



GTT








MARINE
M O N E Y

Alternative Fuels *Time for a reality check!*

TECHNOLOGY FOR A SUSTAINABLE WORLD

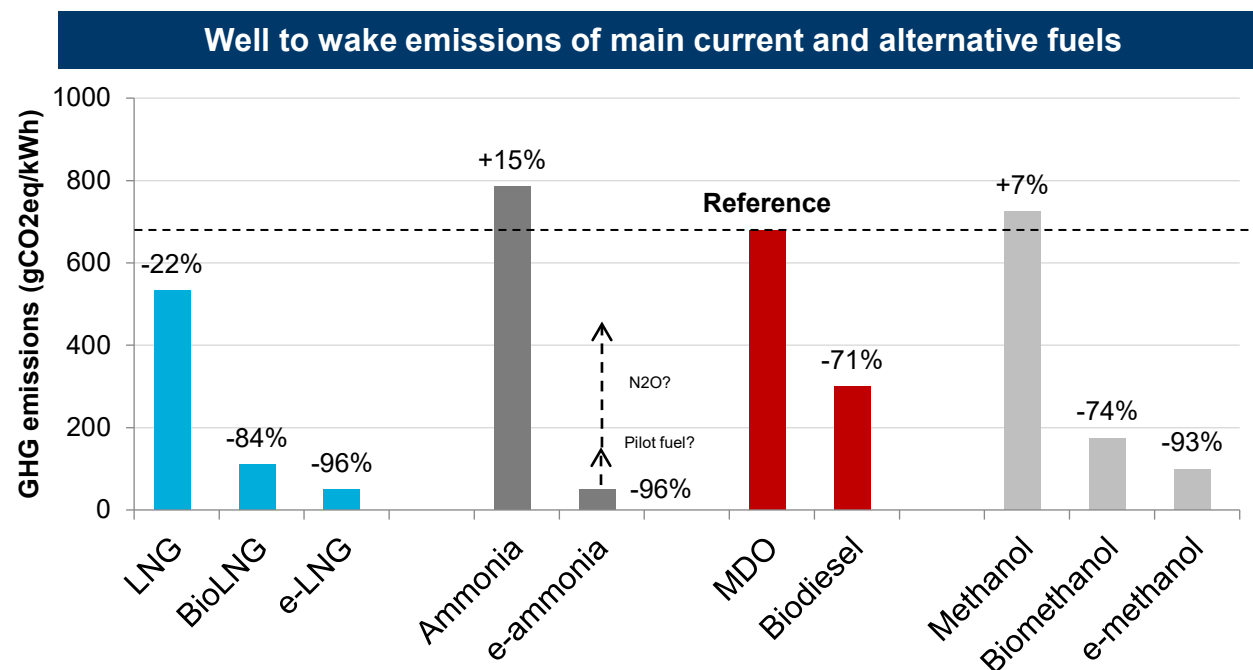
16th November 2023

REGULATION : CHALLENGING TO FOLLOW AND RESPECT

	Status	2023	2024	2025	2026	2027	What is it?
EEXI	In force	 Once in a lifetime notation – Done in Jan 23					Existing vessels design to be as efficient as NB
CII	In force	   In force since Jan 23 First grades and sanctions Revision of rules + choice of further reduction					Annual rating of CO2 emissions
Fuel EU	Voted	 Voted in May 23					GHG content of fuel (WtW)
EU ETS	Voted	 First Tax to pay in 2025 for 2024 emissions  <i>Gradual increase of share of emissions included, to reach 100% by 2027</i>					Taxation of GHG emissions

+ Private initiatives: Poseidon Principles, Sea Cargo Charterers, ...

LNG: ENVIRONMENTALLY FRIENDLY TODAY AND TOMORROW



Currently, LNG is the cleanest available fuel

- Ammonia/Methanol today more polluting than diesel
- Uncertainties regarding N₂O emissions from ammonia (GWP 250!), amount of pilot fuel required, NO_x, Ammonia slip, ...

