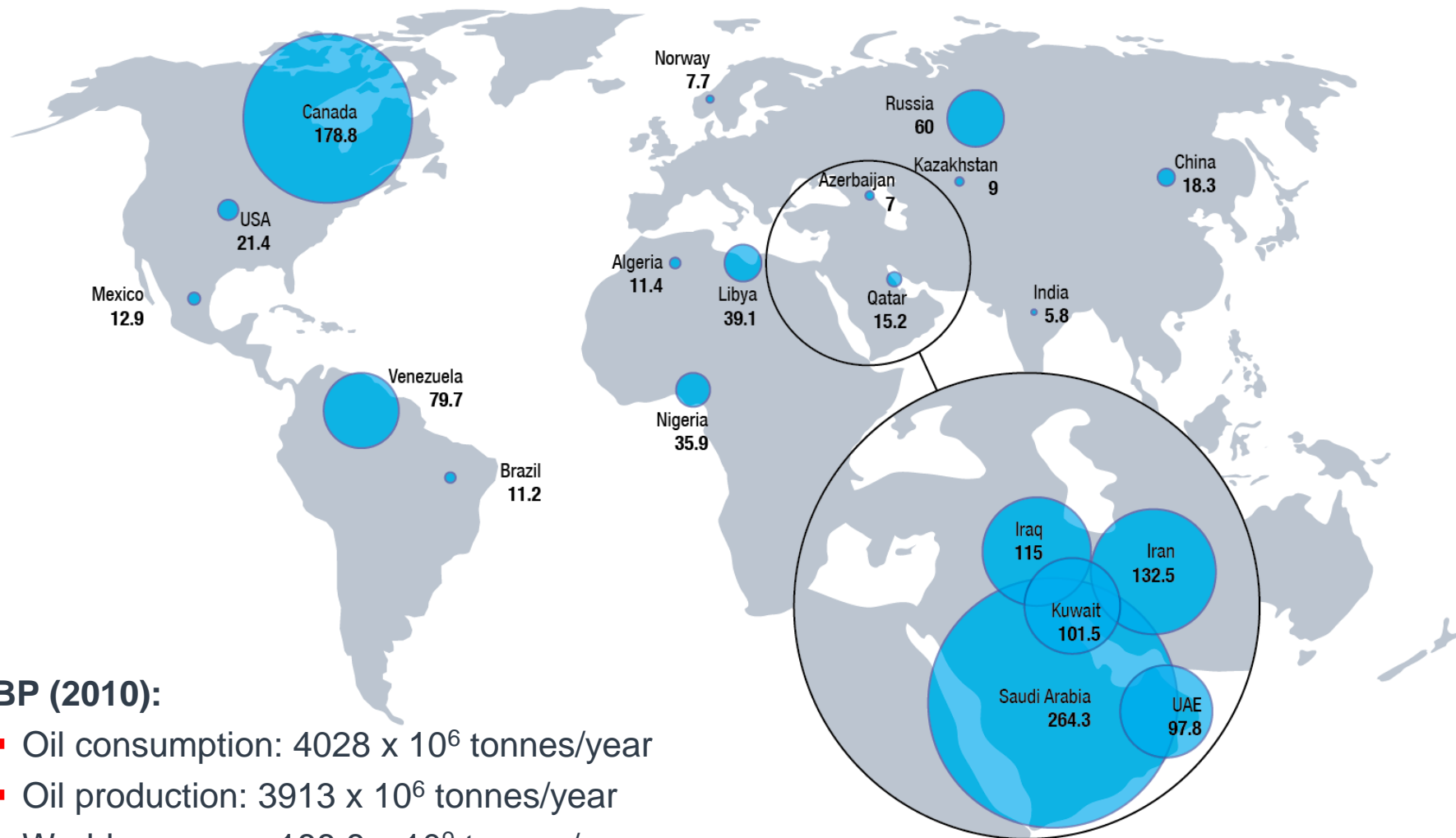
## Fuel prices



Data retrieved end March 2017

Source: Børsen, Bunkerindex, EIA & Methanex

# Remaining Oil Reserves



## BP (2010):

- Oil consumption:  $4028 \times 10^6$  tonnes/year
- Oil production:  $3913 \times 10^6$  tonnes/year
- World reserves:  $188,8 \times 10^9$  tonnes/year
- Years of consumption:  $188\,800 / 4\,028 = 47$  years

