FutureBridge

EXECUTIVE REPORT 2025

Ammonia or Methanol

Which maritime fuel will power the future of low carbon shipping?

Contents covered

Executive snapshot

Ammonia or Methanol: The right fuel to power the future of low carbon shipping

The Maritime fuel landscape

While conventional fuels still dominate global fleets, the rise in methanol-fueled vessels signals a clear shift toward low-carbon alternatives—driven by stringent regulation compliance requirements, infrastructure readiness, and evolving investment priorities.

Navigating the stringent regulatory & emission compliance policies

As global regulations push the maritime sector toward decarbonization, stringent IMO and EU policies are making compliance a central driver of fuel strategy, investment decisions, and fleet planning.

Methanol vs Ammonia: Choosing the right Green Fuel strategy

As shipping companies evaluate alternate fuel strategies for a low-carbon future, Methanol is fast emerging as the preferred choice due to its commercial engine availability, ease of handling, lower toxicity, and cost efficiency.

Strategic takeaways on what will drive the future of low carbon shipping

With stricter emission regulations and evolving fleet requirements, Methanol is fast emerging as the leading maritime fuel, driven by policy alignment, cost efficiency, rising vessel orders, and operational readiness.

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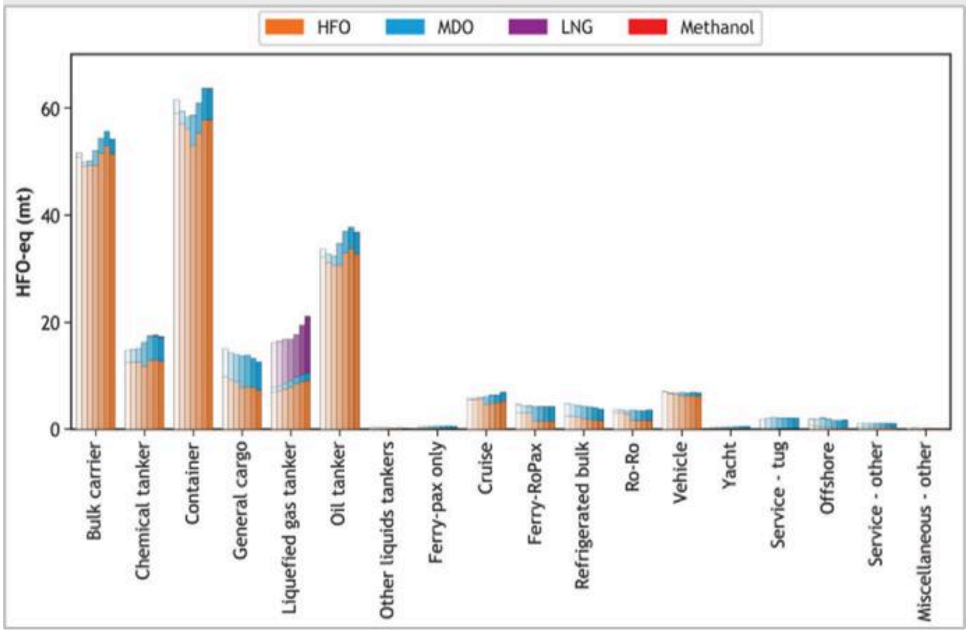
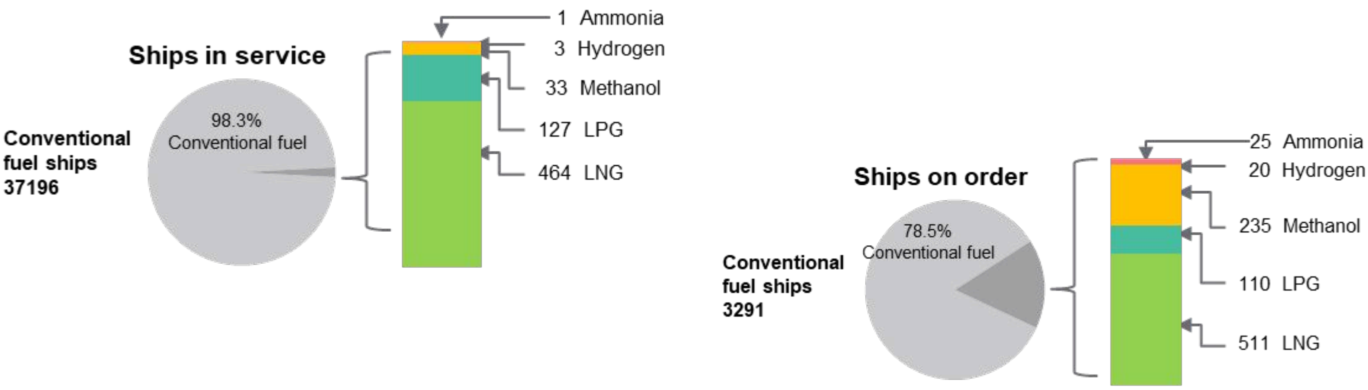
Market overview

