METHANOL INSTITUTE

SIEW Roundtable: Methanol as a Marine Fuel

Tim Chan
Manager, Government Relations and Business Development (AP/ME)

October 31, 2019
Singapore

MEMBERS

Tier 1

MHTL – Methanol Holdings (Trinidad) Limited

methanex – the power of agility

سابك sabic

OCI

Tier 2

Qapac – شركة قطر للإضافات البترولية المحدودة – Qatar Fuel Additives Company Limited

MITSUBISHI GAS CHEMICAL AMERICA, INC.

ATLANTIC METHANOL

PETRONAS

MITSUI & CO., LTD.

Oman Methanol Company L.L.C. – شركة عُمان للميثانول ش.م.م.

Tier 3

Eni Ecofuel

سبكيم Sipchem – EXCELLENCE everywhere

GX G2XENERGY

JM Johnson Matthey – Inspiring science, enhancing life

Mitsubishi International Corporation

Tier 4

FiTech

Advent

HELM PROMAN METHANOL

azelis

MOL Mitsui O.S.K. Lines

Blue World Technologies

CARBON RECYCLING INTERNATIONAL

HALDOR TOPSOE

SCC Southern Chemical Corporation

bse engineering

FUEL FREEDOM – CHEAPER. CLEANER. AMERICAN-MADE.

solvadis – we do chemistry

YCI METHANOL ONE

Palcan

IGPMethanol

NW INNOVATION WORKS – Double Green Bridge

TRICON ENERGY

quantiam technologies inc.

