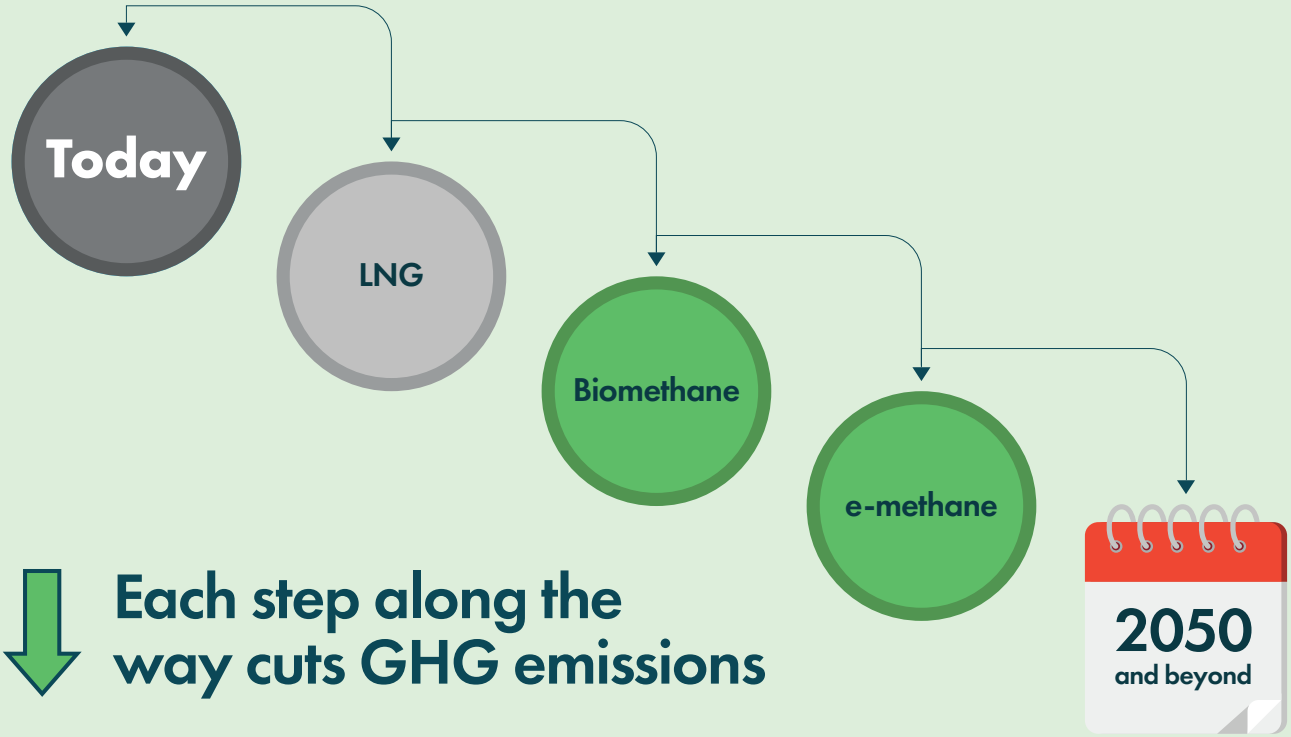
LNG PATHWAY – MID-YEAR MARKET REVIEW



SEA-LNG

AN UPDATE FROM SEA-LNG

JULY 2025

SEA-LNG.ORG

LNG PATHWAY – MID-YEAR MARKET REVIEW

The growing demand, expanding infrastructure, and increased orders for LNG dual-fuelled vessels in 2024 painted a clear message to the market: the industry is looking to decarbonise and it is turning to the LNG pathway as the most practical and realistic solution to achieve this goal NOW. The LNG pathway has the added benefit of cutting local emissions (SOx, NOx and black carbon) which are harmful to human health and still constitute a major global concern that needs to be addressed.

The newbuild orderbook demonstrates a shipping sector committed to the LNG pathway that features low and zero carbon alternative fuels such as bio and e-methane. Increased investment into bunkering infrastructure illustrates the supply-side response from fuel producers, ports and bunker operators. Growth in bunkering volumes at locations worldwide reflects LNG as a fuel going mainstream.