Most conventional vessels today use dual-fuel engines, typically operating on HFO or MDO as the primary energy source

International HFO-equivalent fuel consumption per ship type



Status of world fleet July 2024



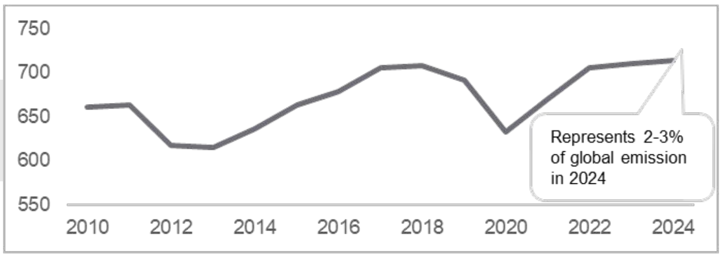
- Emission Control Areas : The North American ECA (covering parts of the US and Canada), The Baltic Sea ECA, The North Sea ECA, The Caribbean Sea ECA
- Fuel Switching in ECAs: Compliance with SOx regulations. Dual-fuel machinery: HFO switched with MDO
- Liquified gas tanker or mostly the product tanker shipping relies largely on HFO and now switching to LNG.

Source: "Fourth IMO GHG Study 2020" International Maritime Organization

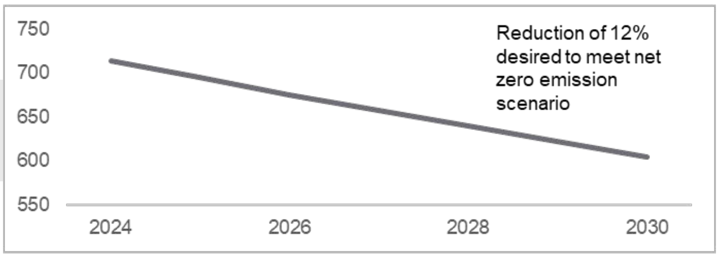
Decarbonizing shipping starts with the fuel

With 90% of global trade reliant on shipping, cutting sector emissions depends on scalable fuel alternatives like e-methanol and ammonia.

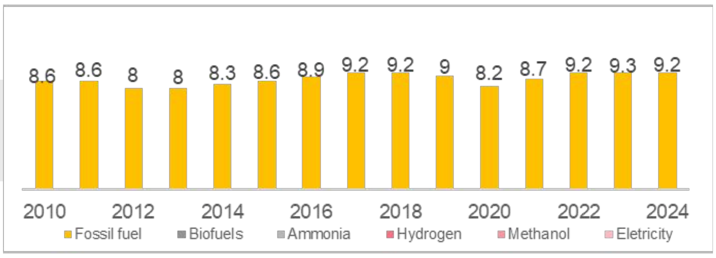
CO2 emissions from international shipping, 2010-2024 (Mt CO2)



