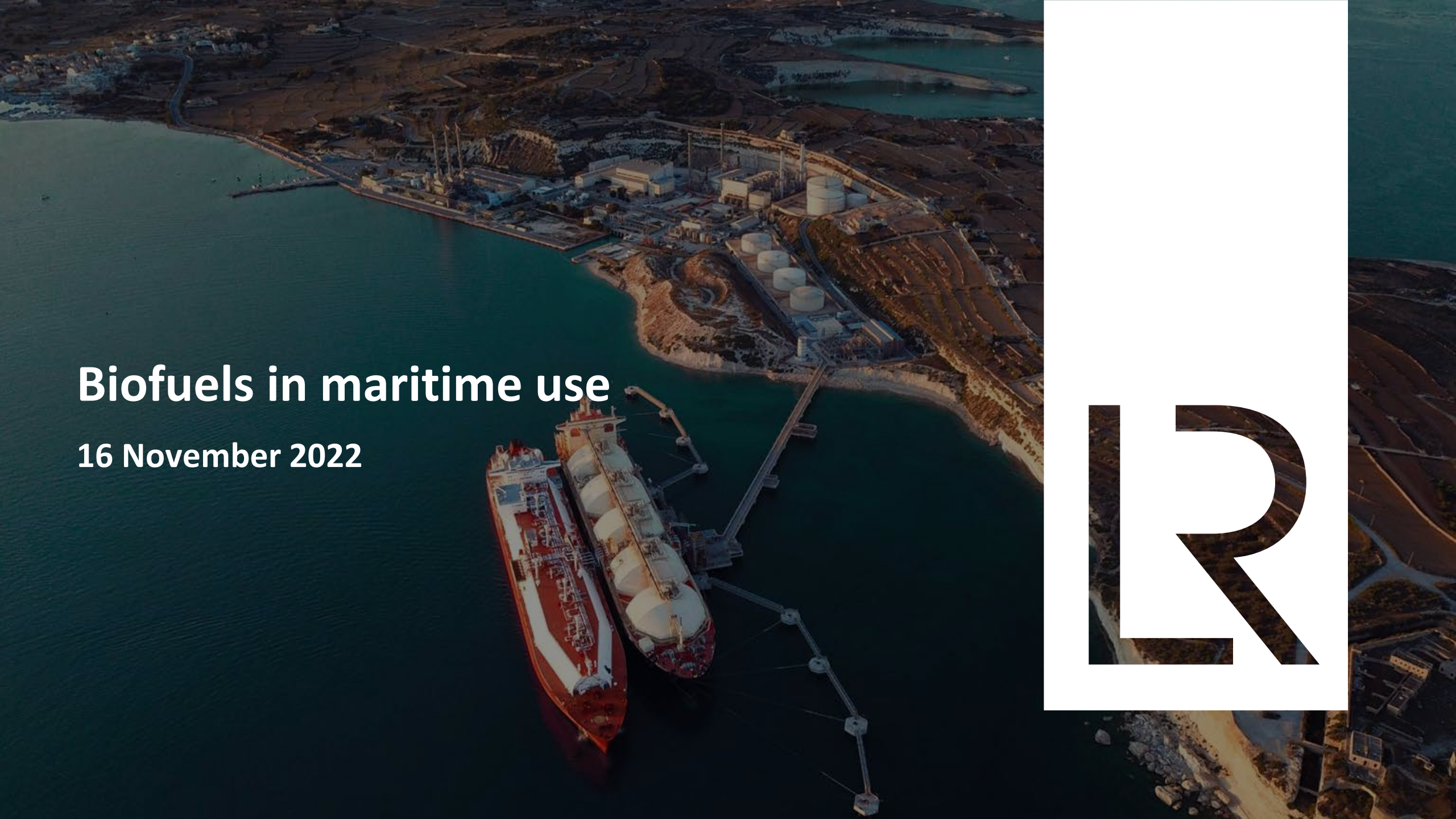
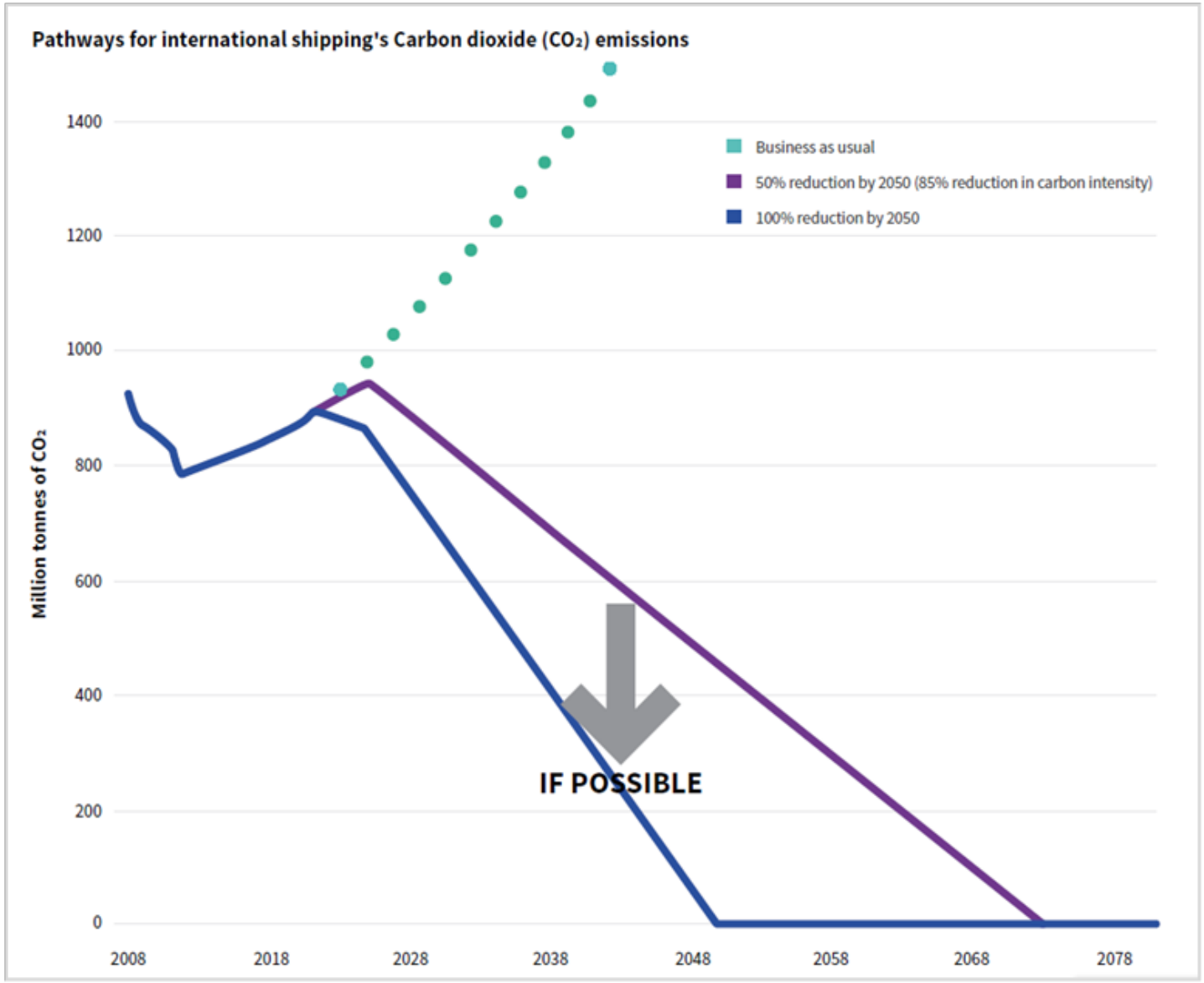