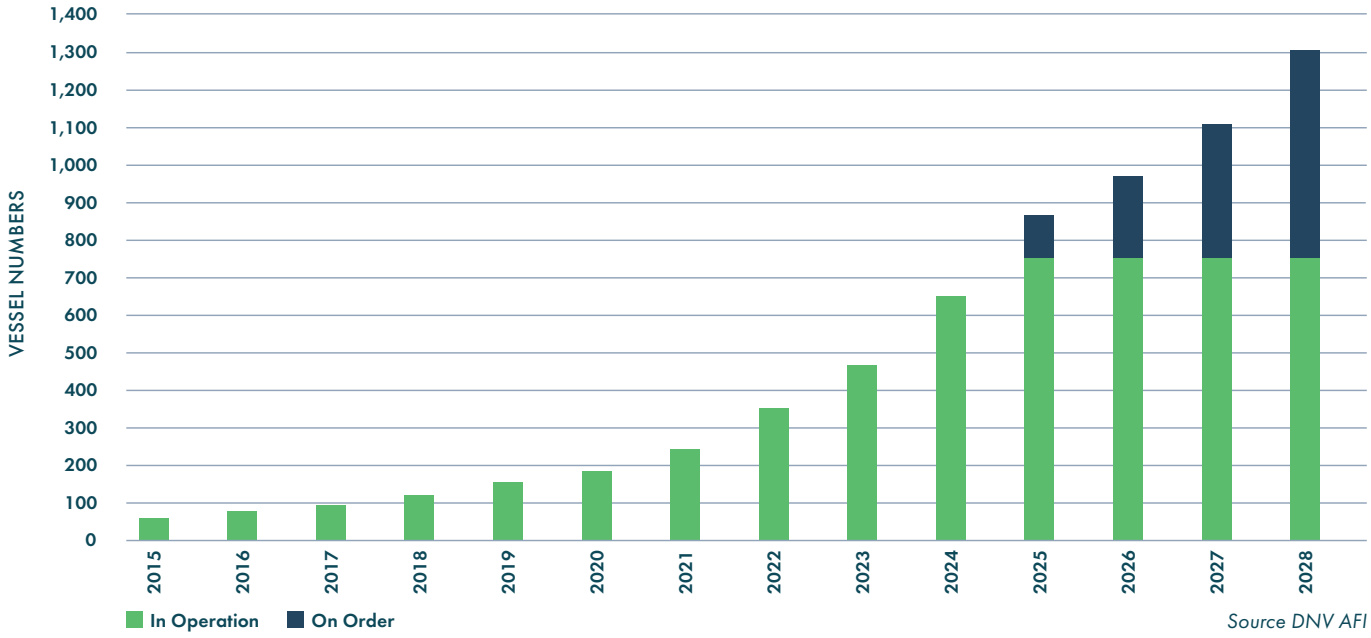
Regulation is helping drive this growth. The inclusion of shipping in the European Union Emission Trading System in January 2024 and the implementation of FuelEU Maritime in January this year mean that significant extra financial liabilities are beginning to be part of transportation costs. Longer term, the IMO Net Zero Framework agreed at MEPC 83 in April should provide a clear mechanism to incentivise the industry to further decarbonise in line with targets set out in its revised GHG Strategy.

Increasingly it is being recognised that the LNG Pathway provides the most credible, immediate option to meet those targets given LNG's capabilities to cut emissions now and achieve future IMO and EU targets through to 2050 using biomethane and e-methane.

Here is the current state of play of the LNG Pathway in maritime.