IMTT – International-Matex Tank Terminals

NAKHODKA FERTILIZER PLANT

CLARIANT

CoogeeChemicals

OLAHMOTORS

VITUSA PRODUCTS™ INCORPORATED

GasTechno ENERGY AND FUELS

Nebraska Public Power District

INDUSTRY OVERVIEW

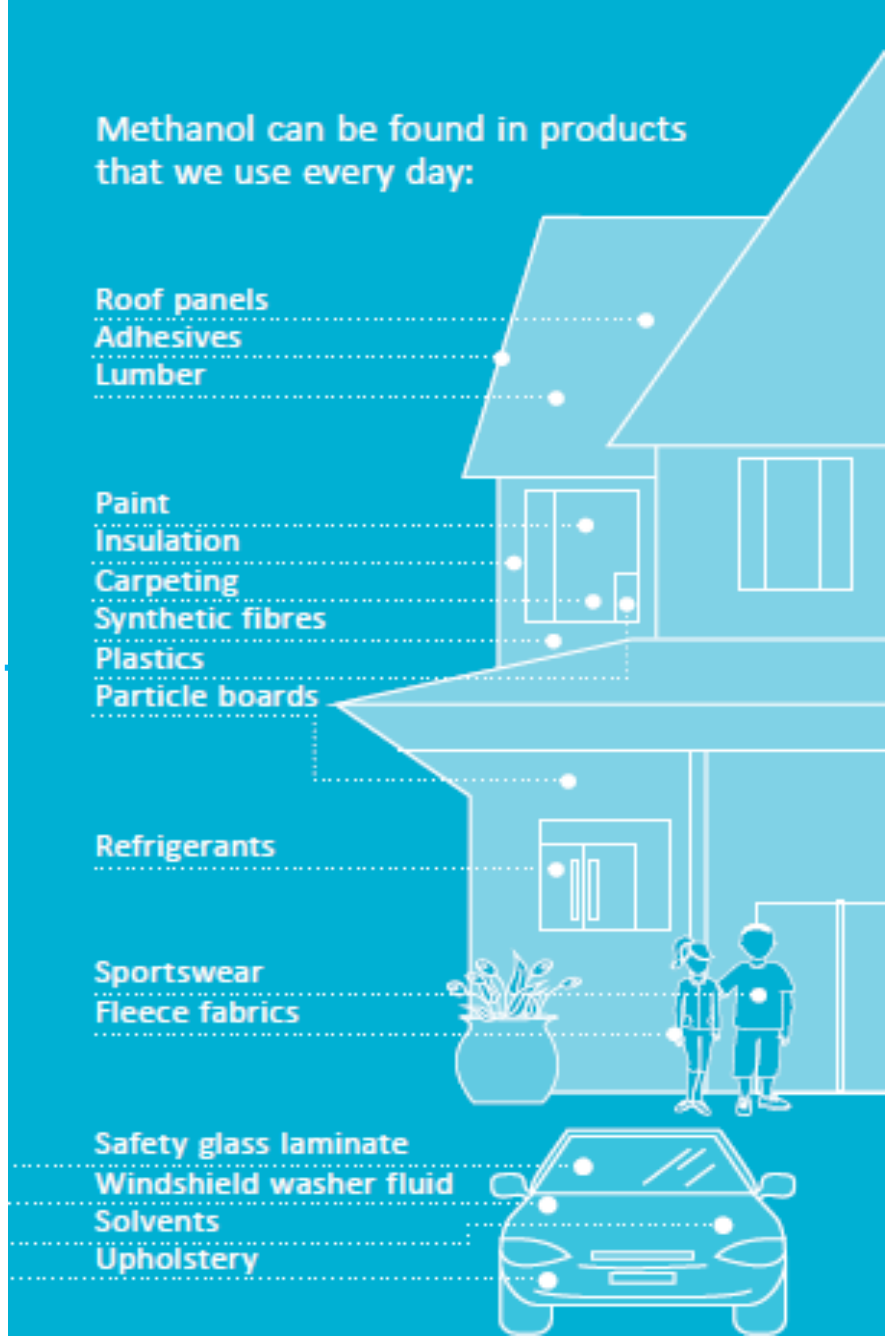
01

METHANOL

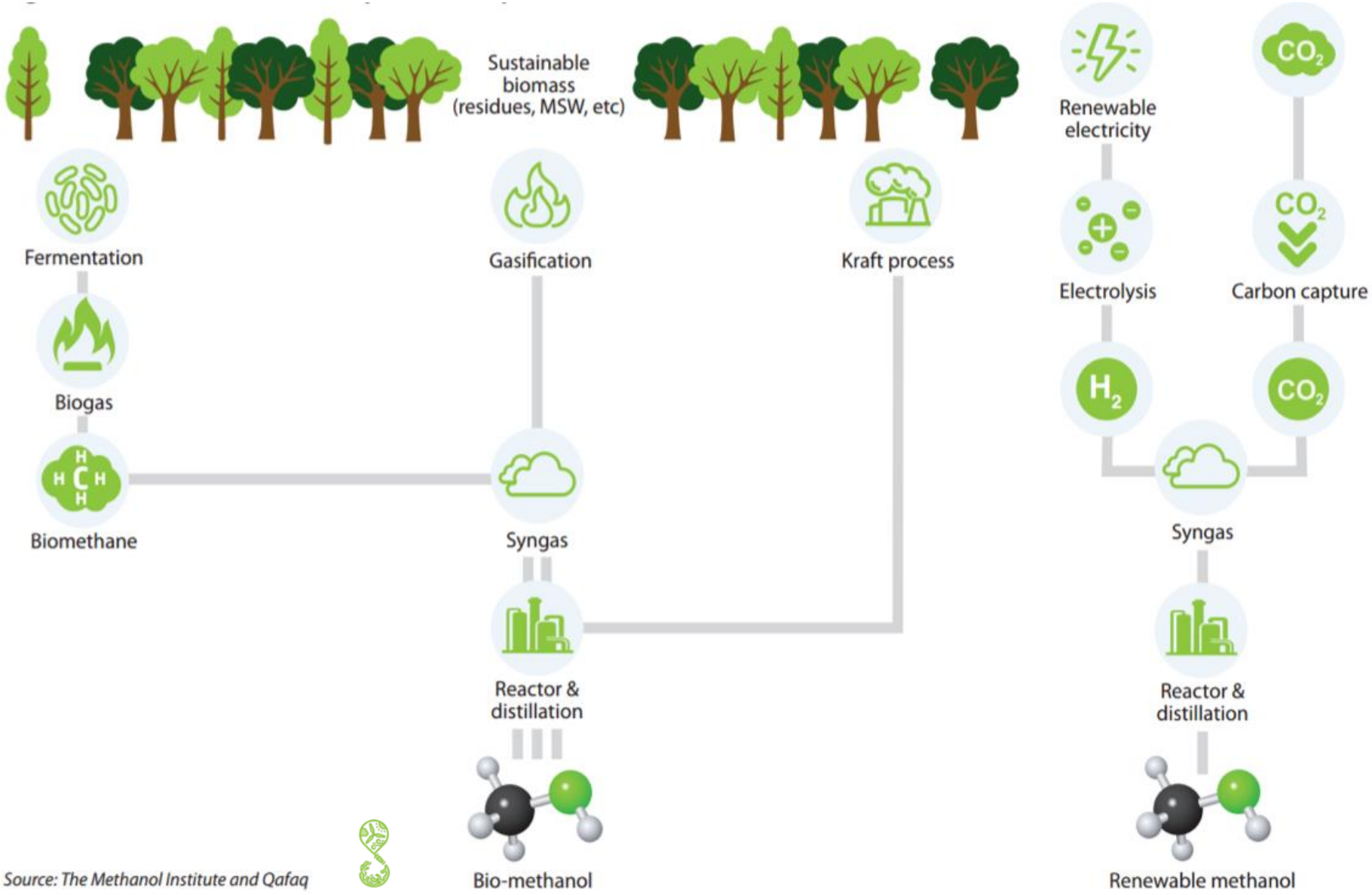
An essential ingredient of modern life

Energy/Fuel substitution markets - represent the fastest growing demand segment for methanol (~45% demand)

Chemical markets - essential ingredient used in countless industrial and consumer products (~55% demand)

