June 2023

LNG FREIGHT RATE ESTIMATES – Results

A study commissioned by ACCC

EXPERTS WITH IMPACT™

FTI CONSULTING

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1. Introduction and executive summary

1.1. Context and purpose of this report

1. The Australian Competition and Consumer Commission (ACCC) publishes LNG netback prices to help Australian market players assess the indifference price of gas for consumption in the East Coast Gas Market in comparison to the price that producers would get if they exported this gas to Asia, the main export market for Australian LNG.[1]

2. In response to changes in LNG export markets, such as an increase in global LNG liquefaction capacity, the ACCC reassessed the LNG netback price series in 2021. The ACCC made the decision to supplement its netback reporting by publishing forward LNG netback prices for a period of up to five years in the future. Therefore, to determine these longer-term forward LNG netback prices, the ACCC requires estimates of LNG freight rates up to five years in the future.

3. Economic consultancy FTI Consulting (FTI) was selected by ACCC to provide medium-term LNG freight rate estimates based on modelling of the LNG shipping market.

4. The objective of this report to the ACCC is to provide the estimated medium-term LNG freight rates and the full costs of shipping of LNG from Gladstone, Australia, to Tokyo, Japan, for the next five years.

5. The computation of these results is based on an FTI Consulting methodology report dated 8th of August 2022 provided to the ACCC.

1.2. Executive summary

6. In this report, we present estimates of LNG freight rates for the period 2023-2028 for four different propulsion engine technologies: ST, DFDE/TFDE, ME-GI/ME-GA[2], and XDF, and the results of the LNG shipping prices from Gladstone to Tokyo based on medium-term freight contracting. The estimates are based on an LNG shipping supply/demand model that computes an annual LNG shipping equilibrium price, providing an opportunity cost estimate for 2023 to 2028 (see box 1 below). This report is an update of the Results Report delivered to the ACCC on 28th of February 2023 (which relied on computations as of December 2022).

[1] Source: ACCC, Gas inquiry 2017-2025

[2] ME-GA is a new propulsion technology made by the same manufacturer as ME-GI (MAN) that operates on lower pressure fuel supply compared to its ME-GI counterpart. ME-GI and ME-GA are grouped together for the purposes of modelling.

Box 1. Methodology to estimate medium-term LNG freight rates[3]

FTI Consulting's fundamental LNG shipping model is based on the simulation of the equilibrium between supply and demand of LNG transport. It estimates:

1) the demand for LNG transport, that is the quantity of LNG transported by unit of distance

2) the supply of LNG transport, that is the capacity of LNG carrier vessels to transport LNG quantities over the water.

Both demand and supply are estimated over a period of one year, using a measurement of the volume of LNG being carried (ton), and the distance sailed (nautical mile) for the shipment. The product of these dimensions (tonne-mile) is the scale of shipping services effectively provided.

In order to estimate the LNG shipping demand, we establish the LNG transport origins and destinations.

To geographically distribute LNG molecule supply and demand, we rely on planned liquefaction and regasification capacities and historical patterns of utilisation. Once LNG molecule origins and destinations have been defined, we run a dispatch optimisation model to determine the flows of LNG from origins to destinations minimizing the total cost to transport LNG. This determines the total annual LNG shipping demand, in tonne-mile.

This provides us with an LNG shipping demand curve that we can match to an LNG shipping supply curve.

Based on the existing fleet of LNG vessel carriers, and the confirmed order book of future LNG vessels, we determine for each vessel the capacity (tonne-mile) to transport LNG and the associated variable costs to provide such services. The variable costs of service for every LNG carrier vessel is the sum of the fuel costs, port fees, boil-off gas costs, other costs, and the part of the freight rate that is not sunk, i.e. the operations and maintenance costs.

The technical characteristics of every vessel (speed, OPEX, fuel consumption, size etc.) are considered to establish each vessel's capacity and associated variable cost to operate, and from that, determine a merit order of LNG carriers' vessels that form our LNG shipping supply curve.

FTI Consulting's model quantifies the annual equilibrium price, in USD/tonne-mile, that results from the intersection of the LNG shipping demand and supply curves, as determined above. From this price of LNG transport in USD/tonne-mile, we determine for different types of LNG vessels the residual LNG freight rate, as the difference between the equilibrium LNG transport price and the other variable charges of the LNG transport price (fuel costs, boil-off costs, port fees, other costs, etc.).

FTI gathers data from publicly available sources on LNG shipping, including LNG trade reports, LNG trades forecasts and LNG shipping reports, to support its modelling and estimates of LNG shipping freight rates. In addition, we have partnered with shipbroker Howe Robinson Partners (HRP) to provide comprehensive, up-to-date information on the global LNG shipping industry. HRP offers a full range of shipbroking services including newbuilding contracts, sale and purchase, demolition, and chartering, as well as market research and valuations. HRP data will be sent every six months to FTI Consulting to keep the model up to date with the latest developments in the LNG shipping market.