Near future, bioLNG reduces emissions, and longer run e-LNG similar to other e-fuels

- Bio LNG can have negative footprint when produced from Manure / Sewage Sludge
- **BioLNG could represent 3% of shipping fuels in 2030 and 13% in 2050** (NTU University Singapore)
- E-LNG is the simplest use for green H₂ thanks to existing infrastructure.

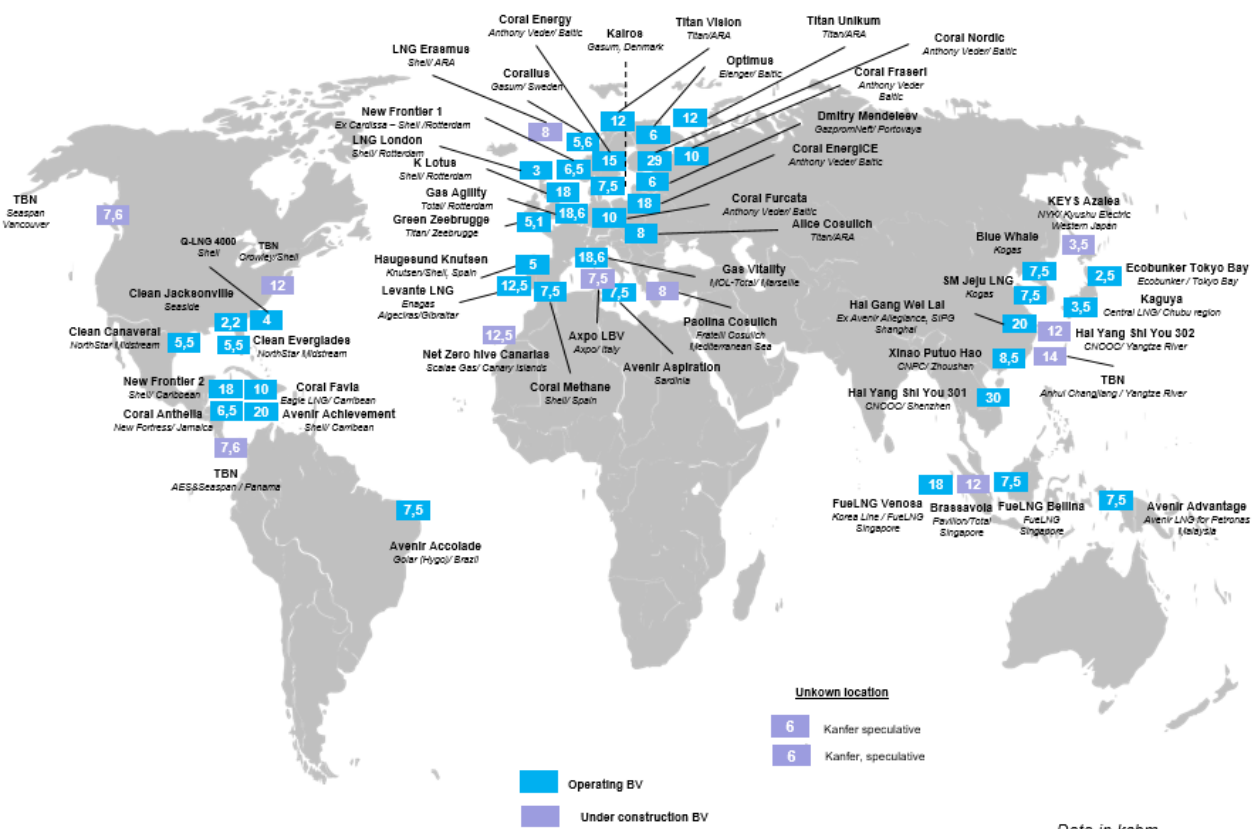
In addition, Uncertainties regarding hydrogen as fuel environmental performance