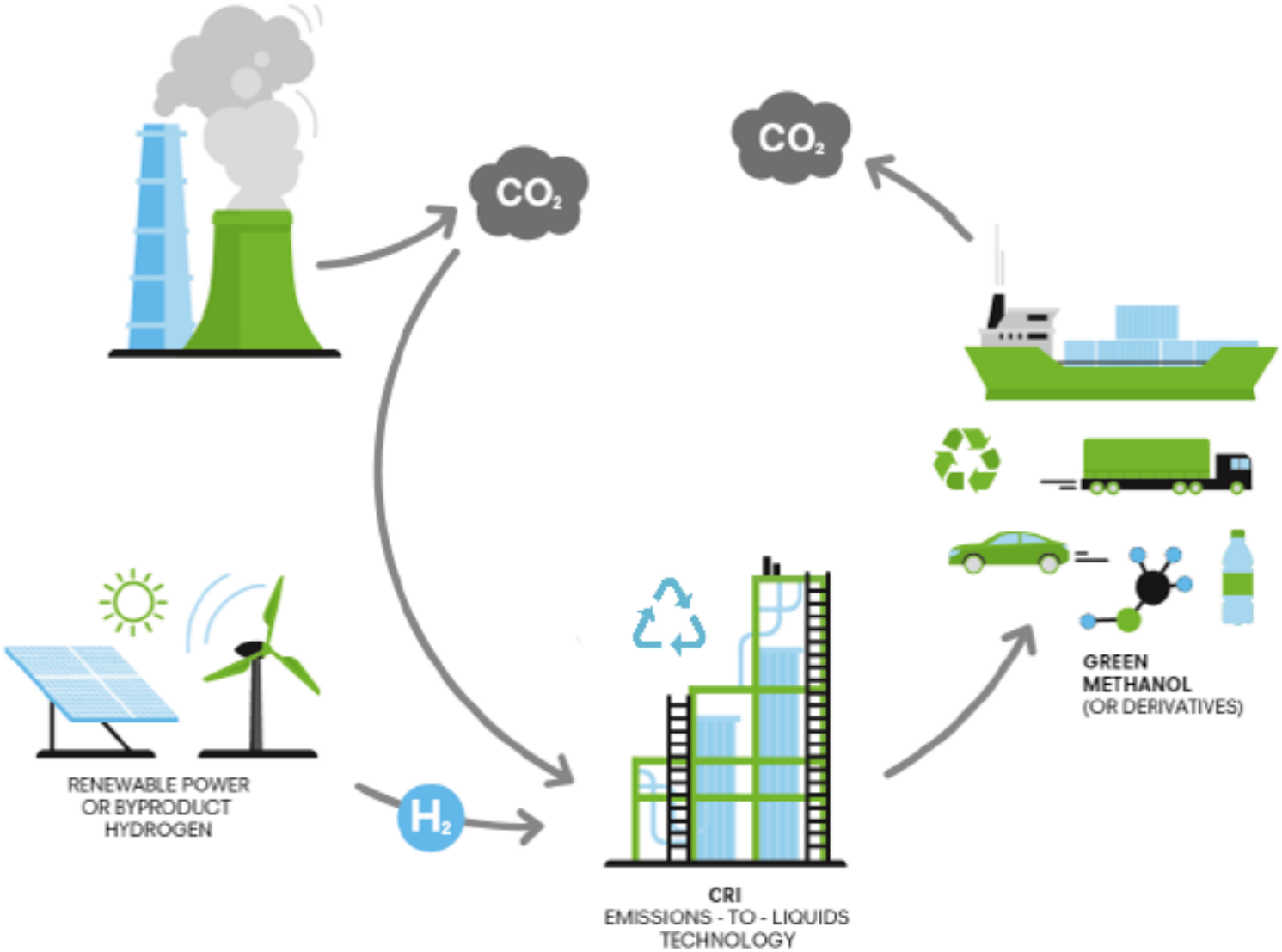


RENEWABLE PATHWAYS ARE RAPIDLY DEVELOPING



Source: The Methanol Institute and Qafaq

RENEWABLE METHANOL CIRCULAR ECONOMIES



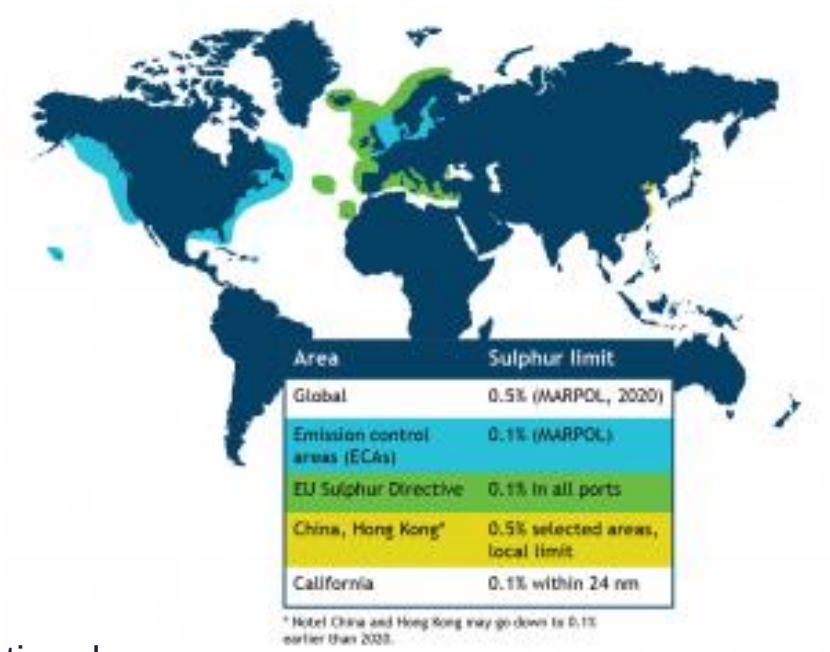
Source: Carbon Recycling International

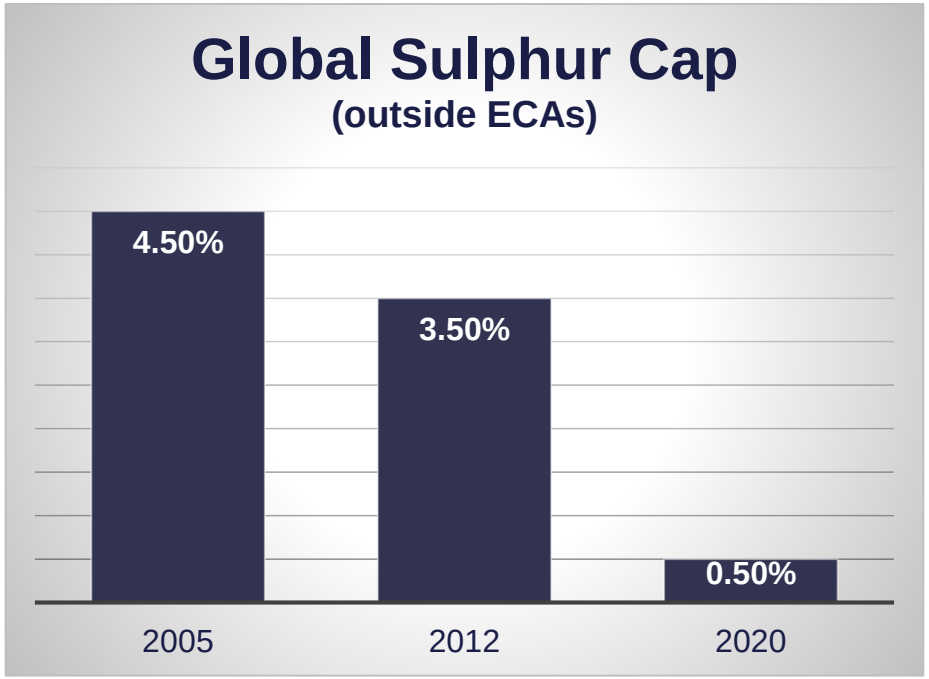
RENEWABLE/BIO METHANOL PROJECTS

INTERNATIONAL REGULATORY LANDSCAPE

02

SULPHUR CAP





International Convention for the Prevention of Pollution from Ships (MARPOL)

1973

2005

Annex VI Prevention of Air Pollution from Ships entered into force

ECAs first introduced with sulphur content limit of 1 %

2010

2015

Sulphur content lowered to 0.1% in ECAS

Global sulphur limit of 0.5%, effective January 2020

2016

>2020

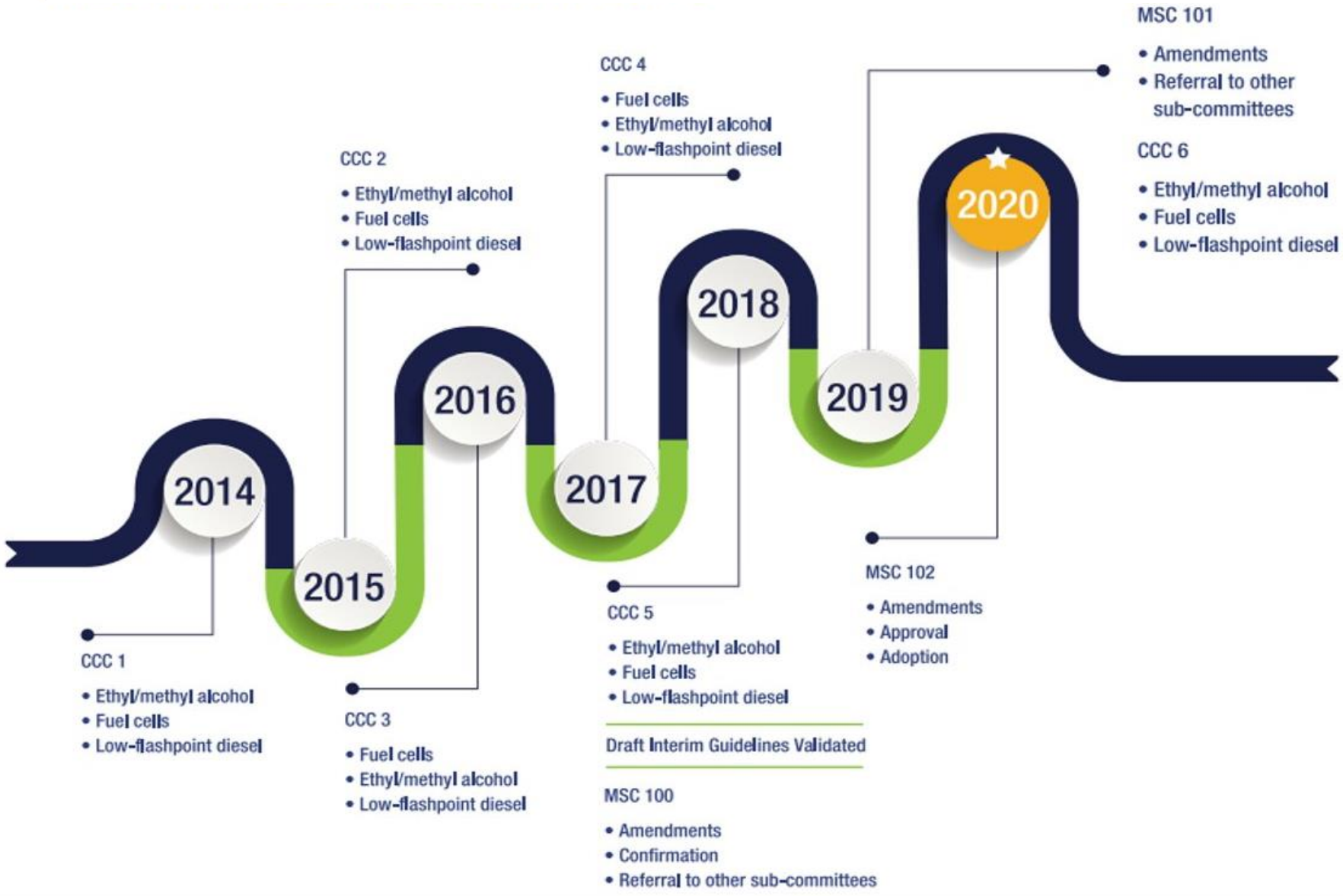
?