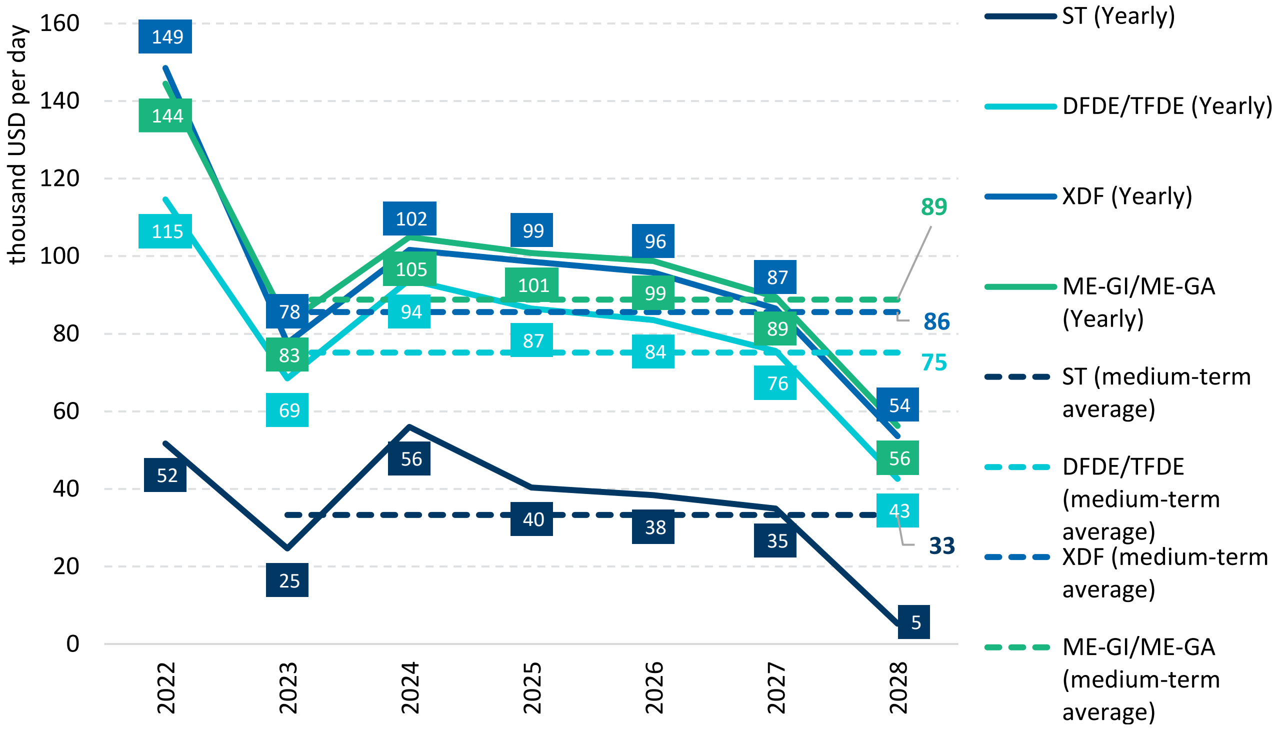
By convention, all model outputs will be expressed in real terms in the year in which we provide the results.

[3] See the ACCC website for a full explanation of FTI's methodology

7. The modelled estimates of the annual LNG freight rates are presented in Figure 1 below, along with a medium-term average: the model's outputs are annual freight rates, and an annual average over the period 2023-2028 was calculated as representative of medium-term freight rates.

8. The medium-term average estimates differ by technology, ranging between 33k USD/day for the ST, i.e. the oldest technology with smallest carrier capacities, to 86k USD/day for the XDF and 89k USD/day for ME-GI/ME-GA, i.e. the newest propulsion technologies with larger carrier capacities.

Figure 1. Average freight rates by propulsion technologies by year and medium-term average, for the period 2022-2028, in real 2023 USD/day



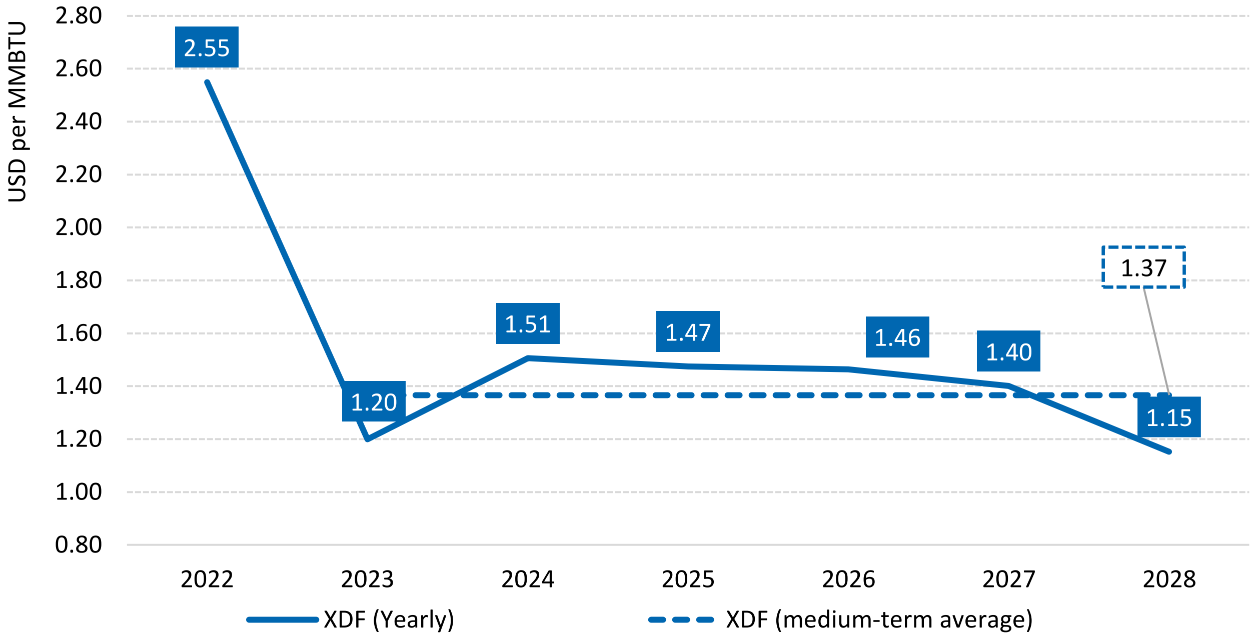
Sources: FTI analysis

Note: The medium-term average considers the period of 2023 to 2028

9. The trend in annual freight rates shows a significant decrease in 2023, followed by an immediate increase, with a gradual reduction until 2028. The reduction in 2023 is a combination of relatively stable shipping demand, coupled with an increase in supply from newly delivered ships. In 2024, new liquefaction capacity adds significant demand to the LNG shipping market. In the following years after 2024, while new liquefaction capacity continues to be added, freight rates decrease due to numerous investments in new ships, confirmed from order books, notably in 2026-2027, and endogenous investments from the model optimisation (to cater for new liquefaction capacity). This result illustrates a stronger excess of supply over demand in late 2020s, which will push some high-OPEX vessels to exit the market through demolition.

10. The yearly estimates and the medium-term average for the LNG shipping price for a round trip from Gladstone to Tokyo are presented in the following Figure 2. The results presented correspond to the XDF propulsion technology, which is expected to be the most common technology on the water from 2025 onwards.[4] As our model assumes a global price equilibrium of freight rates (in USD/tonne-mile) across propulsion technologies, the Gladstone-Tokyo shipping prices of other technologies would be similar (+/- 2%), to the one presented for XDF below.