- +64% vs Diesel for grey H₂
- Potential indirect GWP of 11 for hydrogen (Source: University of Cambridge, mentioned by SGMF)

LNG FUEL: A WELL ESTABLISHED INDUSTRY

LNG BUNKERING MAP (LNGBV > 2K CBM)



LNG VS METHANOL FUEL TODAY

	LNG fuel	Methanol fuel
Fleet in service	>500 (+c.650 LNGC)	30
First vessel in operation	1960	2015
Largest engine installed	96MW	24MW
# ports with bunker vessels	c.40 in service c.10 under construction	0 in service 1 under construction
Current total market size	500 Mt _{LSFOeq}	50 Mt _{LSFOeq}
Current bunker market size	7 Mt _{LSFOeq}	0,15 Mt _{LSFOeq}
Current Bio production	>6 Mt _{LSFOeq} (of biomethane)	0,1 Mt _{LSFOeq}

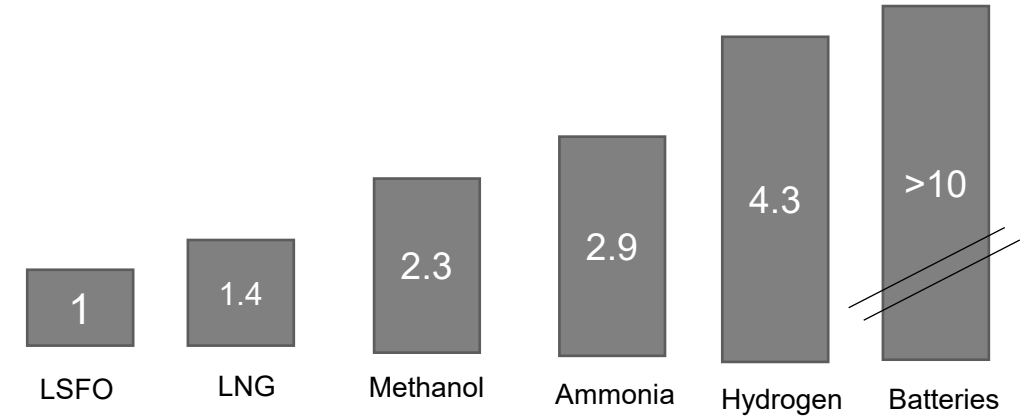
MANY CHALLENGES FOR NEW FUELS

Alternative fuels					
	LNG	Methanol	Ammonia	Hydrogen	Battery
Energy density	●	●	●	●	●
Technology maturity	●	●	●	●	●
Safety	●	●	●	●	●
Fuel supply infrastructure	●	●	●	●	●
Fuel availability (green)	●	●	●	●	●

Many challenges to overcome for new Alternative fuels

- It took 20 years for LNG fuel to really pick up
(even 60 years from first LNG engines on LNG carriers!)
 - Regulation
 - Price
 - Availability
- Liquid hydrogen is challenging technically to store
 - Smallest molecule, very hard to contain
 - Temperature: liquid at -253°C, just 20°C above absolute zero!

Tank size required to have same energy quantity as LSFO



Ammonia/Hydrogen would require fuel tank capacity as large as cargo carriers!

- -> 35-55k cbm fuel tank on large containerships!
 - as large as existing ammonia carriers!
 - ⇔ **1000-1500 TEU!**
- + issue of mass density
 - Methanol/ammonia 2,5x heavier than LNG to have same energy
 - > 5% loss on transportable cargo