IMO Initial Strategy on the Reduction of GHG Emissions adopted at MEPC 72 (April 2018)

Level of ambition of Initial Strategy.

- Carbon intensity of ships to decline through implementation of further phases of energy efficiency design index (EEDI) for new ships.
- Reduce CO_2 emissions per transport work, as an average across international shipping by at least 40% by 2030, and 70% by 2050, compared to 2008.
- Peak GHG emissions from international shipping ASAP, and reduce total annual GHG emissions by at least 50% by 2050 compared to 2008

PROGRESSION OF GUIDELINES FOR METHANOL



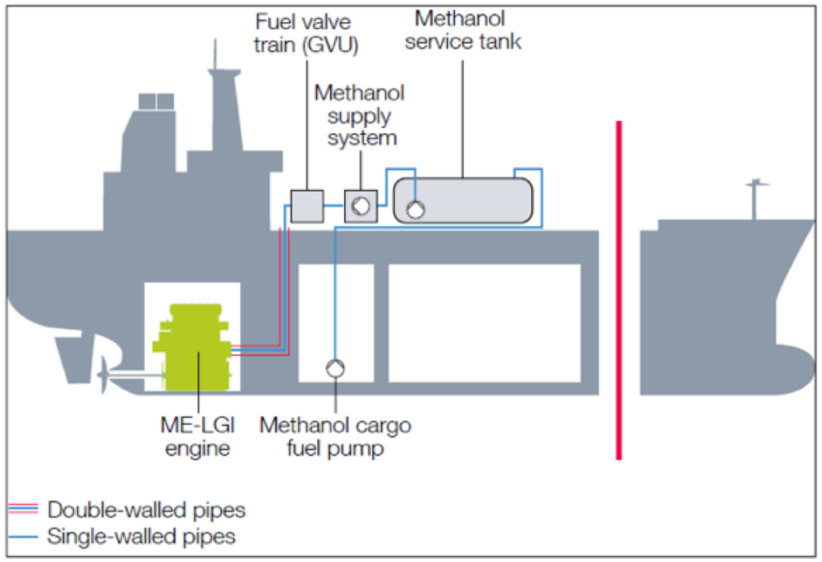
METHANOL AS A MARINE FUEL

03

CONVENTIONAL MeOH EMISSIONS SCORECARD

Methanol (MeOH) achieves low emissions & acts as a bridge in lowering CO_2 in the future (renewable/bio methanol)

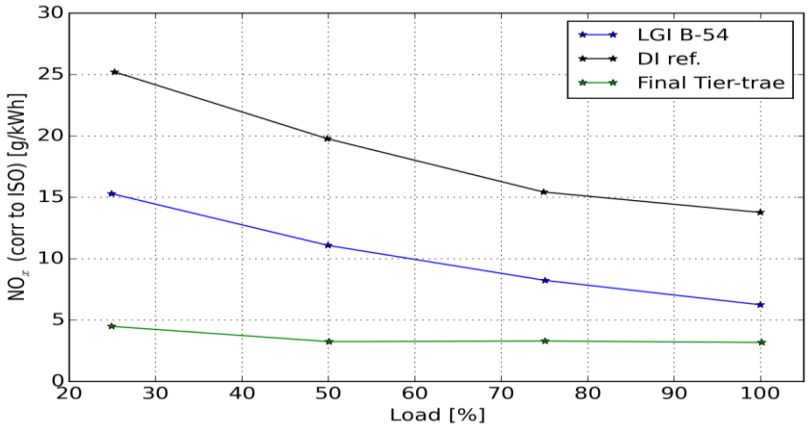
PRACTICAL SOLUTION

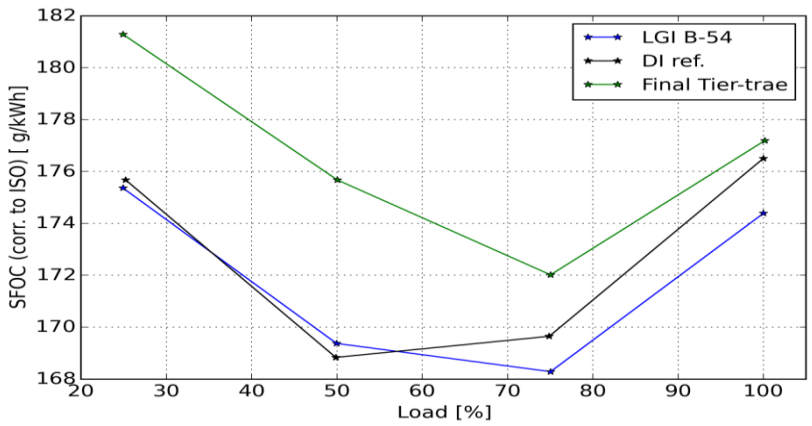


- **Multi – fuel engines will be the norm going forward**
- **Methanol can be readily and safely applied in both new build and conversion**

- **Methanol can be a practical solution for dual fuel applications, to include other alternative fuels such as LPG and LNG**