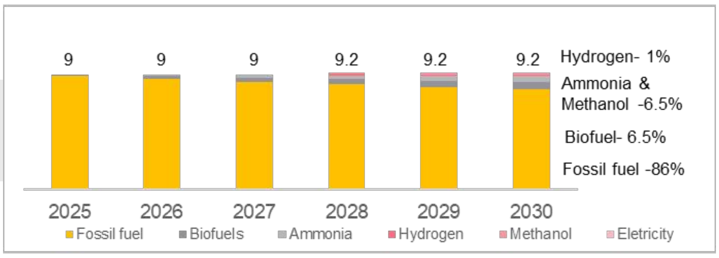
CO2 emissions from international shipping in the Net Zero Scenario, 2024-2030 (Mt CO2)



Energy consumption in international shipping by fuel, 2010-2024 (EJ)



Energy consumption in international shipping by fuel in the Net Zero Scenario, 2024-2030 (EJ)



Source: IEA, We forum, Climate

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Policy overview

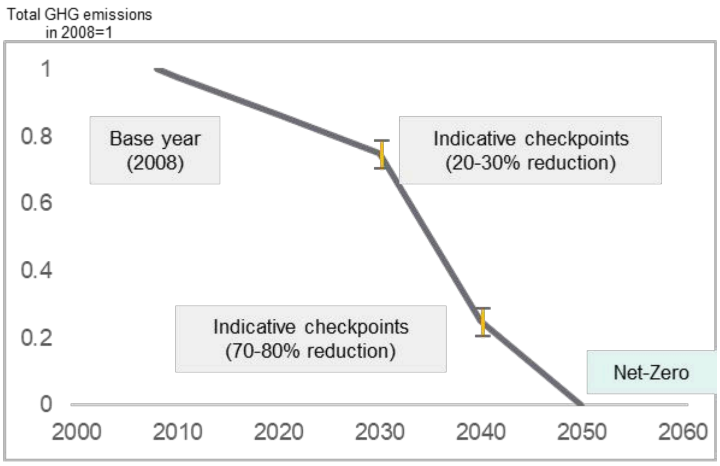
IMO is steering the path to Net Zero shipping targets through a shift to zero and low-emission fuels

European Union has its own strategy to cut down GHG emission

IMO GHG Strategy

In July 2023, the IMO adopted the “2023 IMO GHG Strategy” aiming for net zero emissions by 2050.

IMO GHG reduction goal



IMO mid-term measures

EU members states, EC, Japan

Proposal under consideration: Reduction of GHG fuel intensity (gCO2/MJ) with flexibility mechanism for regulatory compliance

- Flexibility among multiple vessels for Over/-under achievement of compliance (pooling)
- Utilization of banking from previous years
- Payment of contribution to the IMO

China, Brazil, Norway, UAE etc

Correction factor for eligible ports of developing countries that are expected to be negatively impacted by the mid-term measures

Island countries (10 countries)

Levying USD150/tonCO2 based on GHG emission

European Union (EU) Initiatives

- From 2025, ships over 5,000 GT at EU ports must cut GHG intensity.
- The EU mandates a 2% cut in shipping fuel emissions by 2025, rising to 80% by 2050

Source:IMO

IMO has introduced targeted SOx and NOx regulations to curb emissions and accelerate cleaner maritime operations

SOx norms

- 2020: SOx permitted emissions reduced from 3.5% to 0.5%
- Ships operating within designated ECAs must meet Sulphur emission levels of 0.1%

IMO mid-term measures

Outside an ECA established	Inside an ECA established
4.50% m/m prior to 1 January 2012	1.50% m/m prior to 1 July 2010
3.50% m/m on and after 1 January 2012	1.00% m/m on and after 1 July 2010
0.50% m/m on and after 1 January 2020	0.10% m/m on and after 1 January 2015

Source: International Maritime Organization

NOx norms

- IMO NOx control requirements are applied to marine diesel engine of over 130kW output power
- Tier III controls apply to ships while operating in Emission Control Areas (ECA) which are North American ECA, US Caribbean Sea ECA, Baltic Sea ECA and North Sea ECA.