GREEN FUELS: A HUGE CHALLENGE FOR SUPPLY

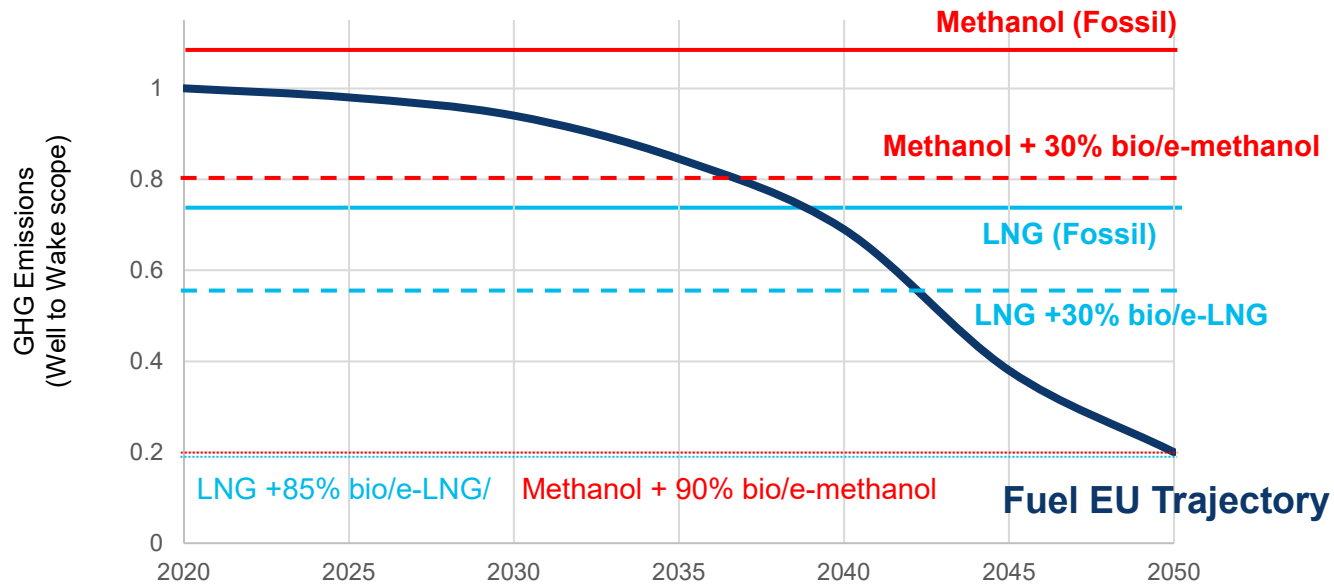
Switching 10% of the bunkering market to green fuels (c.25mtLSFOeq/y) would require...

	LNG	Methanol	Ammonia
Availability of biofuels <i>vs today</i>	X4 <i>(biomethane)</i>	x250	Not applicable
Availability of green hydrogen <i>vs today (for e-fuels production)</i>	x200		
Renewable power <i>(for e-fuels production)</i>	500GW (⇔ All European renewable capacity installed today)		
Reducing GHG emissions by 50% would require			
Share of bio/e-fuels	45%	70%	>60%
Annual Over cost of green fuels <i>(vs diesel)</i>	\$80bln	\$120bln	\$150bln

Assuming shipping takes 100% of those markets!

LNG AS FUEL BEST WAY TO COMPLY WITH NEW REGULATION

LNG AND METHANOL TRAJECTORY VS FUEL EU MARITIME REGULATION



Source: GTT analysis, EU
Base 1 = Diesel



LNG compliant until 2035-2040

- Immediate 20-25% CO₂ reduction vs Diesel
- This gain enables a reasonable, realistic progressive incorporation of bio and e- LNG