Biofuels in maritime use

16 November 2022

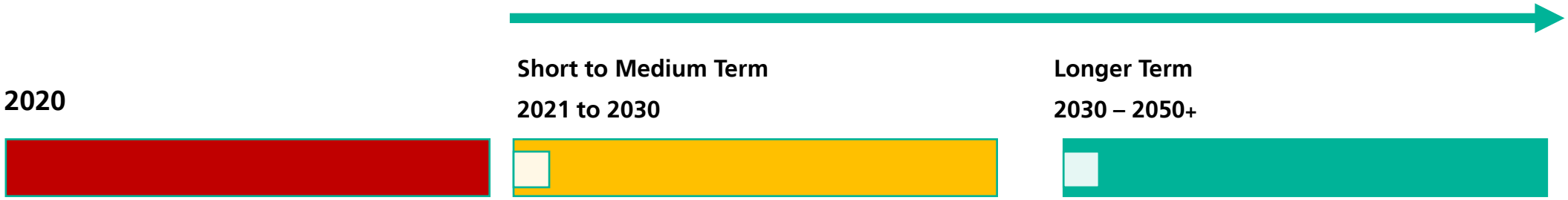
CO_2 emissions from shipping

- Shipping emits around **2.89%** of global CO_2 emissions
- Paris agreement (limit GWP to **1.5°C**)
- IMO GHG strategy
  - Reduce carbon intensity by 40% by 2030, 70% by 2050
  - Reduce GHG emissions by 50% by 2050
  - Phase out GHG emissions from international shipping as soon as possible



Main Fuel- Energy source Options ?

Transition from Fossil to Non-Fossil .....



2020

- Distillates 0.10%
- "ULSFO" 0.10% Residual blends
- 0.50% VLSFO
- HSFO + EGCS
- LNG – (DF)
- Methanol (DF)

Short to Medium Term

2021 to 2030

- Methanol, Ethanol, Ethane, LPG, Ammonia, LNG
- GTL, CTL - Fossil
- Biofuels (renewables: Gas Liquid solid)
  - BTL, HVO non Fossil
- Hybrid Solutions
  Wind – Solar – E-Battery
  - Fuel Cells