NOx norms

Tier	Ship construction date on or after	Total weighted cycle emission limit (g/kwh) n= engine's rated speed (rpm)		
		n < 130	n = 130-1999	n>=2000
I	1 January 2000	17	45*n(-0.2)	9.8
II	1 January 2011	14.4	44*n(-0.23)	7.7
III	1 January 2016	3.4	9*n(-0.2)	2.0

Source: International Maritime Organization

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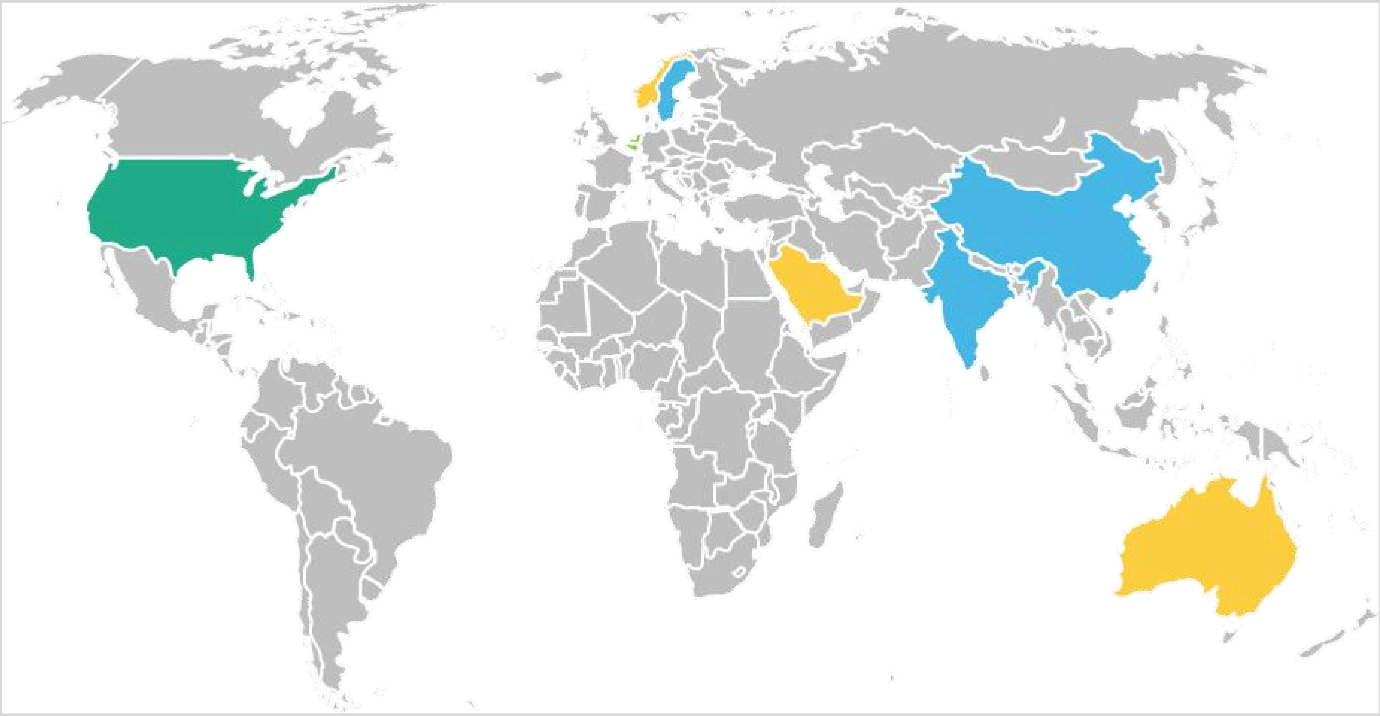
Methanol vs Ammonia

Both Methanol and Ammonia have an infrastructure which can be upgraded

Both fuels require minimal modifications, making them ideal candidates for near-term deployment in maritime operations.