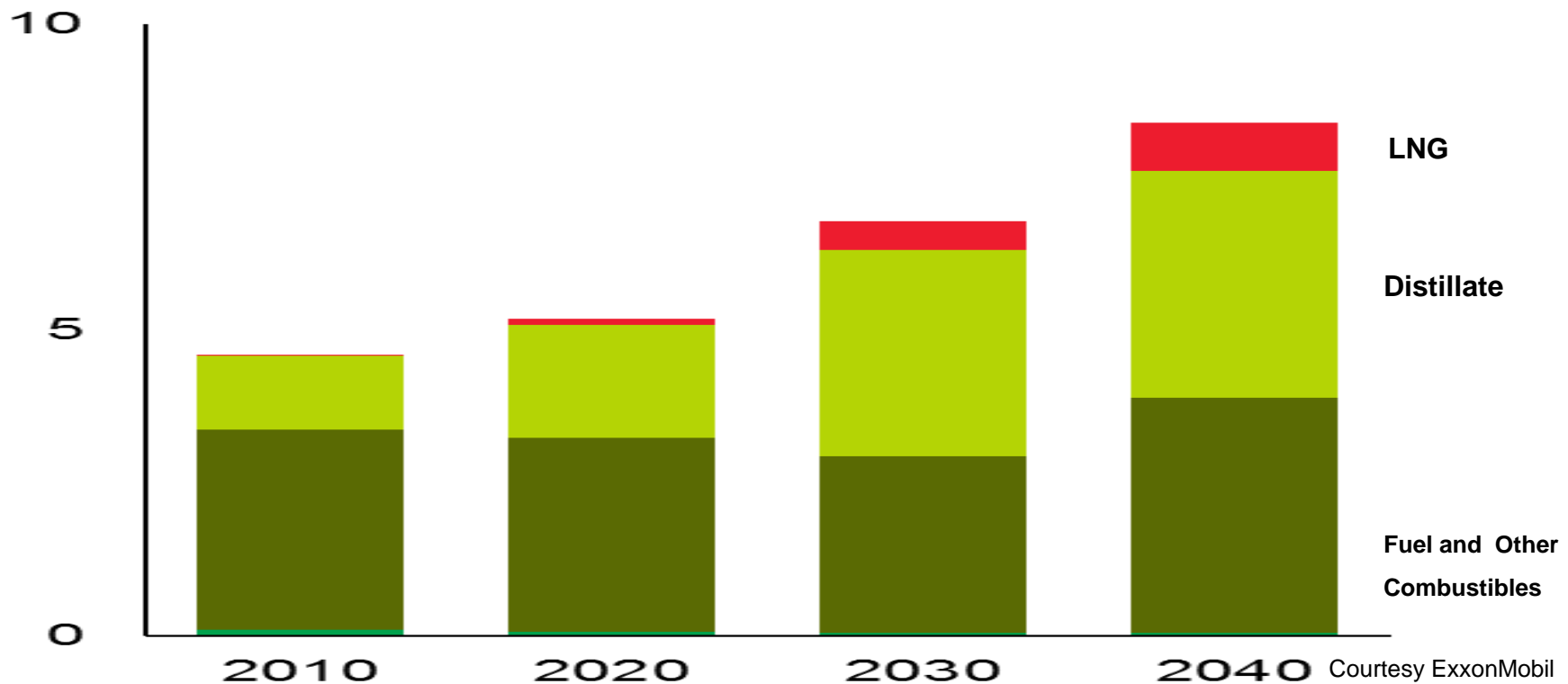
Proven reserves in billions of barrels, Source Oil & Gas Journal

# Liquid Marine Fuel will not Go Away. Low Sulphur Fuels, incl Gas, will be more dominant.



ExxonMobil suggest that 12 % of the fuel then will be gas in 2040.  
This estimate is roughly confirmed by the Fuel oil suppliers in general.