METHANOL / WATER BLENDING (EMULSIFICATION)

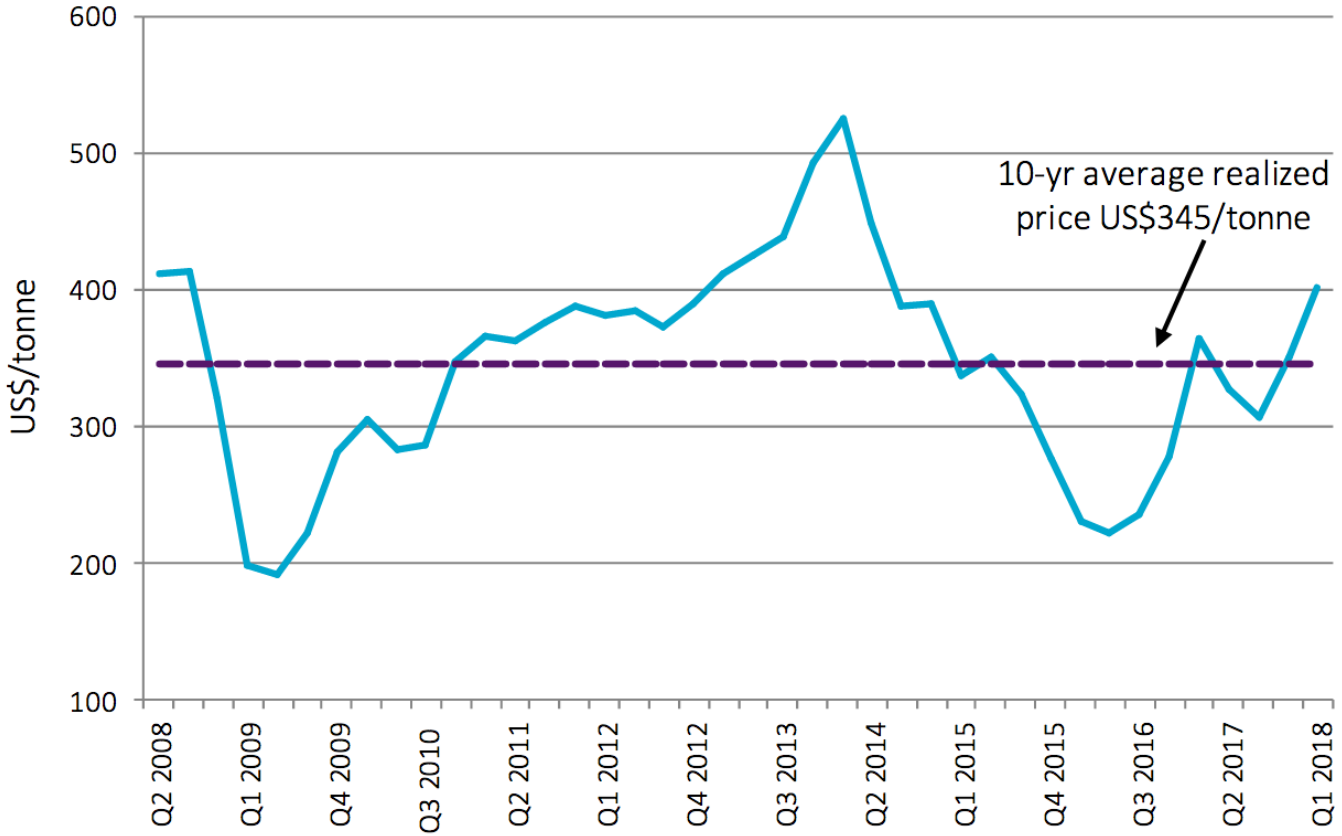




- Approximately 25-40% water is added to the methanol to achieve a new, Tier III solution
- NOx decreases almost linearly with water content, to approximately 2 g/kWh at 50% and 75% load
- Similar system is being planned for fuel oil, so the Tier III compliant technology will be available as a dual fuel solution
- R&D testing completed - service test is under preparation

Source: MAN

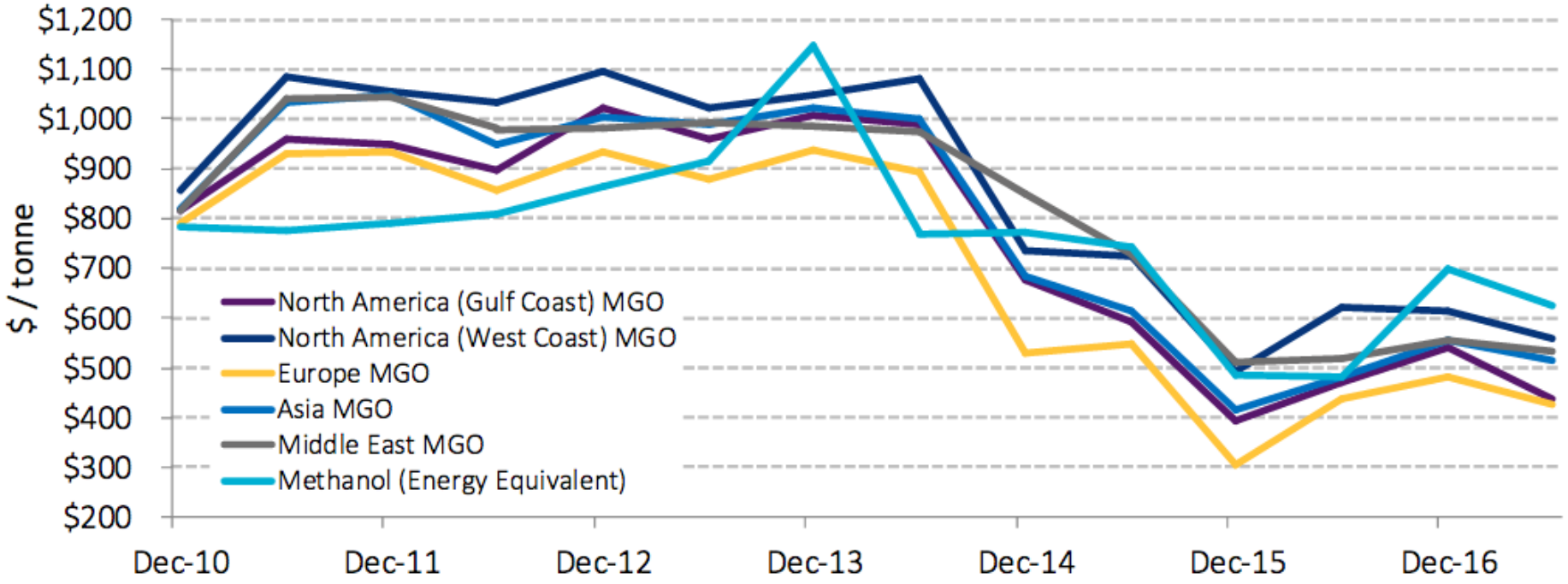
METHANEX 10-YR AVG REALIZED PRICE



- Methanex posts reference prices monthly in Asia and North America and quarterly in Europe
- Realized pricing is lower than reference prices due to discounts specified in contracts