List of countries where methanol and ammonia bunkering facilities are being planned



Countries with upcoming Methanol infrastructure

Countries with upcoming Ammonia infrastructure

Countries with upcoming Methanol and Ammonia infrastructure

Key Observations

Methanol

- Total global methanol production capacity 110 million metric tons
- Current total methanol terminals global level: 117

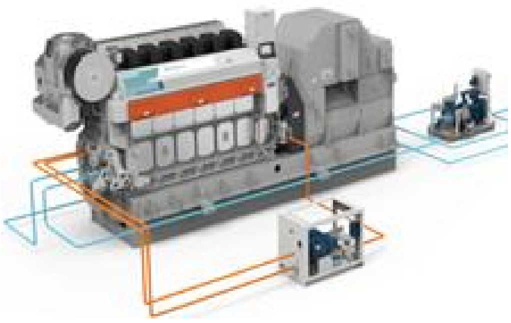
Ammonia

- Total global ammonia production capacity 170 million metric tons
- Current total ammonia terminals global level: 126

Source: DNV GL, FutureBridge analysis

OEMs have developed engines for both methanol and ammonia to support green shipping

Methanol — **Wartsila 32 methanol engine** — WÄRTSILÄ



- Wartsila 32 methanol engine is a fuel flexible engine which operates on methanol, HFO (heavy fuel oil) , MDO (marine diesel oil) and liquid biofuel.
- Wartsila 32 methanol engines are commercial and has recently ordered to power Van Oord's offshore installation vessel Boreas at Yantai CIMC Raffles Shipyard (YCRO) in China

Methanol — **MAN B&W ME-LGIM** — MAN Energy Solutions

- MAN B&W ME-LGIM is world's first 2 stroke methanol engine. It is a dual-fuel engine that can run on methanol as well as conventional fuels.
- Man Energy Solutions has already received an order from Hyundai's shipbuilding division (HHI-SBD) for the delivery of 6 methanol engines (MAN B&W G95ME-C10.5-LGIM dual-fuel) to be installed on AP Moller- Maersk 17,000 twenty-foot equivalent container vessels

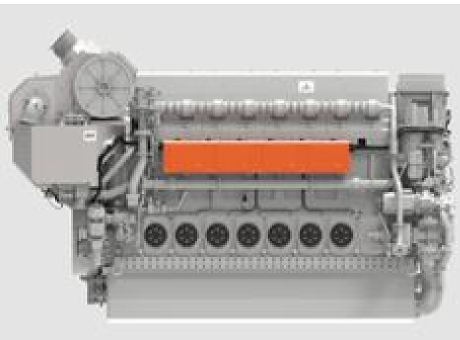
Ammonia — NH3-Fueled Engine

MAN Energy Solutions

- MAN B&W two-stroke 4T50ME-X type has successfully tested ammonia combustion IC engine is a breakthrough in the development of clean marine fuels
- MAN Energy Solutions is broadly expecting to hold its delivery timeline for the first ammonia engine, with subsequent operation onboard a commercial vessel by around 2026.

Ammonia — Wartsila 25 medium-speed 4-stroke engine

WÄRTSILÄ



- The Wartsila 25 engine is for long periods of maintenance-free operation, and it supports dry-docking schedules with a time-between-overhauls of up to 32,000 hours
- The Wartsila 25 engine's modularity offers shipowners and operators maximized flexibility, & efficiency and fuel economy is minimized

Strict IMO Tier III NOx limits constrain ammonia's viability as marine fuel while SCR enables compliance but adds cost and complexity.

IMO NOx control requirements are applied to marine diesel engine of over 130kW output power

Tier	Ship construction date on or after	Total weighted cycle emission limit (g/kwh) n= engine's rated speed (rpm)		
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Tier III controls apply to ships while operating in Emission Control Areas (ECA) which are North American ECA, US Caribbean Sea ECA, Baltic Sea ECA and North Sea ECA.