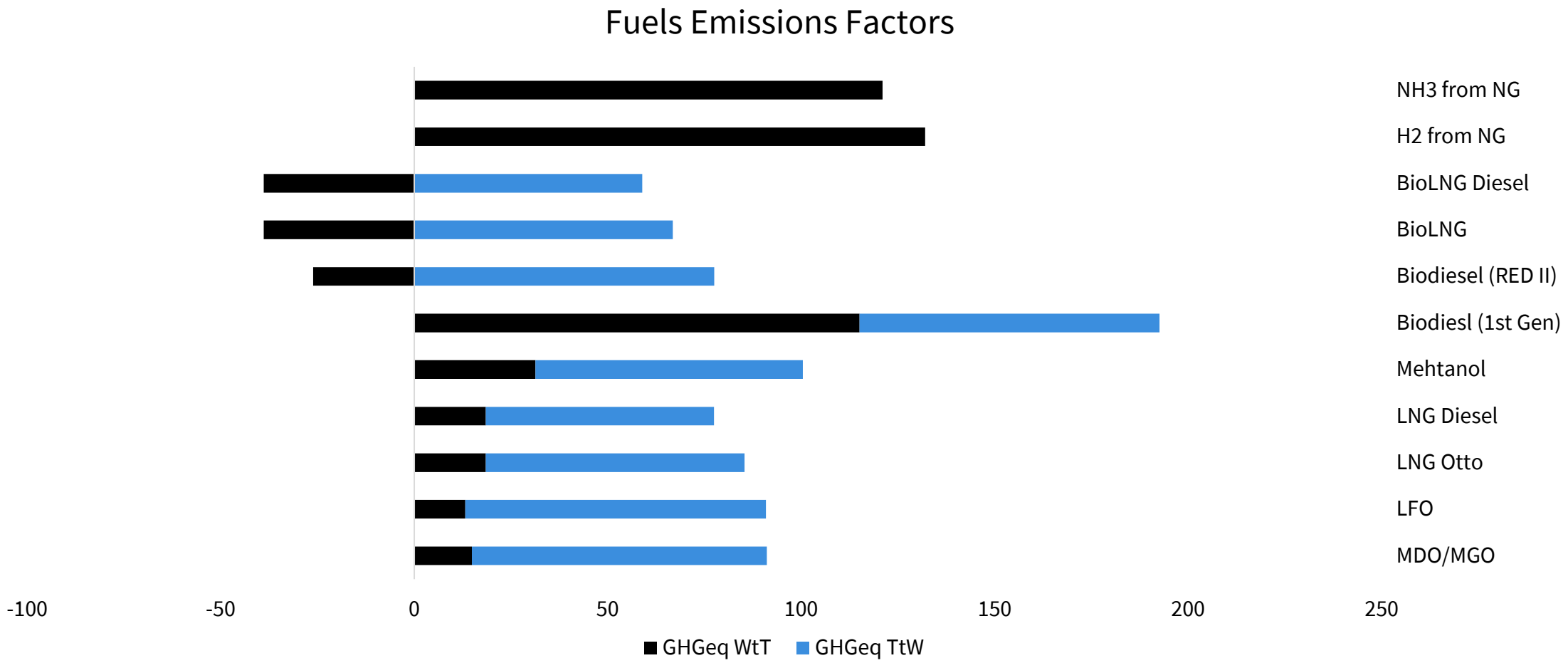
Longer Term

2030 – 2050+

- Non fossil Net Zero carbon liquid and gas :-
- Hydrogen Based:
  / E- NH3 / E- CH3OH / E- H2
- Biofuels / Liquid, Gas
- Nuclear

Drop in bio fuel product
a 'Today can do now' solution towards decarbonisation
based on WTW LCA but not TTW