MBDOE



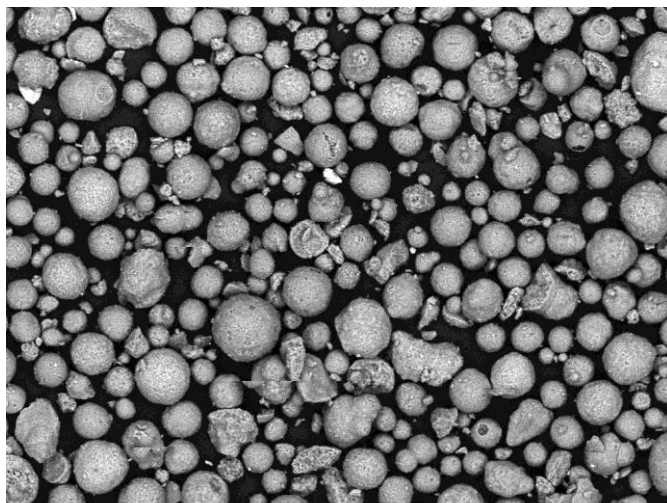
# New Fuel Types < 0.1% Sulphur



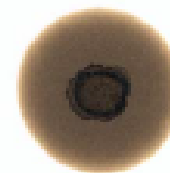
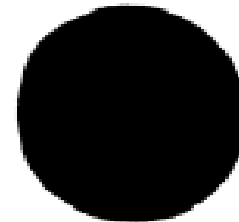
There are a range of new fuels being launched at the moment. These are not distillate types, rather new blends or types.

## General characteristics are:

- Higher viscosity than distillate
- Some may contain cat fines (Al+Si)
- Some have high pour points
- Compatibility with other fuels may also be an issue.



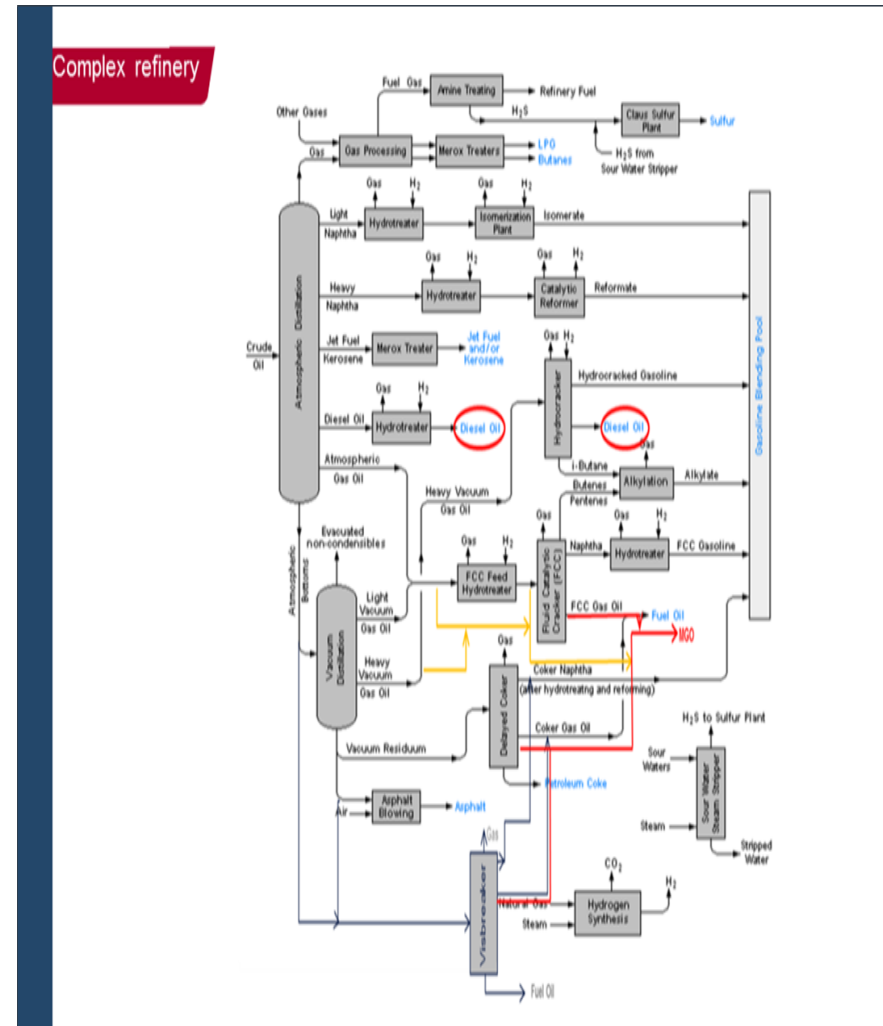
SEM HV: 15.00 kV WD: 16.68 mm  
View field: 577.8  $\mu\text{m}$  Det: BSE  
SEM MAG: 500 x Date(m/d/y): 10/14/11  
100  $\mu\text{m}$  VEGA\\ TESCAN  
MAN Diesel & Turbo