THE LNG DUAL-FUEL FLEET CONTINUES TO GROW

DEVELOPMENT OF LNG-FUELLED FLEET



Source DNV AFI

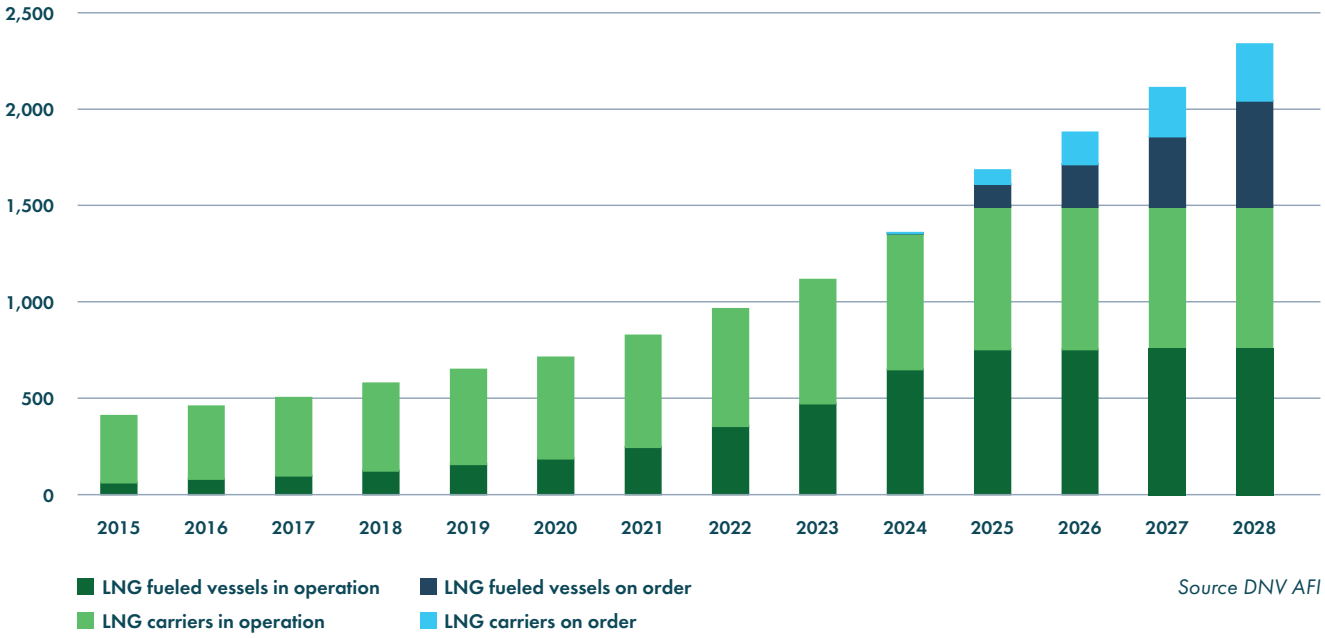
Following the trajectory of 2024, demand for LNG-fuelled vessels continued in the early months of 2025 - clearly demonstrated by the number of newbuild vessel orders. There are now a total of 1,369 LNG dual fuel vessels in operation and on order.

In the first six months of 2025, 87 new LNG dual fuel vessels were ordered, up from 53 in the corresponding period in 2024. The gross tonnage of these vessels amounted to 14.2 million GT versus 4.1 million GT in 2024, reflecting that most of the orders made in 2025 have been for large container vessels.

NOTABLE ORDERS IN THE FIRST 6 MONTHS OF 2025

CAPITAL MARITIME	CMA-CGM	EVERGREEN MARINE	MSC	ONE	TMS GROUP
6x 8,800 TEU LNG DF container ships from Korea's HD Hyundai Samho	12x 18,000 TEU LNG DF container ships from Korea's HD Hyundai Heavy Industries	11x 24,000 TEU LNG DF container ships from China's GSI & Korea's HanWha Ocean	6x 22,000 TEU LNG DF container ships from China's CMHI	8x 16,000 TEU LNG DF container ships from Korea's HD Hyundai Heavy Industries	13x 11,800 TEU LNG DF container ships from China's Zhoushan Changhong International Shipyard