Update on Fuel LCA Guidelines



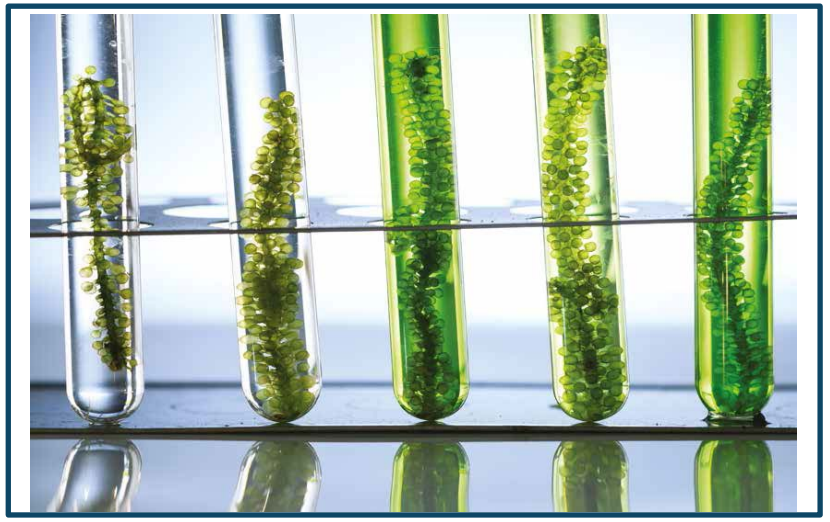
Any fuel produced from organic material

Multiple Variation in Feedstocks

Variation in Processes

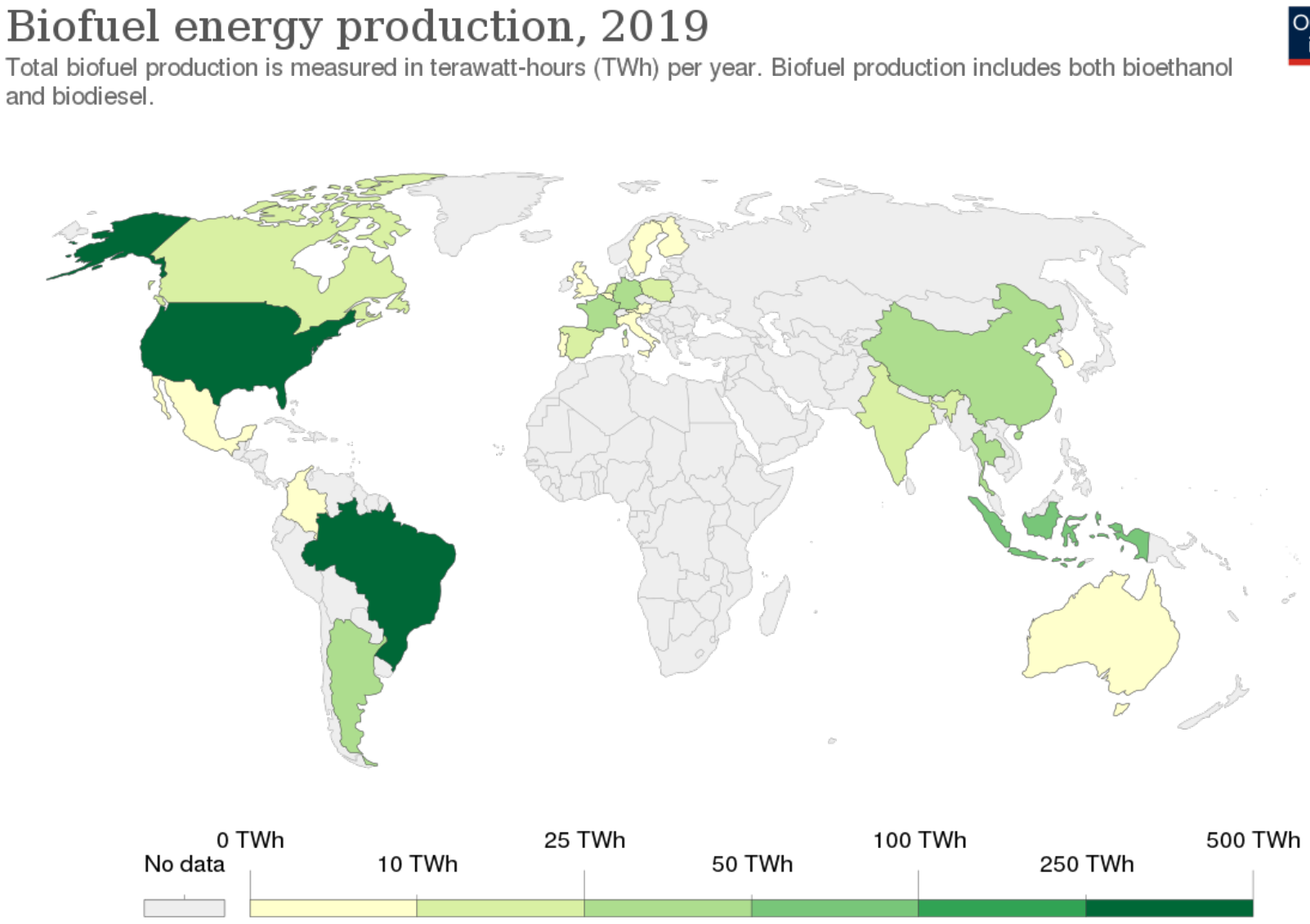
Multiple Products

Social / Environmental

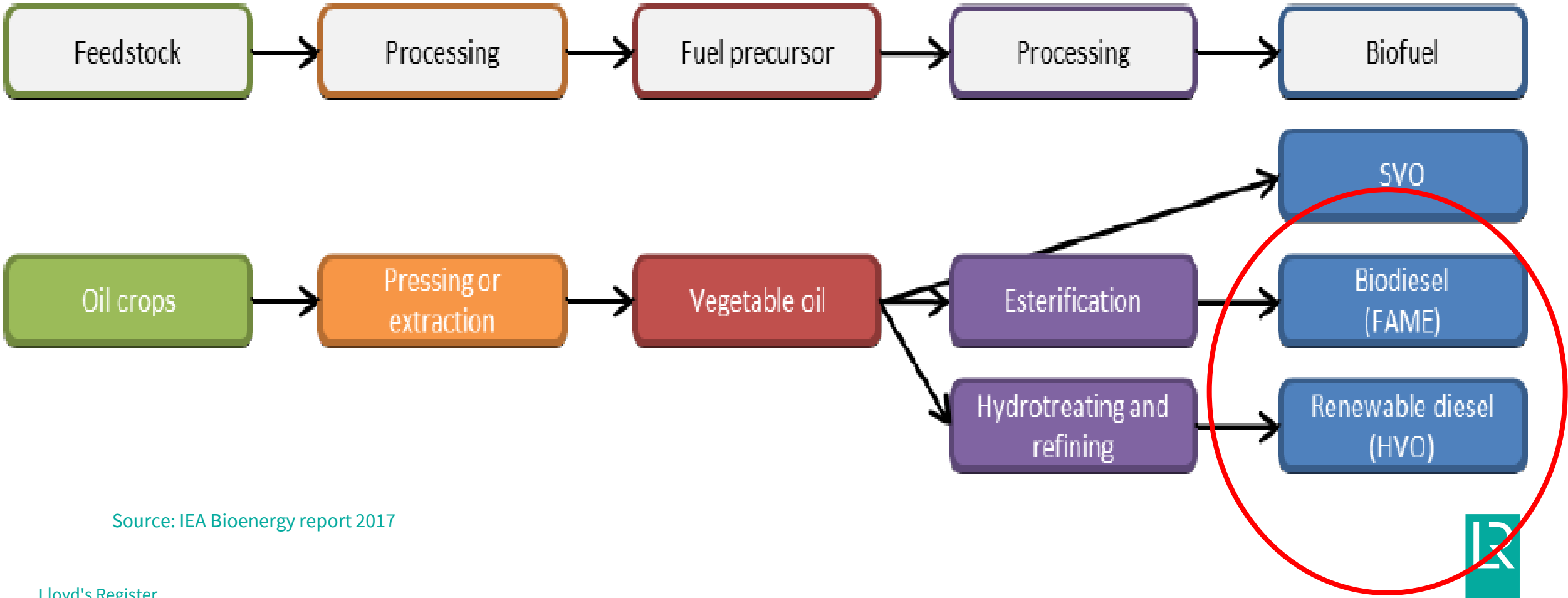


No one biofuel product can be used as a reference fuel for all biofuels -

Availability of Biofuels



A simple example of bio-derived fuel production



Source: IEA Bioenergy report 2017

FAME – requiring more fuel management attention

Functionally similar to petroleum-derived fuels and compatible with existing machinery and infrastructure.

- Lower energy density
- Hygroscopic
- Material compatibility
- Cold Flow Properties
- Oxidation Stability
- Microbial Activity

High Vol % presence of FAME impact on Bronze component

Fuel System and Machinery Considerations

Material compatibility

- Instrumentation is key
- Sensors - (OWS, ODM)
- Paints
- Filters (+ coalescers)
- Joints – seals – components

System Design

- No change from Petroleum arrg.
- Access to tank/pipe - sampling

Fuel management -

- Microbial activity / Tank drainage
- CIMAC Guidelines (2010) FAME in Distillate
  - www.cimac.org –

- Most engine builders providing guidance bulletins – MAN Wartsila + others