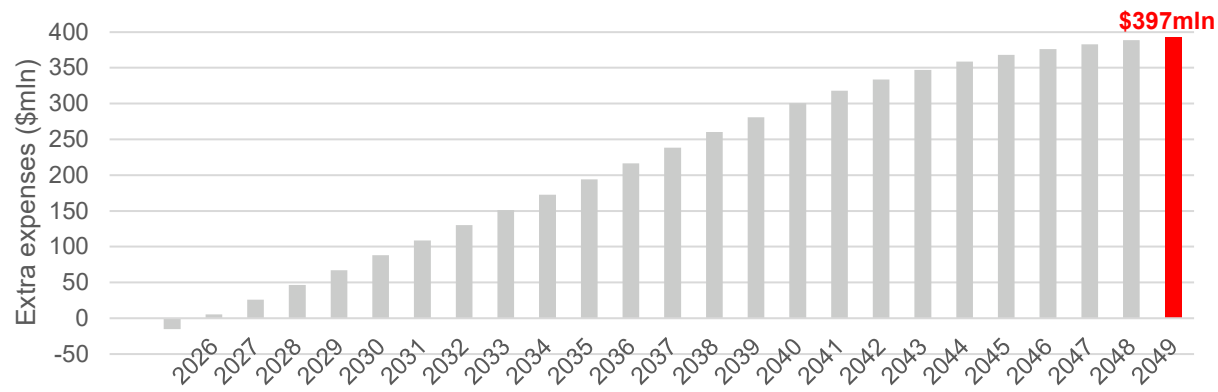
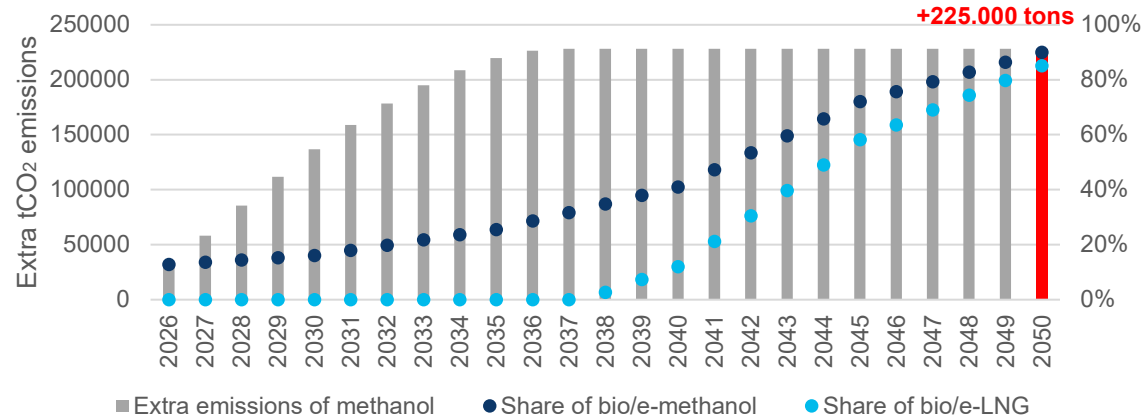
Methanol is not compliant today

- Fossil methanol (produced from coal & Natural Gas) is today **not compliant with Fuel EU trajectory**
- 12% of bio/e methanol must be incorporated to be compliant in 2025

-> Due to lack of availability those vessels are expected to run on diesel

METHANOL AS FUEL MORE GHG AND HIGHER TCO

EXTRA EMISSIONS AND COSTS OF METHANOL VS LNG FUEL ON A LARGE CONTAINERSHIP TO BE COMPLIANT WITH FUEL EU



Making the choice of methanol fuel today is committing to more CO₂ emissions...

- **More than 225.000 tons more CO₂ emitted by a methanol fueled containership** on the lifetime of the vessel
⇒ *Emissions of more than 15.000 cars during 25 years*
- Due to poor performance of fossil methanol vs immediate gains of fossil LNG