DEVELOPMENT OF LNG-FUELLED FLEET INCLUDING LNG CARRIERS

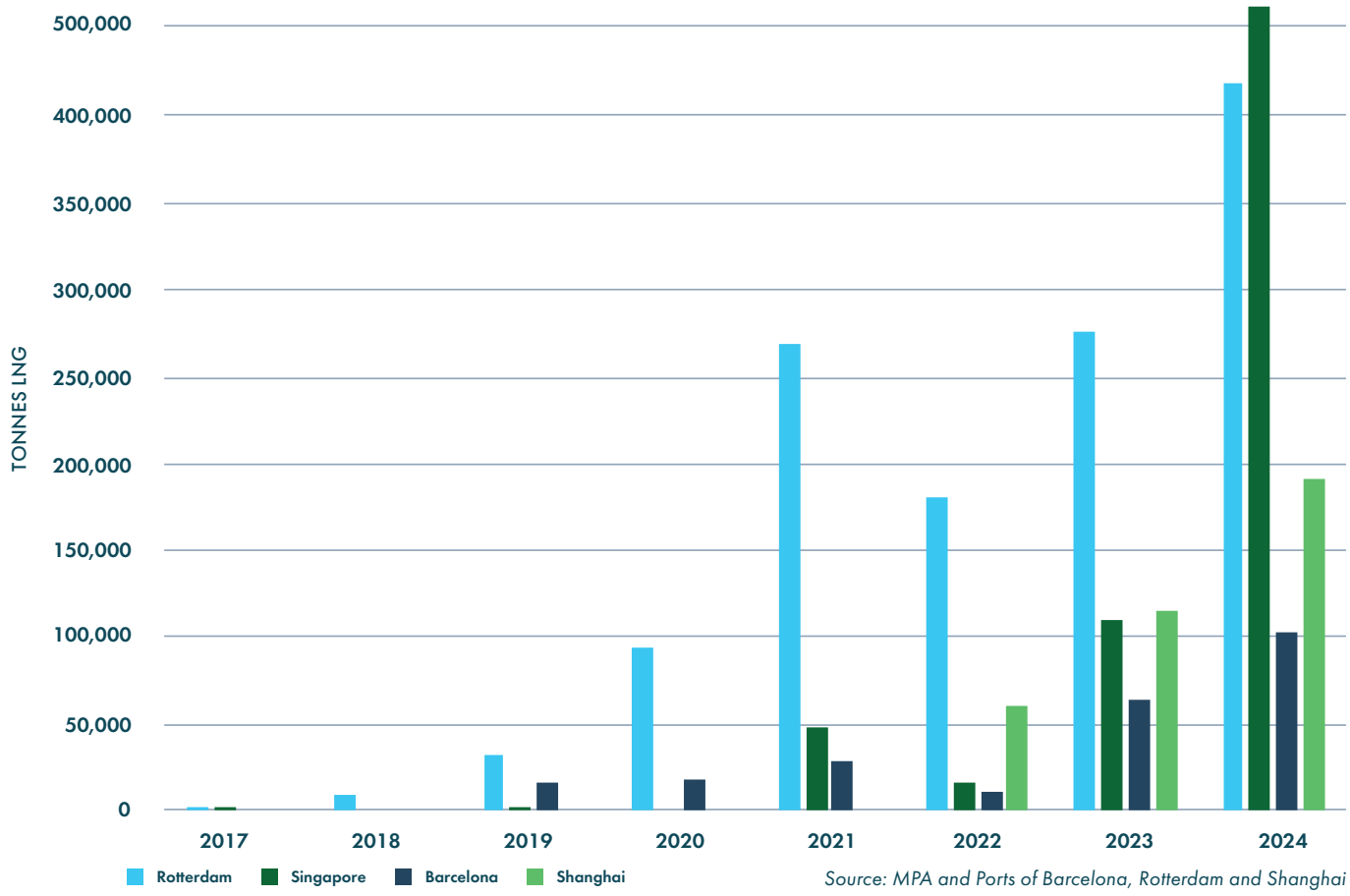


Source DNV AFI

Aside from container vessels, there has been significant market penetration of LNG-fuelled vessels in the cruise, PCTC, bulk and tanker sectors. If LNG carriers are included, then the total number of LNG fuelled vessels in operation and on order increases to more than 2,400, representing over 10% of global gross tonnage.