Source: Methanex Corporation

METHANOL ON AN ENERGY EQUIVALENT BASIS

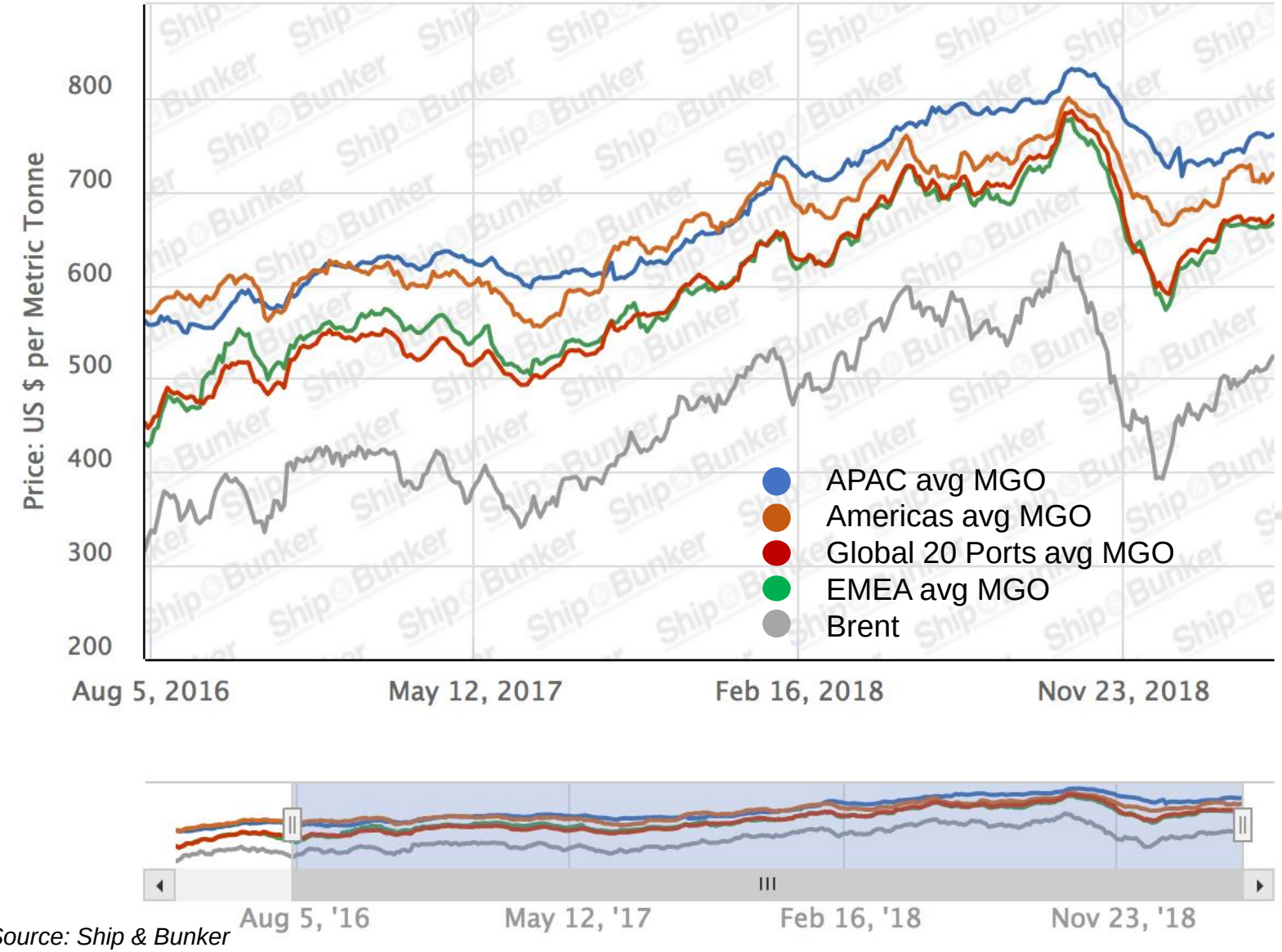


- MGO NA GC: Avg New orleans, Houston; MGO NA WC: Avg LA, San Francisco, Seatle, Vancouver; MGO Europe: Avg Rotterdam, Antwerp, Hamburg; MGO Asia: Avg Shanghai, Korea; MGO Middles East: Avg Fujairah, Kuwait, Khor Faakan

- Methanol: Avg USGC, China and Europe spot prices; adjusted to energy equivalent of MGO (2.16 factor)