# Production of Low-Sulphur HFO



- Sweet crude oil
- Refining – desulphurisation
- Blending – high-sulphur residual fuels with low-sulphur distillates
- Residue-thickened distillate fuel.
- Hydro-processed vacuum gas oil,
- Use of hydro-cracker









## Complex Refinery Process

# MAN Investigation of Scrubber Technology



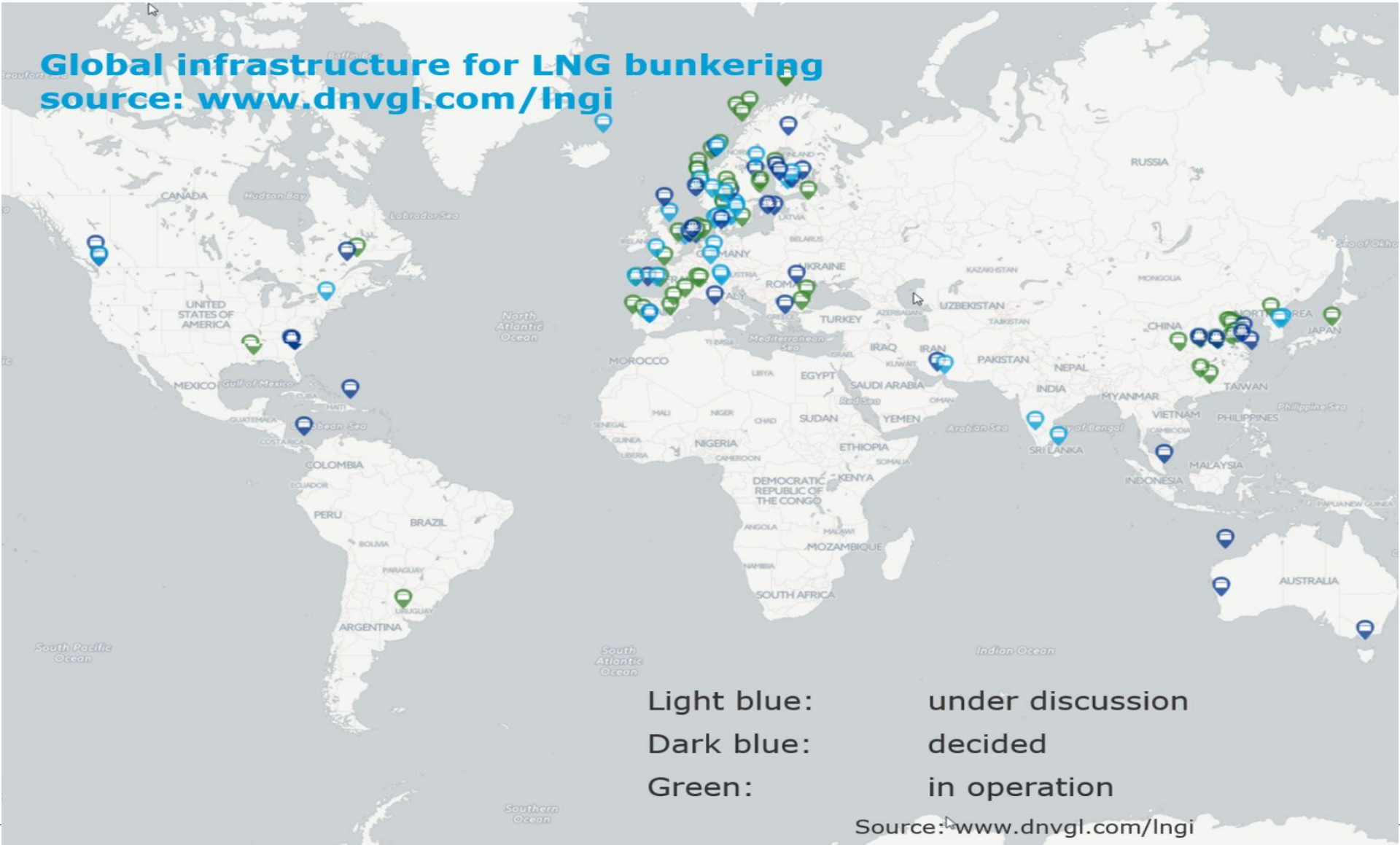
## Tests and future

Objectives	Participants	Scrubber	Goals	Test results	Ship test	Ship test
Development and test of scrubber for after-treatment	Clean Marine MAN Diesel		PM trapping: >90%  SO <sub>x</sub> removal: >67%	PM trapping: 35%  80% (salts add.)  SO <sub>x</sub> removal: 73%  95% (salts add.)	M.V. Banasol  7S50MC-C  9MW	