Figure 2: Average price of shipping Gladstone-Tokyo by year and medium-term average for an XDF propulsion technology for the period 2022-2028 (real USD/MMBtu)



Sources: FTI analysis
Note: The medium-term average considers the period of 2023 to 2028

11. The estimate of the medium-term average shipping price from Gladstone to Tokyo for the period 2023-2028 is 1.37 USD/MMBTU and is higher than the previous report. This increase is driven mainly by the higher LNG prices that are expected to persist over the next few years, thereby increasing the costs associated with the boil-off.[5]

12. Although there is an observed reduction in shipping prices forecasted for 2023, the LNG shipping model still expects a moderate “tight mode”, with the relative position of supply and demand getting more tense over 2024-2027. The lower price observed for 2028 is derived from the "loose mode" of the LNG Shipping model: there is a significant excess of supply over demand, and the least efficient vessels are not used to deliver LNG, thereby driving lower freight rates based on

[4] See Figure 11 for overview of forecasted LNG carrier vessels fleet.

[5] For more details, see Table 1 and paragraph 41.

the marginal ship being a higher efficiency vessel. The lower freight rate modelled for 2028 follows the same pattern of "loose" years as observed in 2015-2017.

1.3. Structure of the report

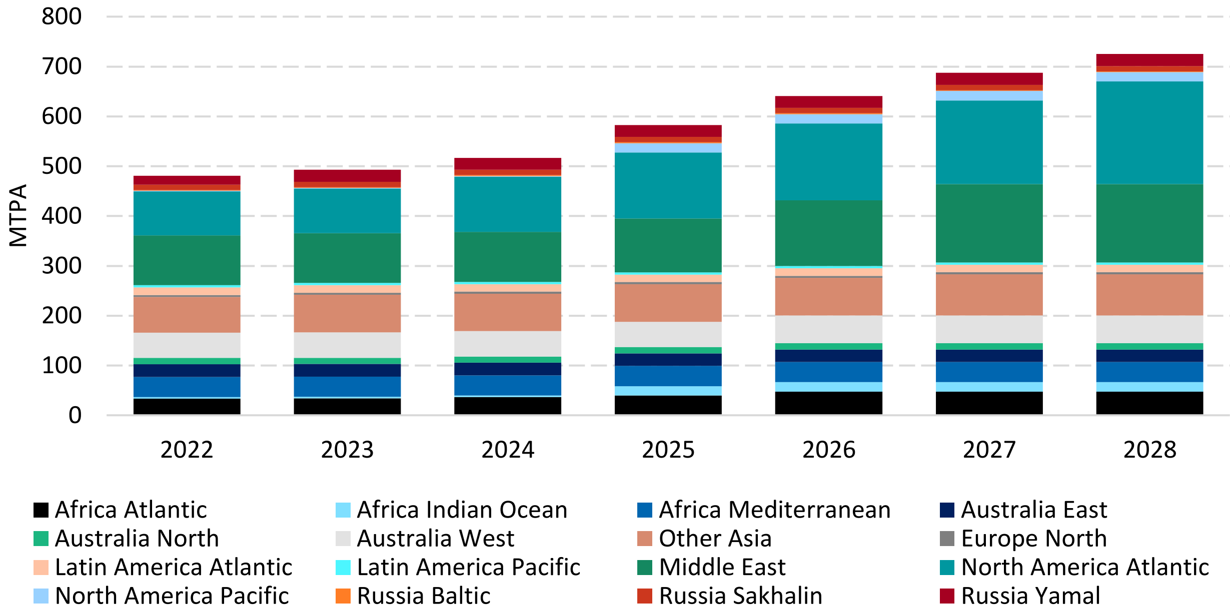
13. This report is structured as follows:

- **Section 1** is the present section, which summarises the context, content and the structure of the report;
- **Section 2** presents the calculation of the demand side of the model, i.e., the annual global shipping demand in tonne-mile;
- **Section 3** presents the calculation of the supply side of the model, i.e., the annual global shipping supply evolution including all the LNG carrier vessel investments and disinvestments;
- **Section 4** presents the results of the equilibrium between supply and demand, i.e., the global shipping price and the annual freight rates per propulsion technology at equilibrium; and
- **Section 5** presents a comparison of the modelled results with alternative estimates from other sources.

2. Calculation of shipping demand

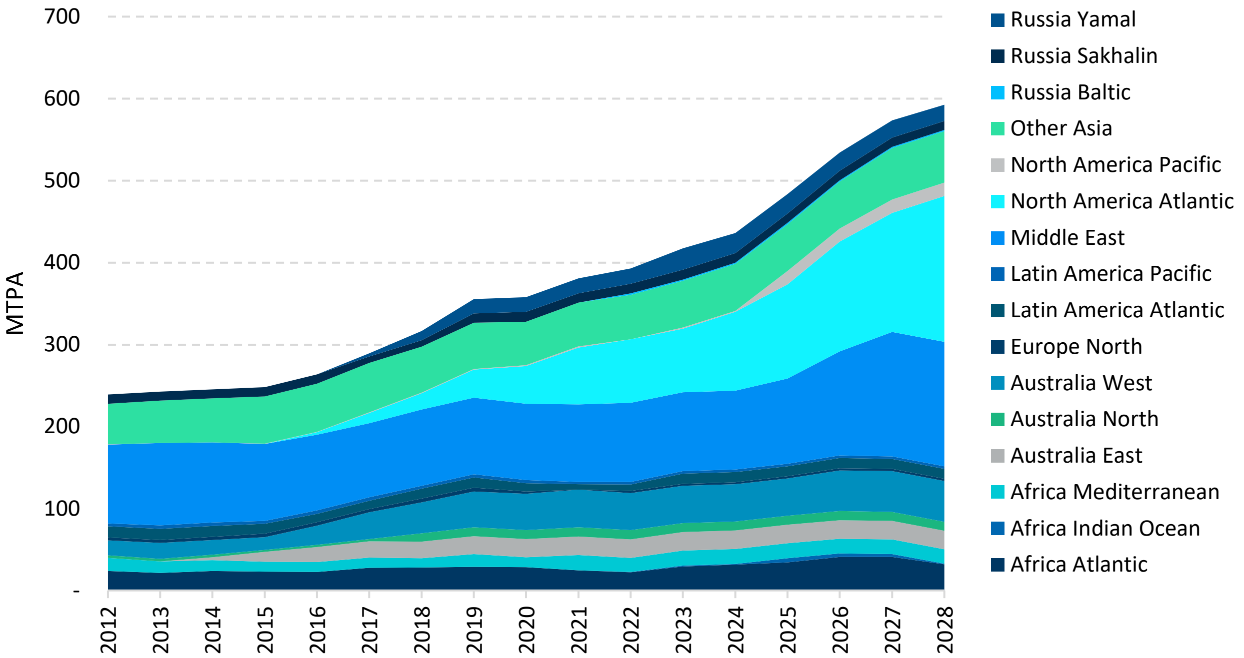
14. As explained in Section 4 of the FTI methodology report dated 9th August 2022, to quantify LNG shipping demand, we construct a forecast of the global LNG molecule trade based on the evolution of planned new liquefaction infrastructures (Figure 3), and from that determine the volume of imports and exports per region, augmenting historical imports and exports in proportion to the new infrastructure's capacities to be commissioned (Figure 4 and Figure 5). Since our previous report (with data as of December 2022), our liquefaction capacities forecast for 2028 (Figure 3) decreased to 725 from 728 million tonne per annum (-3 MTPA) based on cancellation of announced projects. Based on our methodology, as LNG liquefaction terminals capacity increases, imports and exports also increase (as presented in Figures 4 and 5).