LNG BUNKERING VOLUMES ARE INCREASING

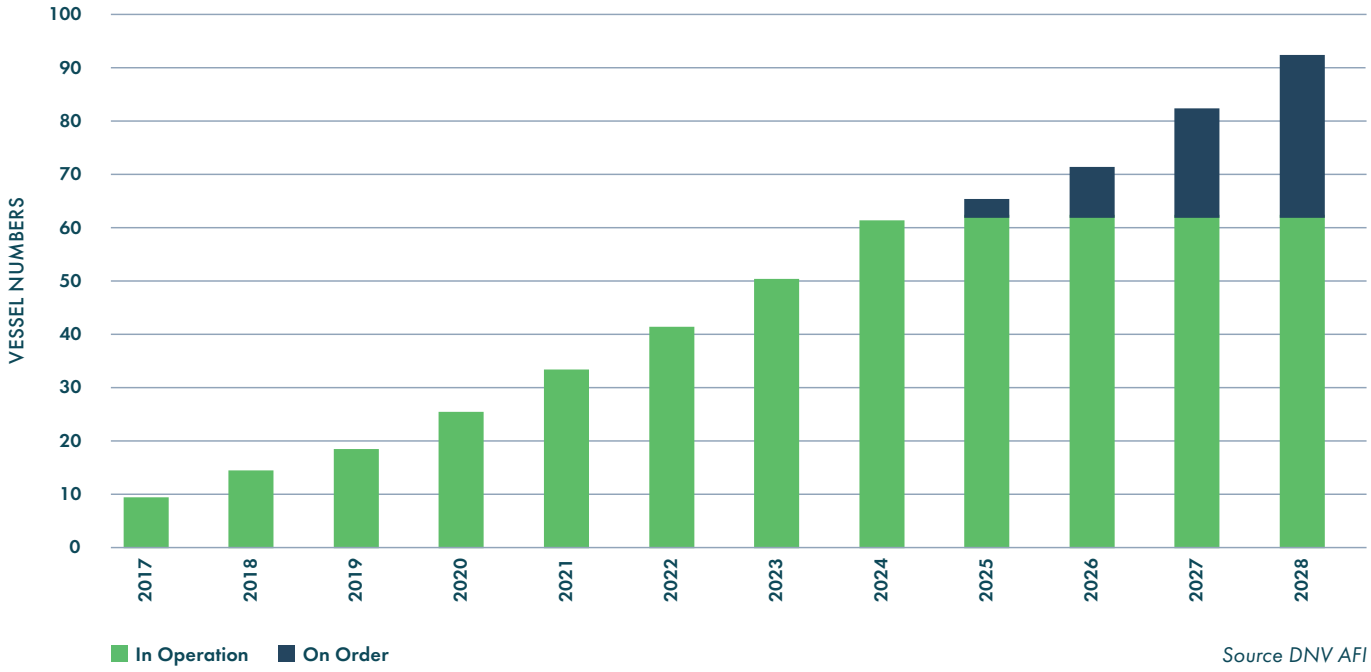
ANNUAL LNG BUNKER SALES: ROTTERDAM, SINGAPORE, SHANGHAI & BARCELONA



Source: MPA and Ports of Barcelona, Rotterdam and Shanghai

The dramatic growth in LNG bunkering volumes the industry witnessed in 2024 is continuing. Q1 2025 volumes in Rotterdam grew by 7% compared with the same period in 2024, and Singapore reported 18% growth over the first five months of 2025 versus 2024. LNG bunkering is developing rapidly in the Western Mediterranean and China, with volumes increasing by more than 60% in Shanghai in the first five months of 2025 compared with the same period in 2024.

LNG BUNKER VESSEL GROWTH



Source DNV AFI

In the first half of 2025 there were orders for 13 new LNG bunkering vessels making a total of 62 in operation with a further 30 on order. There is a clear trend towards larger bunker vessels, circa 17,000 cubic metres. And we are seeing orders being made on a speculative basis, i.e. not tied to specific bunker supplier customers, another sign of a maturing industry.

NOTABLE LNG BUNKERING FIRSTS IN 2025 INCLUDE:

- The first ship-to-ship LNG bunkering of a containership in Long Beach, USA by Seaspan Energy;
- The first ship-to-ship LNG bunker operation in the Middle East in January, with Monjasa supplying LNG to the Costa Smeralda cruise vessel; and
- The first bunkering of a car carrier in Western North America, with Seaspan supplying LNG via ship-to-ship to the MOL operated Lake Herman in Vancouver's English Bay.

BIOMETHANE IS BECOMING A REALITY

Liquefied biomethane (LBM) or bio-LNG is a central next step along the LNG pathway towards decarbonisation. It's chemically identical to LNG, and fully compatible as a drop-in fuel in existing LNG engines with no blending issues, unlike biodiesel and fuel oils.

Bunkering of LBM is growing rapidly in Europe, driven mainly by regulations such as FuelEU Maritime. Bunkering operations have already taken place in key ports across Belgium, France, Finland, the Netherlands, Norway, Spain, Sweden and the UK, involving at least seven major bunker suppliers. The use of LBM is widespread with bunkers being delivered to the cruise sector, container lines, ferries, OSVs, car carriers, tankers, bulkers and small-scale LNG carriers over the past 12 months.