Development and test of scrubber for after-treatment	Aalborg Industries  Alfa Laval  DFDS  MAN Diesel		PM trapping: >75%  SO <sub>x</sub> removal: >95%	PM trapping: 79%  SO <sub>x</sub> removal: 100% (NaOH)	Tor Ficaria  9L60MC-C  20MW	
Development and test of scrubber for after-treatment and EGR	APM MAN Diesel		PM trapping: >75%  SO <sub>x</sub> removal: >90%	PM trapping: 73%  SO <sub>x</sub> removal : 96% (NaOH)	Alexander  7S50MC  9MW	

# Clean LNG supply Coming to Liner Ports within 3-5 Years



Global infrastructure for LNG bunkering  
source: [www.dnvgl.com/Ingi](http://www.dnvgl.com/Ingi)





# Comparison of Supply Chain



## LNG



Export terminal



LNG supply ships  
(Refrigerated)

- Only 5 vessels exist
- \$30mil/vessel

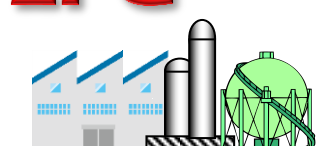


STS

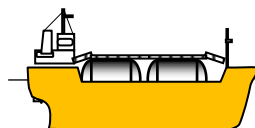


LNG-Fueled  
vessels

## LPG



Refinery



LPG supply ships  
(Pressurized)