Figure 3. LNG liquefaction terminals capacity for the period 2022-2028, in MTPA



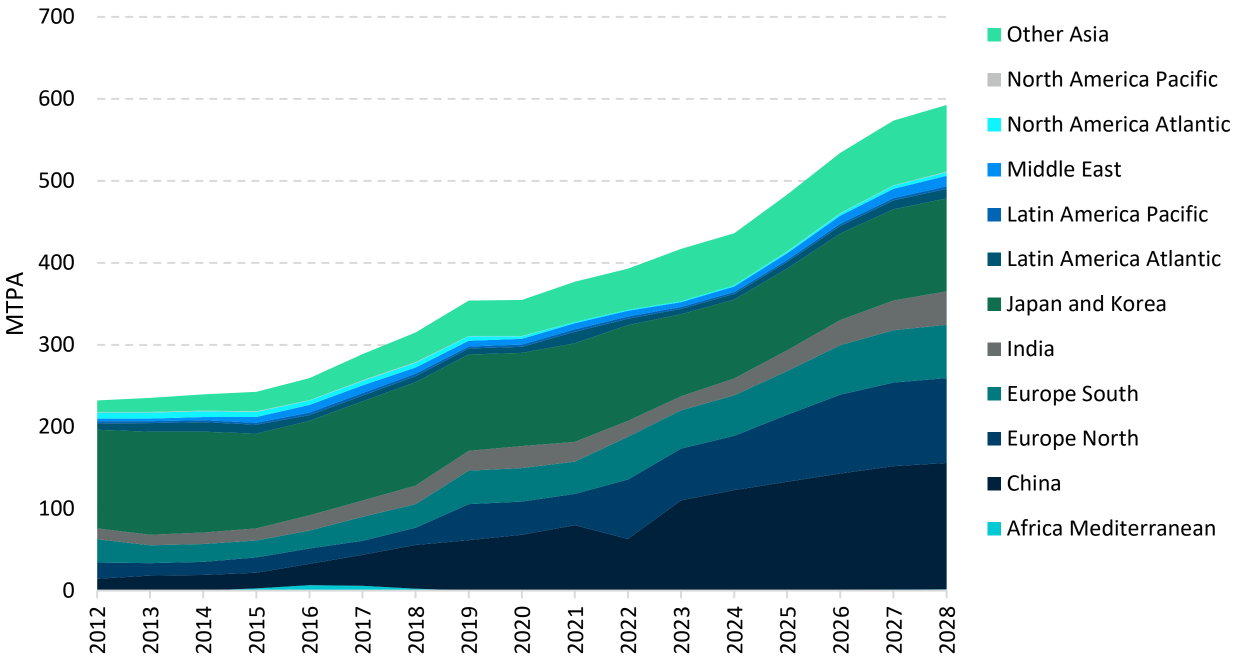
Sources: ICIS, FTI analysis

Figure 4. LNG exports scenario for the period 2012-2028, in MTPA



Sources: BP, ICIS, FTI analysis
Note: Refer to Methodology Report §30-32 for details

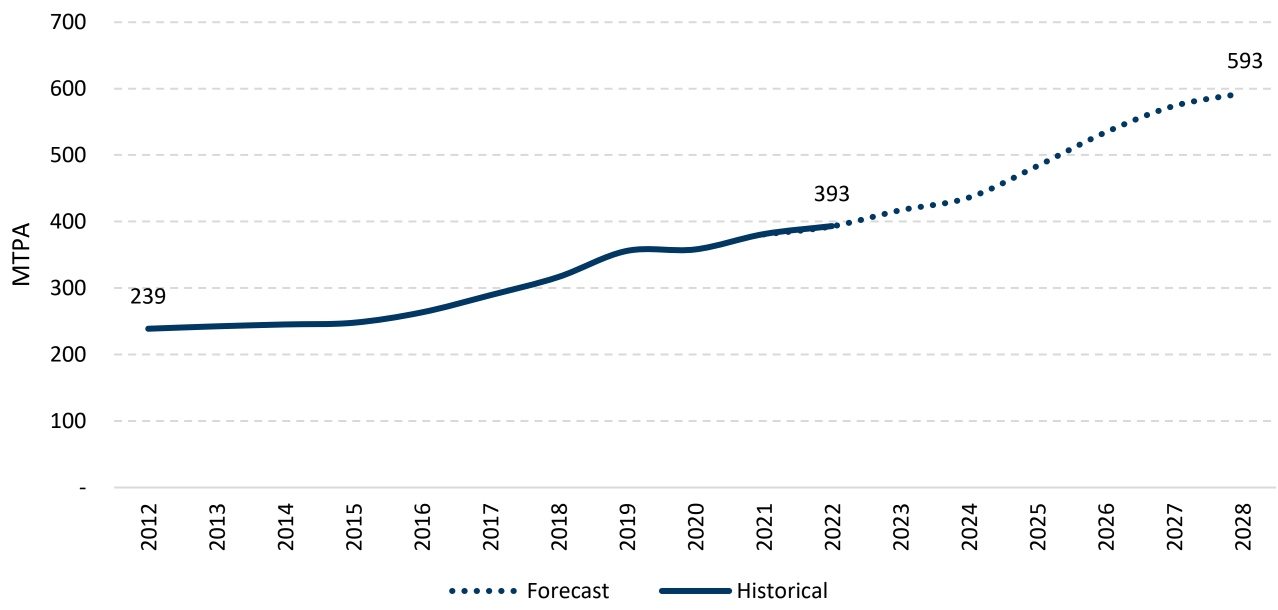
Figure 5. LNG imports scenario for the period 2012-2028, in MTPA