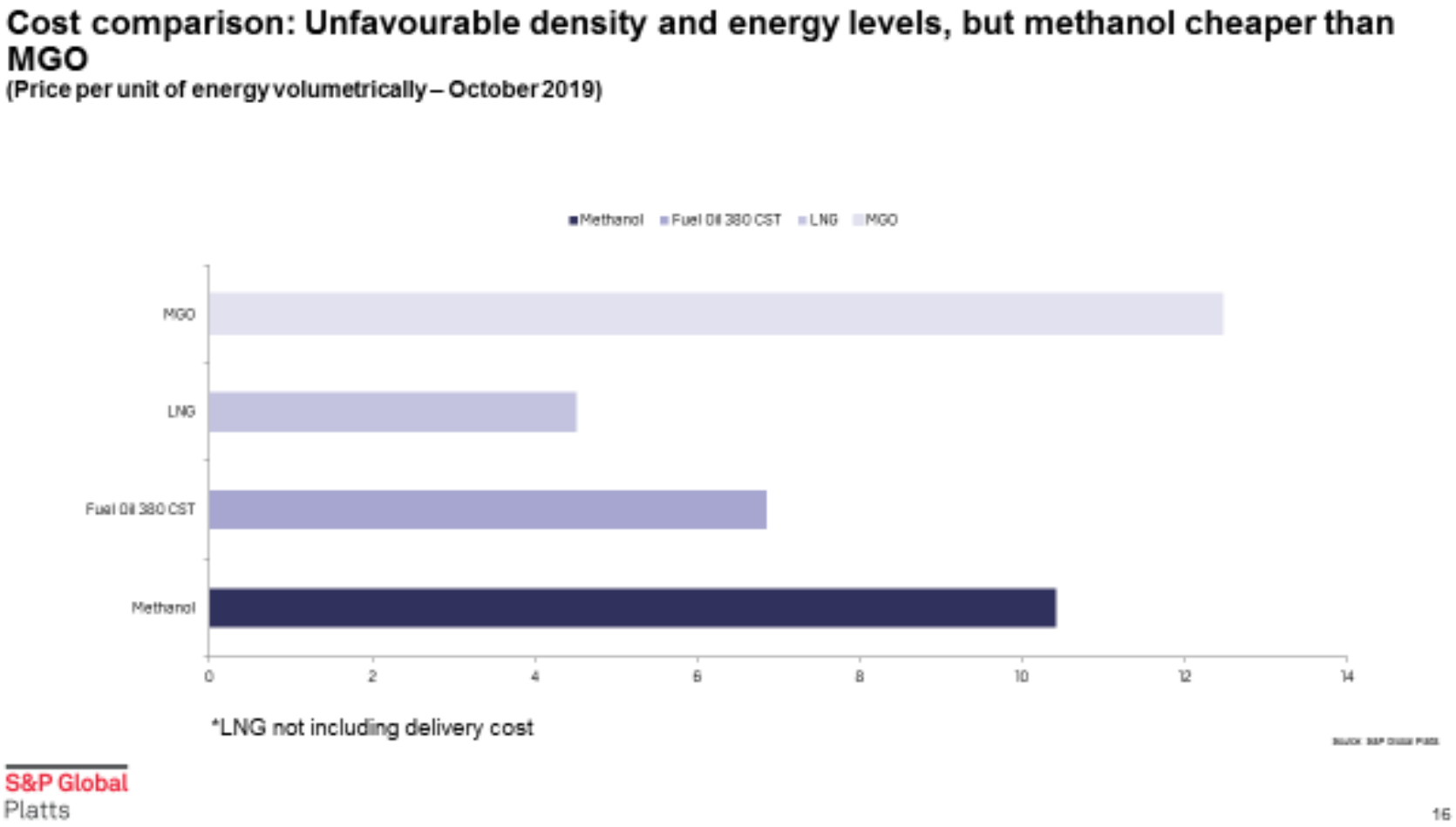
Source: Platts and IHS Chemical

BUNKER PRICING: 2-YR MGO SNAPSHOT



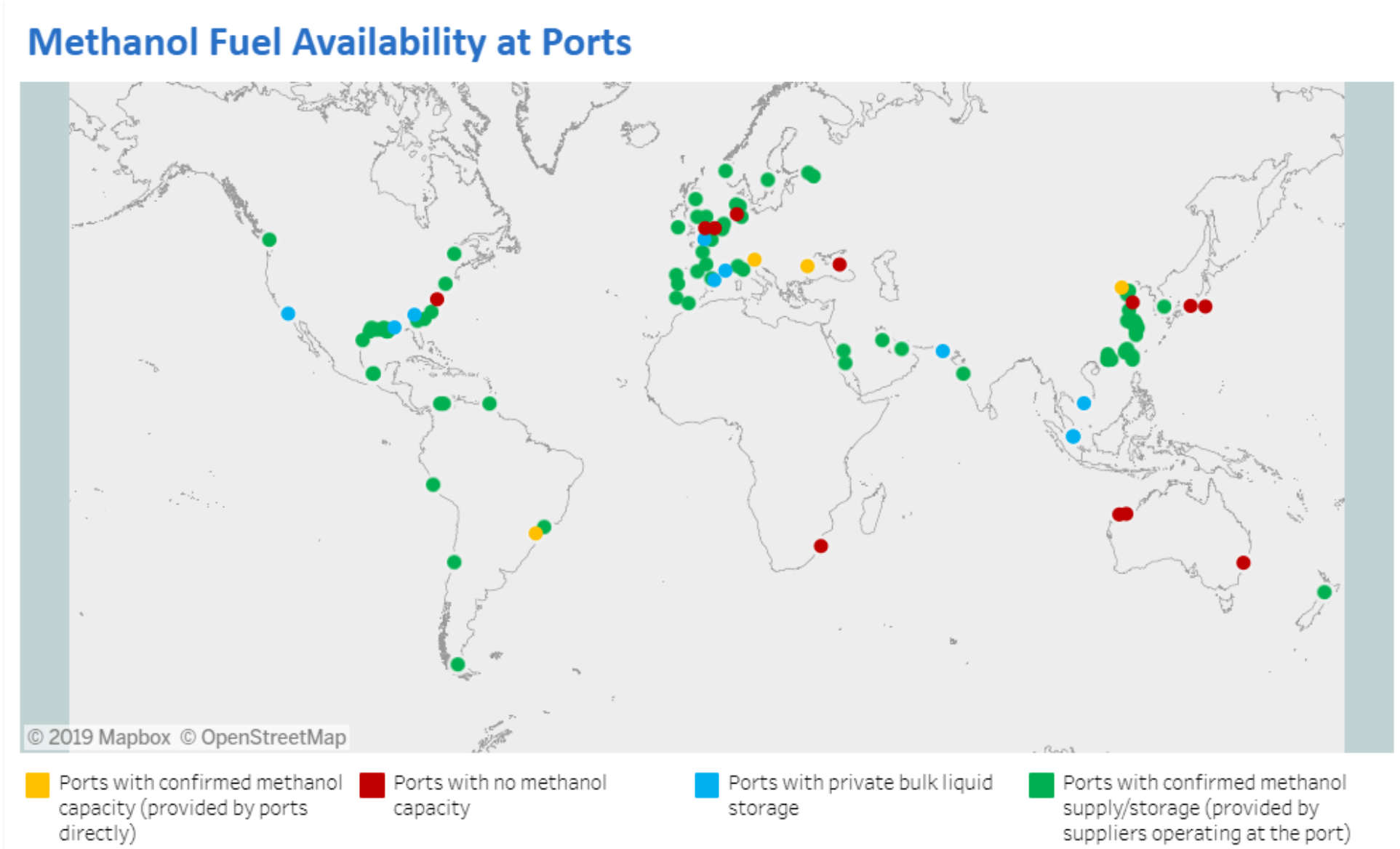
Source: Ship & Bunker

METHANOL ON AN ENERGY EQUIVALENT BASIS



Source: Platts

METHANOL IS WIDELY AVAILABLE AT PORTS



HAZARD COMPARISON

	METHANOL	DIESEL	GASOLINE
Hazard pictograms (CPL)			
Signal word: (CPL)	Danger	Danger	Danger
Hazard statements (CPL)	H225 Highly flammable liquid and vapour. H301 Toxic if swallowed. H311 Toxic in contact with skin. H331 Toxic if inhaled. H370 Causes damage to organs.	H226: Flammable liquid and vapour. H304: May be fatal if swallowed and enters airways. H315: Causes skin irritation. H332: Harmful if inhaled. H351: Suspected of causing cancer. H373: May cause damage to organs through prolonged or repeated exposure.. H411: Toxic to aquatic life with long lasting effects.	H224: Extremely flammable liquid and vapour. H304: May be fatal if swallowed and enters airways H315: Causes skin irritation H340: May cause genetic defects H350: May cause cancer H361: Suspected of damaging fertility or the unborn child H336: May cause drowsiness or dizziness H411: Toxic to aquatic life with long lasting effects
Precautionary statements (CLP)	P210 - Keep away from heat. - No smoking P280 - Wear protective gloves, protective clothing, eye protection, face protection P303+P361+P353 - IF INHALED: remove victim to fresh air and keep at rest in a position comfortable for breathing P305+P351+P338 - IF IN EYES (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower P308+P313 - IF INHALED: immediately call a POISON CENTER or doctor P403+P233 - Store in a well-ventilated place. Keep cool	P201: Obtain special instructions before use P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking P233: Ground/bond container and receiving equipment P241: Use explosion-proof electrical/ventilation/ lighting equipment P242: Use only non-sparking tools P243: Take precautionary measures against static discharge P260: Do not breathe dust/fume/gas/mist/vapours/spray P264: Wash hands thoroughly after handling P270: Do not eat, drink or smoke when using this product P273: Avoid release to the environment P280: Wear protective gloves/clothing/eye protection P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician P302+P352: IF ON SKIN: Wash with plenty of soap and water P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing P308+P313: IF exposed or concerned: Get medical advice/attention P312: Call a POISON CENTER or doctor/physician if you feel unwell P331: Do NOT induce vomiting P332+P313: If skin irritation occurs: Get medical advice/attention P370+P378: In case of fire: Use water spray or foam for extinction P391: Collect spillage P403+P235: Store in a well-ventilated place. Keep container tightly closed P403+P235: Store in a well-ventilated place. Keep cool P405: Store locked up P501: Dispose of contents/container in accordance with local/regional/national/international regulations	P201: Obtain special instructions before use P202: Do not handle until all safety precautions have been read and understood P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking P233: Keep container tightly closed P240: Ground/bond container and receiving equipment P241: Use explosion-proof electrical/ventilation/ lighting equipment P242: Use only non-sparking tools P243: Take precautionary