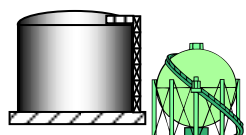
- Around 1,000 vessels
- \$10mil/vessel



STS



LPG-Fueled  
vessels



Export terminal



STS



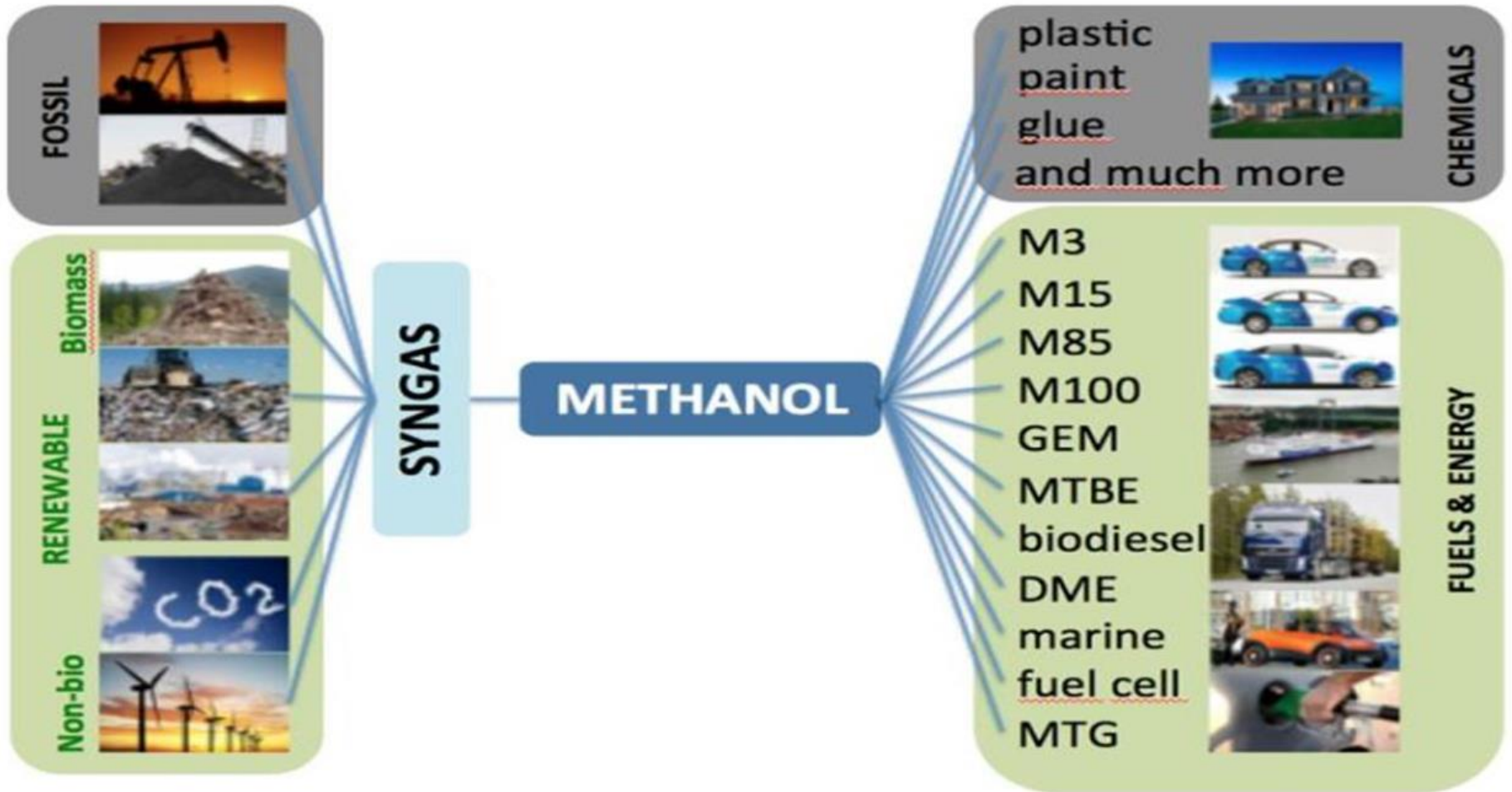
Floating vessels

# Methanol Demand Applications



Feedstock: Abundant/Sustainable

Market: Large/Diverse



# MAN B&W Two-Stroke Engines

MDT Cylinder lube oil standard



Engine type

Two-stroke engines

Engine design

$\leq$  Mark 7

$\geq$  Mark 8

Optimised for improved fuel consumption:  
Part load optimised and derated engines