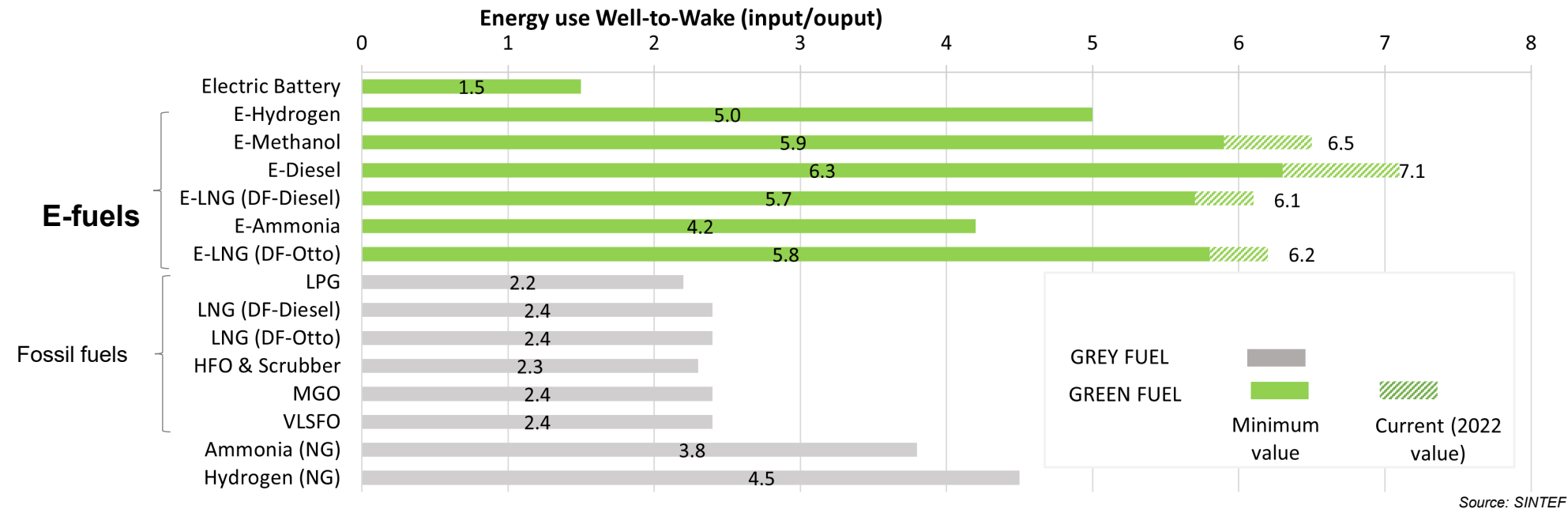
...And to more expenses

- **C. \$400mIn** over the lifetime of the vessel
 - ⇒ *c. 2x price of the vessel!*
- The LNG extra-capex gap is quickly absorbed (1 year)
- Mainly due to larger incorporation of e/bio methanol to be compliant Fuel EU (*and still more polluting than LNG!*)

Assumptions: Consumption: 120t LSFOeq/d (15KTEUs)
 Economics: \$100/tonCO₂ tax applied on 50% of voyage/ LNG fuel : \$400/tonLSFOeq (Long term contract) / Fossil Methanol : \$800/ton LSFOeq (pre crisis value) / Bio & e fuels: \$1200/tonLSFOeq
 Extracapex LNG fuel : \$20-25mIn/ Extracapex Methanol: \$ 5-10mIn
Methane slip included (MEGI engine)

CO₂ SHOULD NOT BE THE ONLY CONCERN

Energy required to produce 1 MWh



E-fuels have a very low energy efficiency

- Due to production process
- Are they the best use of green power?

Other pollutants to be watched

- Huge NO_x production with Ammonia
- SO_x & particulates issue solved with all alternative fuels

SHIFT FROM METHANOL TO LNG ON EXISTING ORDERS ...

AsiaEuropeLNG as Fuel

CMA CGM switches methanol containership order to LNG fuel

ByLNG Prime Staff

November 15, 2023



Image: CMA CGM

French shipping giant CMA CGM has decided to switch a recent order for eight methanol-powered containerships in China to LNG fuel, according to shipbuilding sources.



Thank you for your attention



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