measures against static discharge P260: Do not breathe fume/gas/mist/vapours/spray P264: Wash hands thoroughly after handling P271: Use only outdoors or in a well-ventilated area P273: Avoid release to the environment P280: Wear protective gloves/clothing/eye protection P301+P310: IF SWALLOWED: Immediately call a POISON CENTER or doctor/physician P302+P352: IF ON SKIN: Wash with plenty of soap and water P303+P361+P353: IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower P304+P340: IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing P308+P313: IF exposed or concerned: Get medical advice/attention P312: Call a POISON CENTER or doctor/physician if you feel unwell P331: Do NOT induce vomiting P332+P313: If skin irritation occurs: Get medical advice/attention P370+P378: In case of fire: Use water spray or foam for extinction P391: Collect spillage P403+P235: Store in a well-ventilated place. Keep cool P405: Store locked up P501: Dispose of contents/container in accordance with local/regional/national/international regulations

Methanol classified as “not more dangerous” than other fuels such as gasoline or diesel – fuels largely familiar to most people

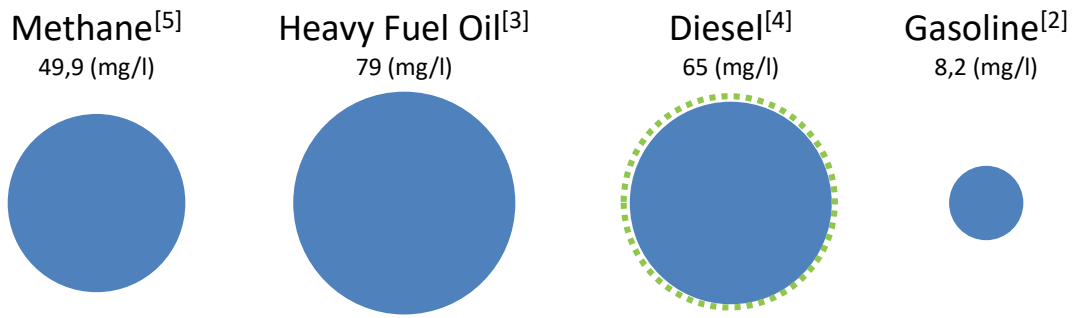
SAFER FOR THE ENVIRONMENT

LC50, LC = LETHAL CONCENTRATION FISH

Concentration in water, at which half the marine population died within the specified test duration

Safer than Diesel by a factor of 240 times

Methanol[1] 15,400 (mg/l)



[1] ECHA, European Chemicals Agency, registration dossier Methanol
[2] Petrobras/Statoil ASA, Safety Data Sheet, ECHA registration dossier Gasoline
[3] GKG/ A/S Dansk Shell, Safety Data Sheet
[4] ECHA, European Chemicals Agency, registration dossier Diesel
[5] ECHA, European Chemicals Agency, registration dossier Methane

Additional Source: Meyer-Werft

METHANOL FUELLED VESSELS AND PILOTS

	DUAL FUEL			FUEL CELL		PROJECT | R&D
						
Quantity	9 + 2	1	1	2	1	+4
Vessel Type	Chemical tankers	ROPAX ferry	Pilot boat	Tourist boat	Ferry	Cruise ships, fishing boats, barges, dredges, others
Owner	MOL, W-L, Marinvest, Methanex, Mitsui, OIIO, NYK	Stena Line	MI/SMA ScandiNaos	Innogy HTWG Konstanz	Viking Line	SUMMETH/MARTEC, Lean Ships, Methaship, Billion Miles[1], FiTech[2], IWAI[3], PCG Product Vessel[4], NTU[2], GMM, Fastwater, Port of Rotterdam Barge, Jupiter, Paxell, Methanex Fishing[5]
Engine Type	2 stroke MAN	4 stroke Wärtsila	high speed Scania, Weichai	Serenergy fuel cell stacks		SI hybrid, dual fuel, etc.
Design	new build	retrofit	retrofit	retrofit	retrofit	new build & retrofit

All projects are based in the EU unless noted otherwise[1]China/SG, [2]EU/China/SG, [3]India, [4]Malaysia, [5]China

BROADLY, METHANOL IS…

- **A cost effective and "future proof" fuel which can be produced from a variety of feedstocks – to include renewables**
- **One of the top 5 seaborne chemical commodities – safely handled for over 50 years**
- **A lower cost alternative for converting vessels, boilers and other power sources to methanol – minimal and economically viable without subsidies**
- **Widely available and alleviates many infrastructure and safety limitations both on land and at sea, trading within a narrower price range than competing fuels**
- **Not as well understood as a fuel, even though it has similar handling characteristics as distillate fuel**

THANK YOU

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