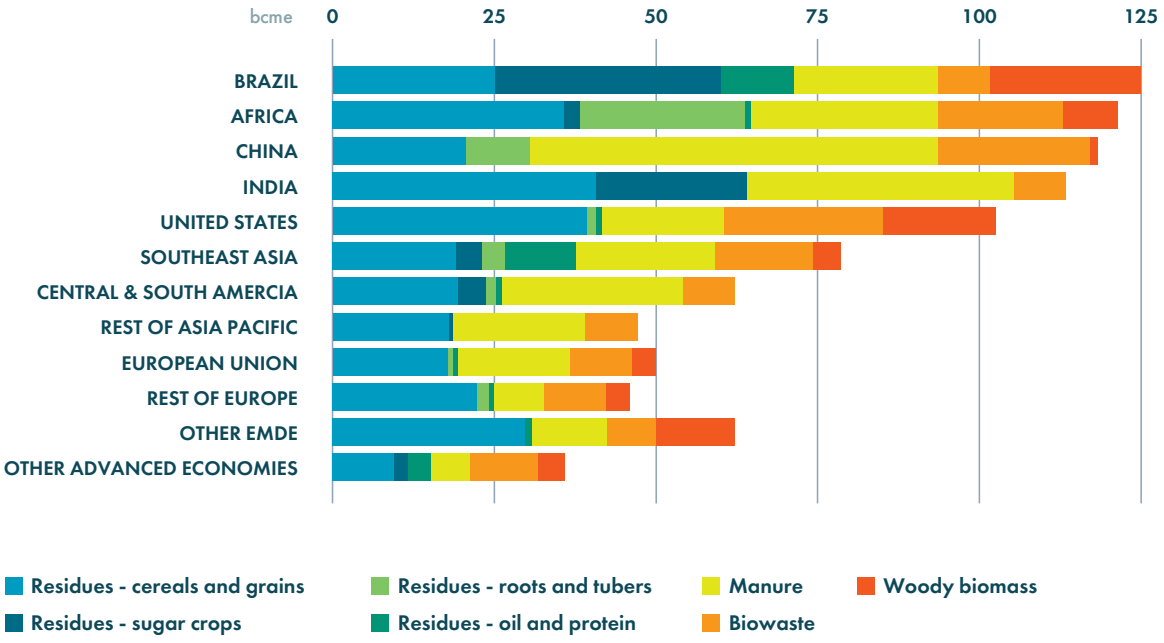
In February 2025, Furetank conducted its first LBM bunkering in collaboration with Molgas. While in March, Titan and Mitsui OSK Lines (MOL) completed the first LBM and LNG bunkering operations of a multi-year contract. Hapag Lloyd has taken delivery of multiple LBM bunker stems over the past few months in fulfilment of its ZEMBA tender award.

In April, 7,500 cbm vessel, Avenir Ascension began operating on 100% LBM for 2025 to reduce emissions by more than 3,500 tonnes. And in June, Molgas conducted the first LBM bunkering from the Dunkerque LNG terminal.

The growing liquidity of the market is demonstrated by the recent introduction of LBM bunker price assessments by price reporting agencies S&P Global Commodity Insights and Argus.

These are very promising developments for the LNG pathway but what of the long-term potential of the use of LBM as a marine fuel? The IEA's recent report, Outlook for Biogas and Biomethane states that biomethane is an underutilised resource in the energy transition. It is currently growing at a rate of 20% per annum and the IEA estimates some 1 trillion cubic metres of natural gas/ biomethane could be produced every year using organic waste streams (this would be the equivalent of around 25% of global natural gas demand today) yet only around 5% of the total potential for biogas and biomethane production is currently being utilized. The opportunities for greater production of LBM are significant and will be exploited given the obvious benefits.