Restricts the use of ammonia as a shipping fuel

Source: International Maritime Organization

Cost involved in installing SCR

Expenditure type	Typical cost incurred
Capital expenditure (including system installation)	$500,000
Operational costs required to meet IMO III for 25 years	$4.95m
Catalyst recharge cost	$ 1.05m
System maintenance cost	$150,000
Fuel penalty due to back pressure caused by SCR (may/ may not incurred)	$900,000

*10MW engine, powering a vessel of 20,000 DWT that spends 8000 hrs p.a. in ECA

Note: GREET model considers zero Global Warming Potential for NOx emissions. So the NOx emissions are zero. Hence GREET model, by default considers Ammonia fuel engine type and engine energy consumption with SCR. Since there is no existing operational Ammonia based engine in marine as of now, we believe that the upcoming ammonia engine will have to come with installed SCR technology to meet with the stringent IMO regulations

Source: International Association for Catalytic Control of Ship Emissions to Air

Methanol is easier to handle due to lower corrosiveness and being liquid at ambient temperature

Ammonia is highly toxic and corrosive in nature

Fuel	Flash Point (° C)	State of Fuel at Ambient Temperature	Autoignition temperature (° C)	Corrosiveness	Toxicity
LNG	-188	Gas	540-580	Non-corrosive	Not toxic
Hydrogen	Not defined	Gas	500-585	Non-corrosive	Not toxic
Ammonia	132	Gas	630	Highly corrosive	Highly toxic
Methanol	11-12	Liquid	385-470	Moderate	Low acute toxicity
Biodiesel (HVO)	>61	Liquid	~254	Moderate	Not toxic

Methanol easily vaporizes, forming a flammable mixture at low temperatures.

Methanol is corrosive to some materials, requiring compatible tank coatings and piping.

As a liquid at ambient conditions, methanol can be stored in standard tanks with minor modifications.

Methanol is widely used in bulk transport, with established safety protocols.

Notes:

- Flash point is an indication of how easy a chemical may burn. Materials with higher flash points are less flammable or hazardous than chemicals with lower flash points.
- Autoignition temperature is the minimum temperature required to ignite a gas or vapor in air without a spark or flame being present.
- The flammability limits show the range of vapor concentrations of a certain chemical, expressed in volume percent, over which a flammable mixture of gas or vapor in air can be ignited at 25C and atmospheric pressure.

Source: SEA\LNG Ltd, report by DNV

Among liquid clean fuel options, Methanol is among the most economic fuel along with blended HFO

Types of Fuels	Units	2023	2025	2030	2035	2040	2045	2050
Fossil Fuels								
WTI Crude Oil	USD/Barrels	89.0	93.0	106.0	123.0	141.0	162.0	187.0
HFO Grade Bunkering Fuel	USD/GJ	17.4	21.5	24.8	29.1	33.7	39.0	45.3
MDO Grade Bunkering Fuel	USD/GJ	23.2	23.6	26.9	31.2	35.8	41.1	47.4
Alternate Fuels in Marine Sector								
Blue Hydrogen	USD/GJ	18.7	14.9	13.6	16.5	18.3	19.6	20.7
Green Hydrogen	USD/GJ	52.7	46.7	35.4	36.6	35.1	33.7	31.6
Bio-Methanol	USD/GJ	29.01	28.22	28.05	28.61	29.23	29.91	30.66
Blue Methanol	USD/GJ	19.5	16.5	15.4	17.7	19.3	20.3	21.2
Green Methanol	USD/GJ	80.90	74.36	62.24	63.81	62.49	61.36	59.54
Blended HFO with 20% Bio Diesel (BD20)	USD/GJ	22.3	25.7	29.0	33.4	38.0	43.3	49.6
Renewable Diesel (RD100)	USD/GJ	44.5	40.9	36.0	37.7	38.0	38.4	38.6
Blue Ammonia with SCR	USD/GJ	31.1	27.2	27.6	32.9	37.0	40.5	43.8
Green Ammonia with SCR	USD/GJ	78.1	71.3	60.0	63.7	64.4	65.4	65.7