Sources: BP, ICIS, FTI analysis
Note: Refer to Methodology Report §30-32 for details

15. The global LNG demand forecast is then the sum of the projected imports for each of the 20 zones presented above[6]. LNG demand is expected to grow from 239 MTPA in 2012 to 593 MTPA in 2028. This represents a 5% downward revision from the previous report's 2028 forecasted LNG demand.

Figure 6. Global LNG demand for the period 2012-2028, in MTPA



Sources: Historical data: bp, Forecasts: ICIS, FTI analysis

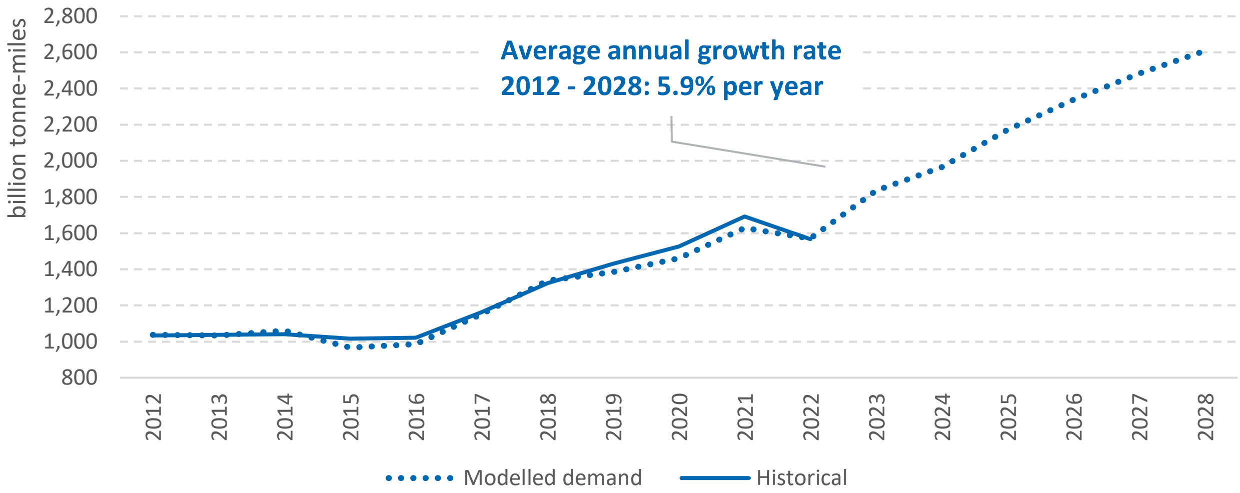
16. Then, using a dispatch optimisation model, we compute the LNG shipping demand, in tonne-mile, by minimizing the total global LNG shipping costs to transport LNG from production areas to consumption areas, relying on an estimate of the cost of each LNG route[7]. In this optimisation, we take into account forced routes stemming from fixed-destination LNG trade set by long-term contracts, which are assumed as fixed and are hence not subject to the route optimisation algorithm.

17. Thus, FTI Consulting's shipping demand model determines the optimal global LNG flows between export and import zones (considering obligations of long-term contracts) and establishes the annual shipping demand in billion tonne-miles, as showed in the Figure 7.

[6] The model takes into account estimated reductions in Russian LNG exports from the Yamal and Sakhalin zones, as identified in the IEA Gas Market Report Q2 2023.

[7] The total cost of shipping on each route is based on the cost of transporting LNG using an average LNG carrier with standard capacity.

Figure 7. Shipping demand modelled for the period 2012-2028, in billion tonne-miles



Sources: FTI analysis

18. Our modelled shipping demand follows the same trends as the actual shipping demand calculated based on the historical ICIS LNG carrier voyages database, confirming the utility of our LNG shipping demand estimation.

19. We observe a reduction in the shipping demand in 2022 both in the historical data (-7% from 2021) and the modelled data (-4% from 2021), despite the high demand for LNG in Europe and Asia. Part of this is explained by the reduction in travelled routes by spot charters that normally transport cargo from North America to Asia and have since exported to Europe driven by the high spot prices. Due to the shorter routes from North America to Europe, the total mileage is reduced. Based on analysis of import-export data[8], exports from North America to the Japan/Korea zone decreased by 37% in 2022 compared to 2021, while the exports to the Northern and Southern European zones increased by 144% over the same period.

20. As shown in Figure 7, the shipping demand increases on average by 5.9% per year between 2012 and 2028, reaching 2,609 billion tonne-miles in 2028. The evolution of the shipping demand follows the accelerated LNG molecule demand growth trends over the same period: global LNG liquefaction capacity increases from an average annual growth of 5.8% between 2012 and 2028.