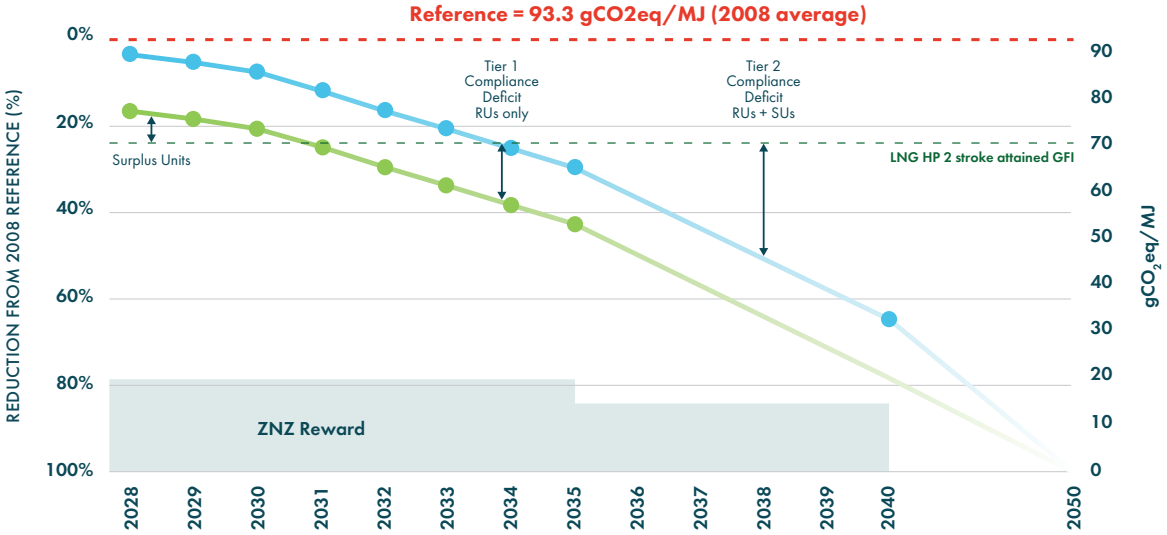
POTENTIAL FOR BIOGASES BY REGION AND BY FEEDSTOCK TYPE, 2024



LNG DUAL-FUEL ENGINES OFFER THE BEST RETURNS UNDER THE IMO NET-ZERO FRAMEWORK

The Net-Zero Framework for greenhouse gas emissions reductions agreed by the IMO and its delegates at MEPC 83 provides a clear decarbonisation framework for the global shipping industry. While many details need to be decided, it should, in principle, enable all fuel pathways, be they LNG (methane), methanol or ammonia, to compete on a level playing field.

IMO NET-ZERO FRAMEWORK



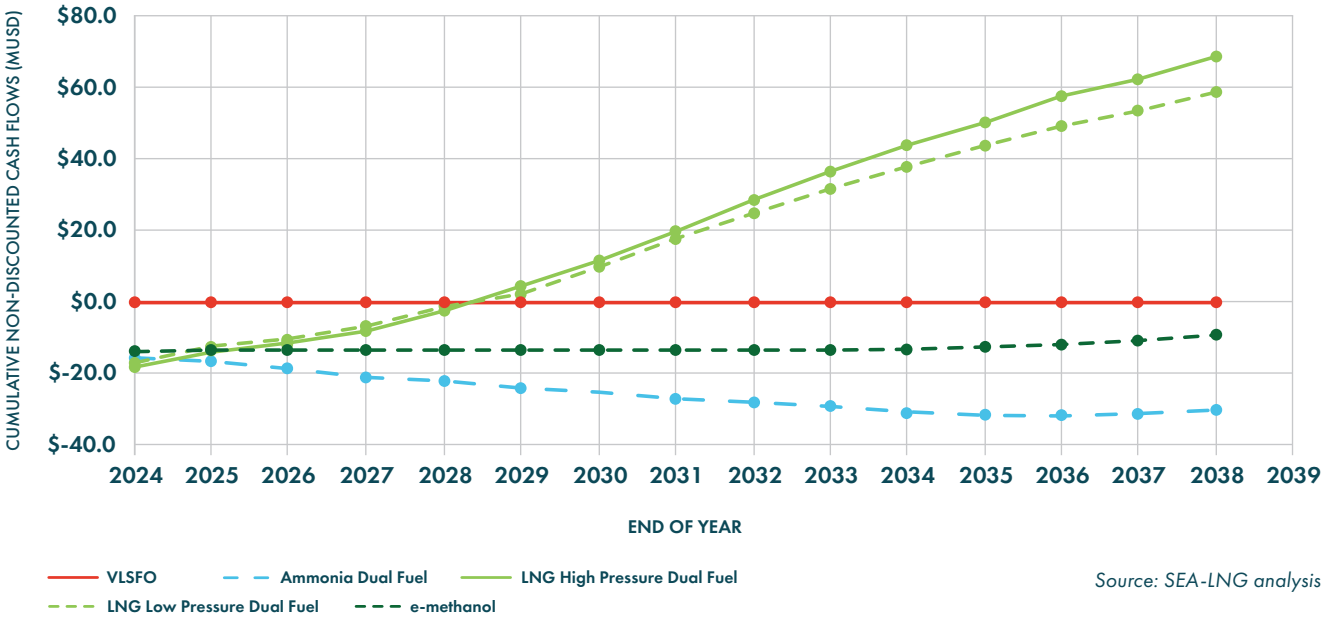
YEAR	2028	2029	2030	2031	2032	2033	2034	2035	...	2040
BASE	4%	6%	8%	12.4%	16.8%	21.2%	25.6%	30%		65%
DIRECT	17%	19%	21%	25.4%	29.8%	34.2%	38.6%	43%		-