Material	Recommended	Not Recommended
Metals	Carbon steel Stainless steel Aluminium	Brass Bronze Copper Lead Tin Zinc
Elastomers	Fluorocarbon Nylon Teflon® Viton®	Nitrile rubber Neoprene Chloroprene Natural rubber Hypalon Styrene-Butadiene rubber Butadiene rubber
Polymers	Carbon filled acetal	Polyethylene Polypropylene Polyurethane Polyvinylchloride
Others	Fibreglass	

Current Bio fuel in marine – ISO EN and ASTM Specifications

Current Biofuel types have no international standards only national / regional

FAME (biodiesel) – cheapest –

- EN 14214 (B100) EN 16709 (B30) and ASTM D7963 (B100) +++

HVO (renewable 'green' diesel)

- EN 15940 paraffinic fuels (HVO)

ISO 8217 ~ 2024 will provide the operational and technical specs to be met by drop-in fuels – *allowing any percentage of blend from deminimis to B100*

— synthetic or renewable sources such as Hydrotreated Vegetable Oil (HVO), Gas to Liquid (GTL) or Biomass to Liquid (BTL);

— co-processing of renewable feedstock at refineries with petroleum feedstock.

Lessons learnt - experience so far

- NOx emission values are generally within allowable limits - more increased at lower loads/ less effect at normal operating loads
- Carbon monoxide (CO) emissions generally reduced across the load range
- Tank to wake CO2 emissions (kg/ MT fuel) decreased between 2.5% and 6.0% (due to the lower carbon content)
- Tank to wake CO2 emissions (kg/GJ) comparable with fossil fuels (due to the respective energy contents)
- Specific fuel consumption increased
- No need to adjust engine settings
- No operational problems reported with storage, handling, treatment and usage onboard

Lubrication on biofuels some experiences

- Lubricant oil mixed with biofuel blends (high proportion) in medium speed engines may be prone to oxidation, soot/deposit formation and wear
- For two-stroke engines, taking regular scrape down samples are important to evaluate the wear and cylinder combustion condition during biofuel use
- OEMs working with lubricant suppliers for specific formulations however little information as feedstock vary for these biofuels
- Specific conclusion from a ship trial:
  - Avoid taking scrape down samples immediately after changing to Biofuels, should be kept running for couple of days, especially when running on low load (stabilize condition)
  - Adjust CLO feed rate accordingly during and after changing to Biofuel (nominal two days)
  - For Biofuel especially for B20 cylinder oil BN40 may be insufficient, is not enough for this specific trial, suggest using higher BN