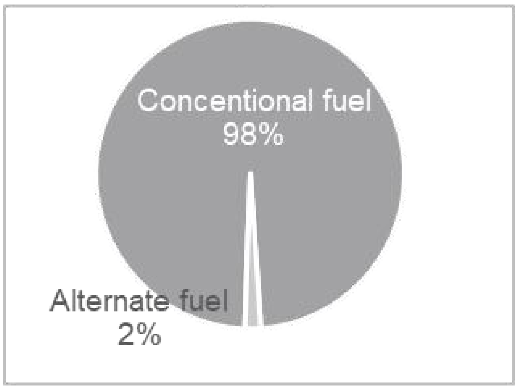
*Note- Global Average prices at the port

Source: Ship & Bunker; FutureBridge Analysis

Bulk and container ships are preferring Methanol as alternate fuel for ships

Share of alternate fuel ships

In service



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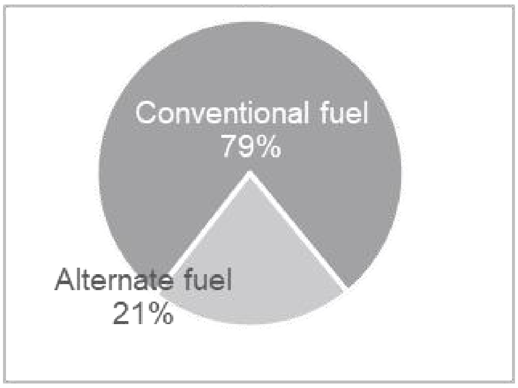
Total ships in service

On order



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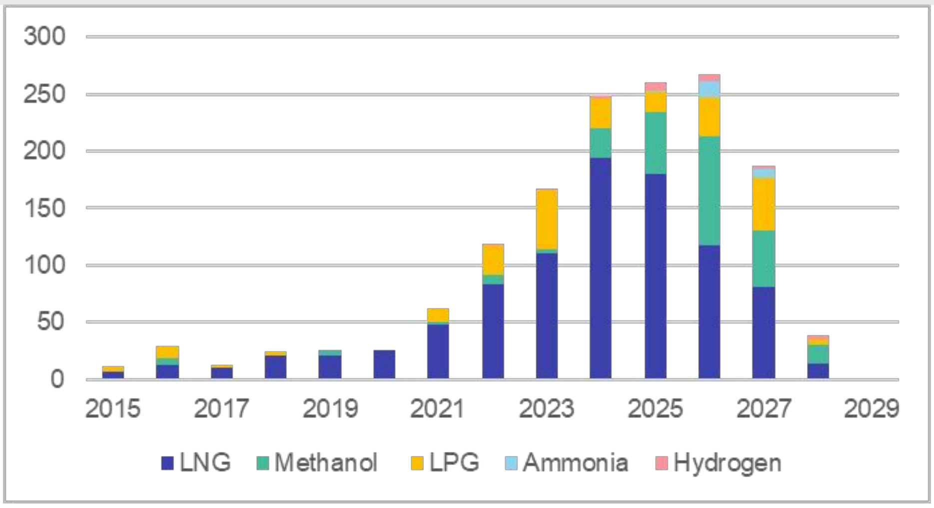
Total ships in order

New building alternative fuel ship



- Due to regulatory push to reduce GHG emissions, shipowners are turning towards building alternative-fuelled vessels, which will help to create demand pushing forward the port and infrastructure development.
- Two such shipowner initiatives are from A.P. Moller – Maersk, which has 19 methanol-fuelled vessels on order, and COSCO, which has 12 ultra-large, methanol container ships on order which will create demand to support methanol bunkering opportunities.
- Liquid Gas tankers are preferring LNG as alternate fuel

Source:IMO

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Key takeaways

1

Based on IMO report “Fourth IMO GHG Study”

Methanol is emerging as the fourth important fuel after HFO,MDO and LNG.