[8] Source: ICIS Country-to-country flows

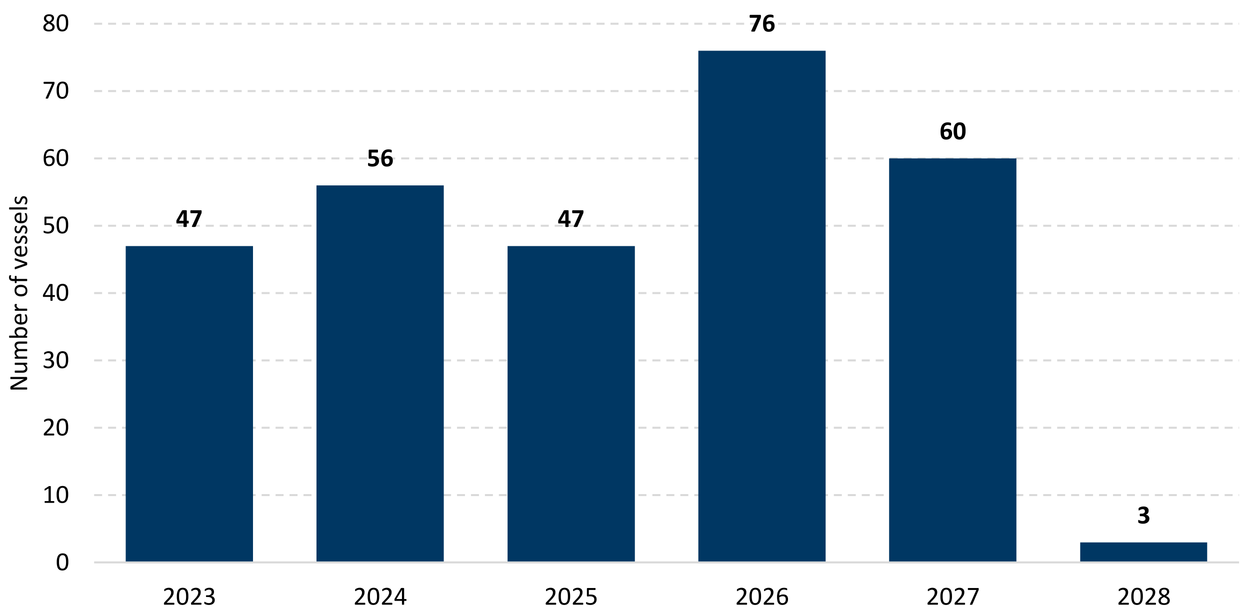
3. Calculation of shipping supply

21. On top of the operational LNG carrier vessels fleet and the LNG carrier vessel orders registered by the shipyards, our model endogenously balances supply and demand for shipping by investing in new ships (modelled investment) and removing old and uncompetitive ships (modelled disinvestment).

3.1. Known fleet and modelled investment

22. First, we rely on the existing operational fleet and firm orders in the ICIS order book, and information from HRP. Compared to our previous report, a net total of 10 new LNG carrier vessels have been added in the order book for 2023-2027. For 2028, there has been only 3 confirmed and registered orders according to HRP.

Figure 8. Orderbook for LNG carrier vessels for the period 2023-2028

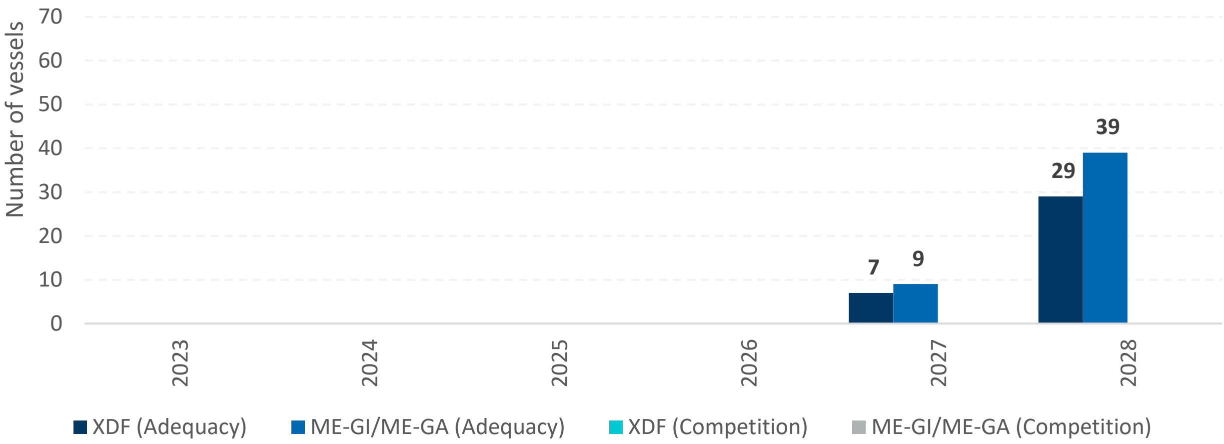


Sources: ICIS order books, HRP, FTI analysis

23. Second, we model two types of new ship investments, that add to the operational and ordered LNG carrier vessels: (1) adequacy investment, and (2) competition investment.

24. The results of the expected investments to be made between 2023 and 2028 are presented in Figure 9 below. New vessels joining the fleet based on the modelled investments have the average properties of the vessels expected to be commissioned between 2023 and 2028, based on order book.

Figure 9. Modelled investments in new LNG carrier vessels for the period 2023-2028



Sources: FTI analysis

25. In Figure 9 above, the modelled investments in new ships correspond to adequacy investments only. These investments are necessary to meet the growing demand for LNG shipping from 2025 onwards. There is no additional competition investment, which means that the Long-Run Marginal Cost (LRMC) of new investments in ME-GI/ME-GA or XDF technologies remain above the Short-Run Marginal Cost (SRMC) of the operating LNG carrier vessels. Shipbroker HRP indicated to us that until 2026, all LNG carrier ship building is committed, and no additional vessel could be ordered. Beyond 2026, we set a total shipbuilding capacity at the level of the maximum observed number of ships expected to be delivered during the years of full shipyard capacity use (estimated maximum 76 additional vessels in 2026). This limits the modelled investments to 16 LNG carriers in 2027, given the confirmed orders of 60 new vessels.