Supporting uptake of Biofuels

Class & Statutory

- Providing Initial guidance and requirements
- Administration support exemptions MARPOL Annex VI reg 3.2 - IMO looking at LCA for CO_2

Oil majors

- Producing biofuels for marine use
- Trialling products

ISO / CIMAC

- Updating guidance notes for Biofuels use in marine
- ISO looking to set standard for biofuels quality in marine use

IACS

- Looking into implications of Biofuels
- Impact on EIAPP certificates - MARPOL Annex VI Reg 18.3.2.2
- IMO still to provide guidance

Fuel Testing consultancies

- Biofuels quality testing
- Emissions monitoring projects

OEMs

- Building experience and guidance
- Supporting the trials
- Learning curve for all
- Long term use still to be achieved

Unified Interpretation of MARPOL Annex VI reg 18.3

Regulation 18.3 "Fuel oil for combustion purposes delivered to and used on board ships to which this Annex applies shall meet the following requirements."

Unified Interpretation 12.1

A fuel oil which is a blend of not more than 30% by volume of biofuel should meet the requirements of regulation 18.3.1 of MARPOL Annex VI. A fuel oil which is a blend of more than 30% by volume of biofuel should meet the requirements of regulation 18.3.2 of MARPOL Annex VI. For the purposes of this interpretation, a biofuel is a fuel oil which is derived from biomass and hence includes, but is not limited to, processed used cooking oils, fatty-acid-methyl-esters (FAME) or fatty-acid-ethylesters (FAEE), straight vegetable oils (SVO), hydrotreated vegetable oils (HVO), glycerol or other biomass to liquid (BTL) type products. The Product Name, as entered onto the bunker delivery note, should be of sufficient detail to identify whether, and to what extent, a biofuel is blended into the product as supplied.

Biofuels up to B30 - verification of the NOx impacts is not required

Unified Interpretation of MARPOL Annex VI reg 18.3

Regulation 18.3.2.2 "fuel oil for combustion purposes derived by methods other than petroleum refining shall not cause an engine to exceed the applicable NOX emission limit set forth in paragraphs 3, 4, 5.1.1 and 7.4 of regulation 13."

Unified Interpretation 12.2

A marine diesel engine certified in accordance with the requirements of regulation 13 of MARPOL Annex VI, which can operate on a biofuel or a biofuel blend without changes to its NOX critical components or settings/operating values outside those as given by that engine's approved Technical File, should be permitted to use such a fuel oil without having to undertake the assessment as given by regulation 18.3.2.2 of MARPOL Annex VI. For the purposes of this interpretation, parent engine emissions tests undertaken on DM or RM grade fuels to the ISO 8217:2005 standard, as required by paragraph 5.3.2 of the NOX Technical Code, should be valid for all DM or RM grade fuels used in operation, or that the engine may be designed for, or capable of operation on, including those meeting the ISO 8217 standards superseding ISO 8217:2005.

Biofuels higher than B30 - should meet Reg18.3.2 of MARPOL Annex VI. NOx verification not required if the biofuel can be burnt without changes to the NOx critical components or settings/operating values

LR FOBAS biofuel support

Biofuel quality assessment and analysis programme

Operational risk assessment

Support in emission calculation and/or setting up emission monitoring programme

Advisory support

FOBAS network

FOBAS Labs:
UK, Singapore, Shanghai, Panama

Panama Labs:
Local analysis

FOBAS Service Centres:
Singapore, Rotterdam, Greece, UK

Access to network of other labs in most ports

Sample Kits Store:
UK, Singapore and local clients stocks

5
LR GMT offices worldwide

150
ports with bunker quantity survey capability

4
fuel laboratories worldwide

FOBAS Industry engagement

ISO TC28/SC4/WG6 (Marine fuel specification – ISO 8217)

ISO TC28/SC4/WG18 (Methanol as marine fuel spec – ISO 6583)

CIMAC WG7 (Fuels)

CIMAC WG8 (lubes)

Intertanko Bunker Subcommittee

Etc.

Thank you

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