2

IMO SOx and NOx regulations have significant impact on the choice of fuel. Methanol has both low SOx and NOx emissions compared to Ammonia. According to ship order book, many ship companies are betting on Methanol as an alternative fuel

3

Based on the following parameters we expect that Methanol can replace HDO/MDO in short to medium term specially in trading routs which are passing through ECAs.

– Cost economics
– Preference of shipping companies and current ship order book
– Ease of handling

What’s Next?

Key Questions Worth Exploring

Can Methanol and Ammonia coexist in the shipping industry?

Given their distinct characteristics, is it likely that methanol and ammonia will coexist in the shipping fuel market, or will one fuel dominate? What factors will determine the eventual market share of each fuel type?

What factors drive shipping companies to choose Methanol over Ammonia?

Why are some shipping companies choosing methanol over ammonia as a fuel for the green transition across key shipping routes? How does methanol’s lower toxicity and less complex storage needs influence their decisions?

What are the operational and safety considerations for Methanol vs. Ammonia?

How do operational and safety challenges, such as the toxicity of ammonia versus methanol’s volatility, play a role in the decision-making process of shipping companies? What are the mitigation strategies that influence the final decision on fuel selection?

How do policies and regulations affect the choice between Methanol and Ammonia?

With tighter regulations in ECAs limiting sulfur content, how does the IMO’s sulfur cap push companies toward either ammonia or methanol as compliant fuels for operations in these regulated areas?

How are new ship orders reflecting the shift to low-emission fuels?

What percentage of new ship orders are opting for low-emission fuels like methanol and ammonia compared to traditional fuels? Is the industry seeing a significant increase in the adoption of these fuels for new ships?

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About FutureBridge Energy practice

FutureBridge offerings across the 8 pillars of energy transition

Hydrogen & its derivatives including E-fuels

- Hydrogen (Green, Blue, Turquoise, Pink...)
- Offshore & onshore Green hydrogen
- Hydrogen value chain including last mile connectivity
- E fuels – E-Methanol, E Ammonia, E-methane, E-SAF

Biofuels

- Biofuels : Renewable & biodiesel
- Bio-methane
- Waste to fuels
- SAF

Electricity

- Renewable energy options: Wind, solar, geothermal
- New sources of energy (ocean/ tidal)
- Low carbon energy: Nuclear
- 24/7 Carbon free electricity
- Energy storage
- Flexible generation
- EV charging

CCUS & carbon trading

- Industrial carbon capture
- Carbon dioxide removal including BECCS and DACS
- Carbon storage and transportation
- Carbon utilization & sequestration
- Carbon offsets and credits

ENERGY TRANSITION INITIATIVES

Future of oil & gas and energy utilities

- Decarbonization of assets
- Energy intensity reduction
- Industrial revolution 5.0
- Adjacent sector technologies

Heating & cooling

- Waste heat recovery
- Renewable heating & cooling

Digitalization

- Digital readiness assessment
- Digital solution discovery
- Digital partner selection

Scope 1-2-3 emissions reduction for hard to abate sectors

- SBTi targets & GHG emissions
- Lifecycle assessment
- Energy intensity reduction
- Process & equipment optimization

Our Energy team

With over 100 years of combined global experience, our Energy team delivers cutting-edge solutions to global clients across emerging domains such as **Energy Transition, Decarbonization** and **Green Fuels.**

Mukesh Dhiman

Practice Head

With **23+ years of experience,** Mukesh guides global energy clients through transition, innovation, and growth strategies across emerging domains.

Devay Gupta

Senior Director

With **18+ years of experience,** Devay drives growth and transformation for global energy clients across oil, gas, and emerging green fuel domains.

Saurabh Jain

Director

With **20+ years of experience,** Saurabh leads energy transition and decarbonization strategies for global clients across the US, Europe, and Asia.

Saurabh Uniyal

Associate Director

With **15+ years of experience,** Saurabh leads strategic advisory and management consulting initiatives for global energy clients with a focus on new energies & sustainable solutions.

Schedule a 1:1 deep dive session

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