Tier 1 RU: $100/TCO2e

Tier 2 RU: $380/TCO2e attained GFI

SEA-LNG has undertaken some initial analysis of the commercial implications of the Net-Zero Framework utilising Z-Joule's POOL.FM evaluation model using GHG intensity and fuel price assumptions from DNV, published by the IMO, and market intelligence on CapEx. We analysed the investment case for a 14,000 TEU container vessels operating a trans-Pacific route, from Japan to the US West Coast. The analysis compared LNG, ammonia and methanol dual fuel vessels against a vessel fuelled by VLSFO over a 15-year investment period, focusing on the metric of relative payback.

RELATIVE PAYBACK BY FUEL TYPE



Source: SEA-LNG analysis

Our analysis shows that both high-pressure and low-pressure LNG dual fuel engines offer a relative payback period of about 4.5 to 5 years compared with VLSFO because of lower compliance costs due to LNG's lower carbon intensity, or GFI. Ammonia and Methanol fuelled vessels do not payback over the 15-year investment horizon. The results are driven by the fact that LNG offers immediate GHG reductions while ammonia and methanol dual fuel vessels will either have to buy large quantities of expensive green versions of those fuels to comply, from Day 1, or use VLSFO and pay for Remedial Units.

Once the additional investment in the LNG vessel is recovered, by about 2030 for an investment made today, the LNG dual fuel technology offers significant commercial optionality through fuel-switching and the fact that it can leverage widespread, global infrastructure.

It should be noted the analysis did not take into account the ZNZ Reward Mechanism as this will not be decided until March 2027. Assuming the Reward Mechanism is designed in a technology neutral way, then this is unlikely to change the comparative advantage provided by the LNG pathway.

More details of our analysis can be found here.

It should also be remembered that LNG is not an exclusive choice. When adopted as part of a basket of practical and realistic decarbonisation technologies, such as advanced-propellor or wind-propulsion, GHG reductions are increased still further.

Additionally, the emissions performance of all LNG engine technologies continues to improve. Wärtsilä announced in April that their NextDF technology reduced methane emissions on their 46TS-DF 4-stroke engine to 1.4 percent of fuel use across all load points, achieving as low as 1.1 percent in a wide load range. This is nearly three times lower than the default methane slip factor of 3.1 percent specified in FuelEU Maritime.

CONCLUSIONS

LNG is here today and being used in record quantities as a marine fuel by ever increasing fleet of LNG-fuelled vessels. All these vessels are cutting local emissions which are harmful to health. Technological improvements continue to reduce the carbon emissions with the best engine technologies cutting GHG emissions by 23% on a well-to-wake basis.

LNG is maturing. A growing global bunker industry is serving an active LNG dual fuel fleet of more than 700 vessels. LNG fuelled vessels are no longer newbuild news but business as usual.

As regulations bite, there is growing recognition that the LNG pathway offers a practical, realistic and futureproof solution for the shipping industry. A solution which is lower cost and implementable today. LBM is regularly bunkered and its production continues to grow rapidly.

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Back Cover: LNG-powered MSC AZRA arriving Gioia Tauro February 2024. Photo credit MSC.