No

Yes

Base design

Cylinder lube oil

Low S fuel

15-40 BN oil

15-40 BN oil

15-40 BN oil

High S fuel

70 BN oil

70-100 BN oil

100 BN oil

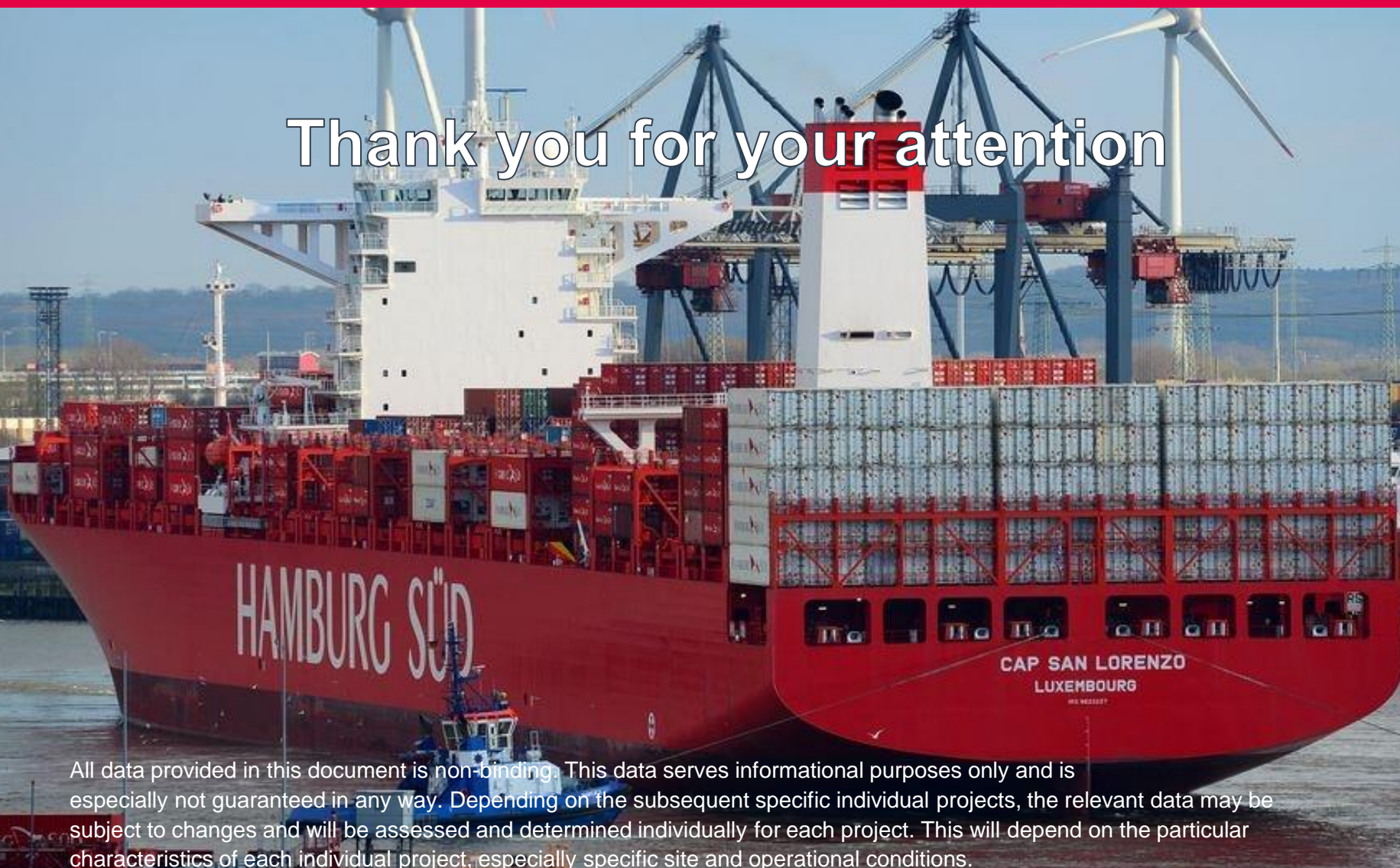
# What will we see in 2020 and beyond at the Marine Market. ?



- More use of Scrubbers and HFO together.
- Many different residuals/diesel 0.5% sulphur fuel-oils.
- More vessels using LNG, LPG, methanol, ethane...  
But how much depends on price and availability.
- Challenges with new fuels, and we need to be prepare and ready to adapt designs, lubes, auxiliary systems,...
- We need to be alert to new Fuels and prepare new CIMAC Fuel recommendations and ISO standards.

**2020-2030 will be a period of uncertainty before the fuel winners and losers become clear.**

# Thank you for your attention



All data provided in this document is non-binding. This data serves informational purposes only and is especially not guaranteed in any way. Depending on the subsequent specific individual projects, the relevant data may be subject to changes and will be assessed and determined individually for each project. This will depend on the particular characteristics of each individual project, especially specific site and operational conditions.