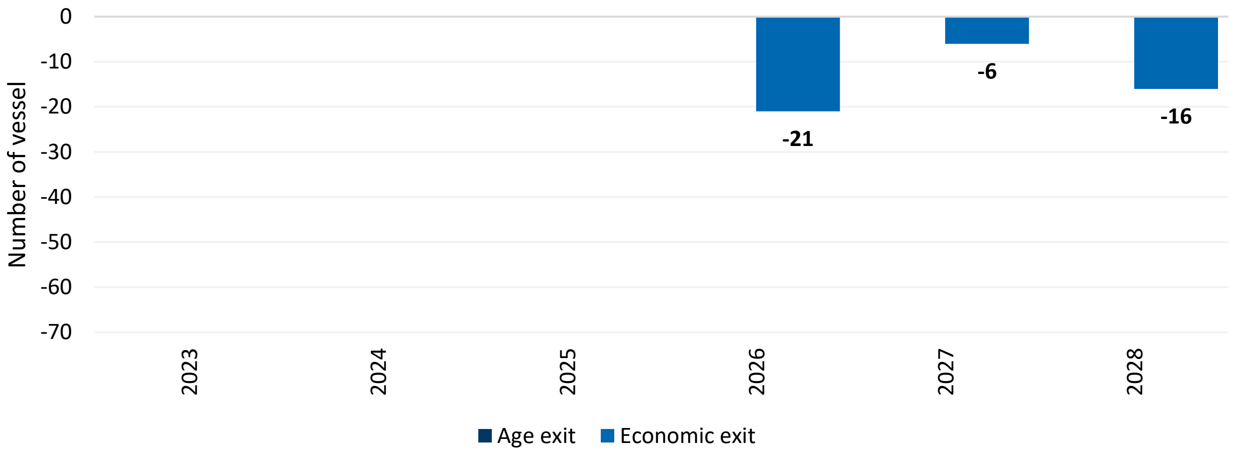
3.2. Modelled disinvestment

26. As explained in the methodology report (Paragraph 53) from August 2022, we model two different mechanisms for LNG carrier vessels to exit the market: (1) age exit, and (2) economic exit[9]. The exit of vessels is capped at 20% of the existing fleet to reflect a degree of inertia in shipowners' disinvestment decisions, as suggested by LNG shipbroker HRP.

27. The results of the model for disinvestment are illustrated in the Figure 10 below.

[9] Vessels converted to FSRUs are also removed from the existing fleet, based on the FSRUs in the most recent GIIGNL report.

Figure 10. Exit of LNG carrier vessels for the period 2023-2028



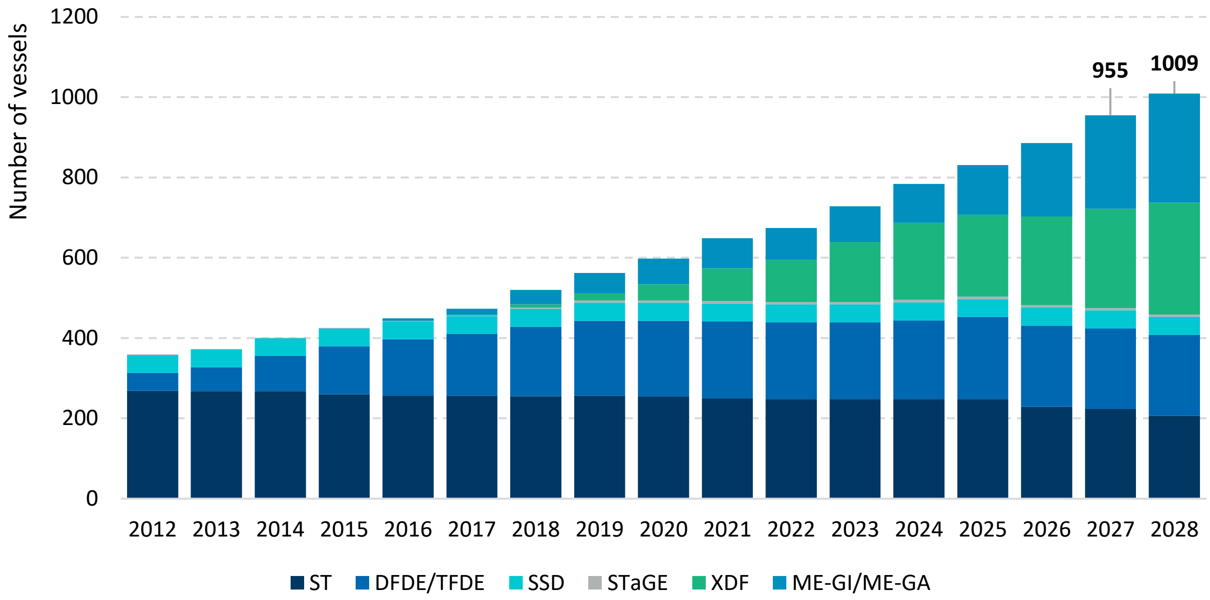
Sources: FTI analysis

28. The results show significant divestments in 2026 to 2028 with a total of 43 ship exits for economic reasons. Over the years of 2025 to 2027, a significant wave of new by XDF and ME-GI/ME-GA vessels would be delivered and replace ST-powered vessels that do not get used during the tight conditions. As loose conditions appear in 2028, old vessels that had prolonged service during the tight years could be also be expected to exit.

3.3. Global fleet of LNG ships

29. The sum of the actual LNG carrier vessels fleet from 2012 to 2022, the confirmed orderbook until 2028 and the modelled investments and divestments, results in a fleet of 955 ships in 2027 and 1009 ships in 2028. This represents an increase of 22 units compared to our previous report where 987 vessels were expected by 2028. The total supply capacity of the fleet amounts to 2,636 billion tonne-miles by the end of 2028, which is lower by 4% compared to the previous report, due notably to adjustments in availability (actual voyages and average miles travelled) based on 2022 data.

Figure 11. Global LNG fleet by technology for the period 2012-2028



Sources: 2012-2021: ICIS and GIIGNL, 2022-2028: ICIS and FTI analysis

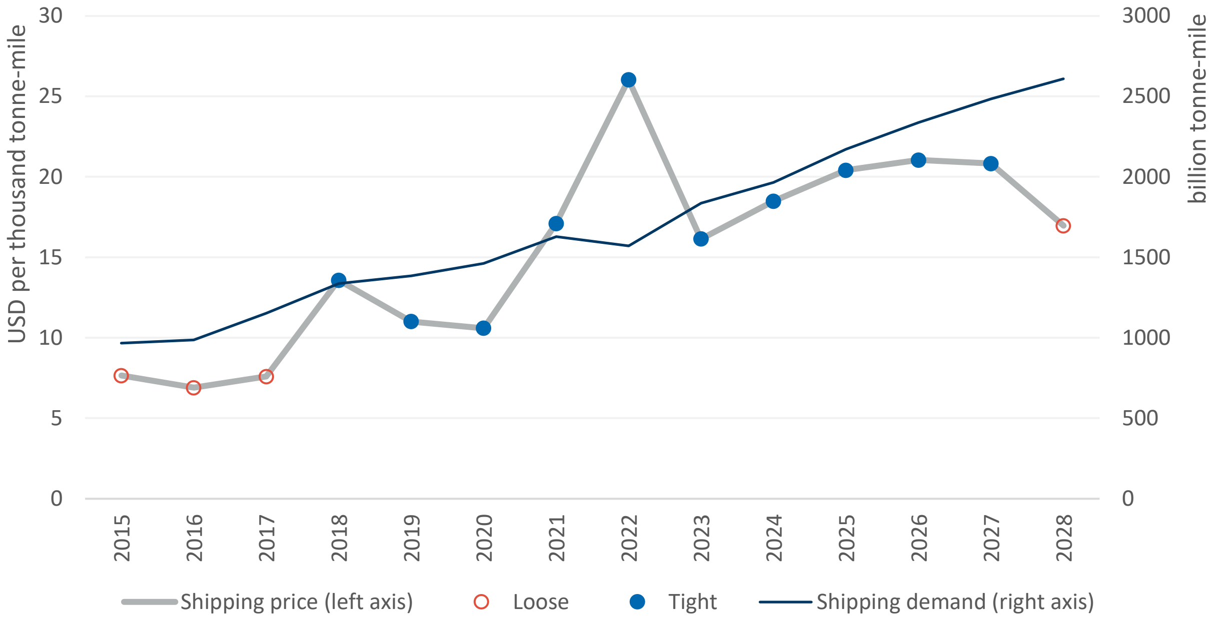
4. Determination of the price equilibrium and freight rates

4.1. Results of the model

30. The model assesses the equilibrium between LNG shipping supply and demand, on an annual basis. The result of the model is the equilibrium shipping price (USD/tonne-miles) which serves as the basis to calculate the average freight rates (USD/day) for each type of propulsion technology.

31. We present in Figure 12 below the results of the equilibrium shipping price.

Figure 12. LNG shipping demand (billion tonne-miles) and shipping price (2023 USD per thousand tonne-mile) for the period 2015-2028



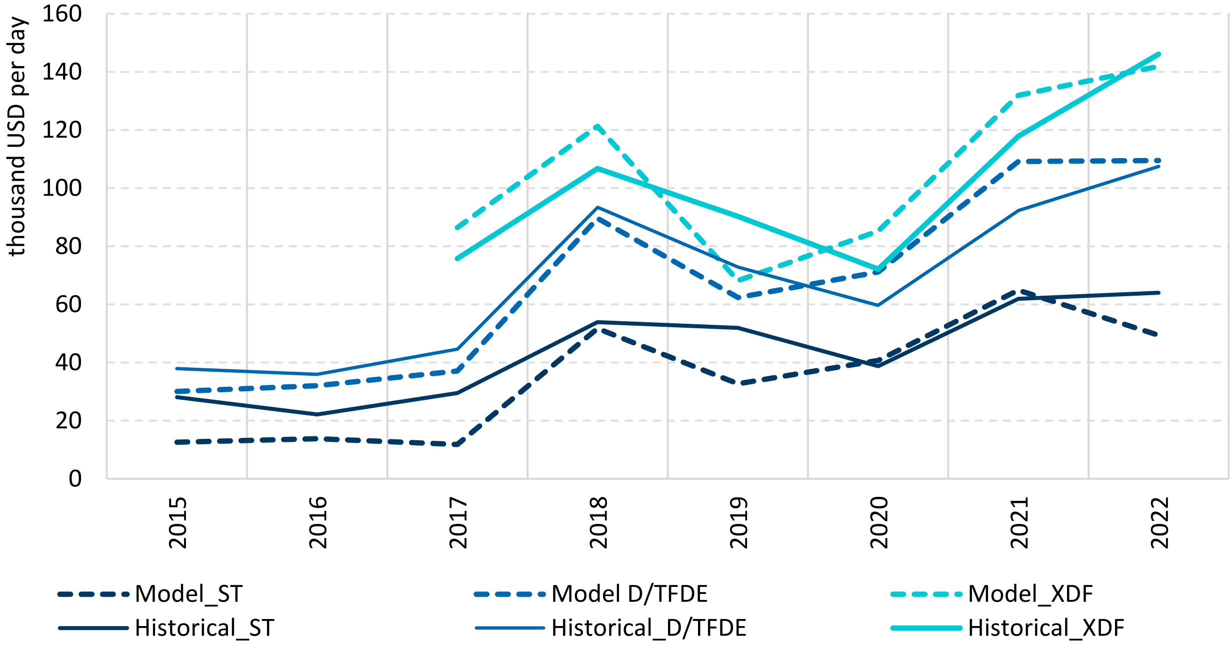
Sources: IMF (for inflation), FTI analysis

32. The equilibrium price varies between periods of tension between supply and demand, i.e., tight periods, when the price of shipping is higher, and periods of slack, when the price of shipping decreases due to a higher supply/demand ratio. FTI Consulting models variation of equilibria between supply and demand over the years, resulting to variation in the prices. After an exceptional year in 2022 with record high gas prices in Europe and Asia, and record high LNG shipping price, the regression model linking shipping price and supply/demand equilibria was updated to capture novel market behaviours displayed in 2022. Notably, we used a 2-factor regression of LNG shipping price against LNG shipping market equilibria and gas prices. Through this update, we allowed scarcity pricing for LNG shipping to be linked to prevailing gas prices (as opposed to a fixed multi-year scarcity value previously used).

4.2. Back cast of the model

33. In Figure 13 below, we present the results of the modelled freight rates as well as actual data for the historical period between 2015 and 2022.

Figure 13. Modelled freight rates vs. historical actual freight rate for the period 2015-2022, in current prices



Sources: Actual data: HRP, Modelled data: FTI analysis

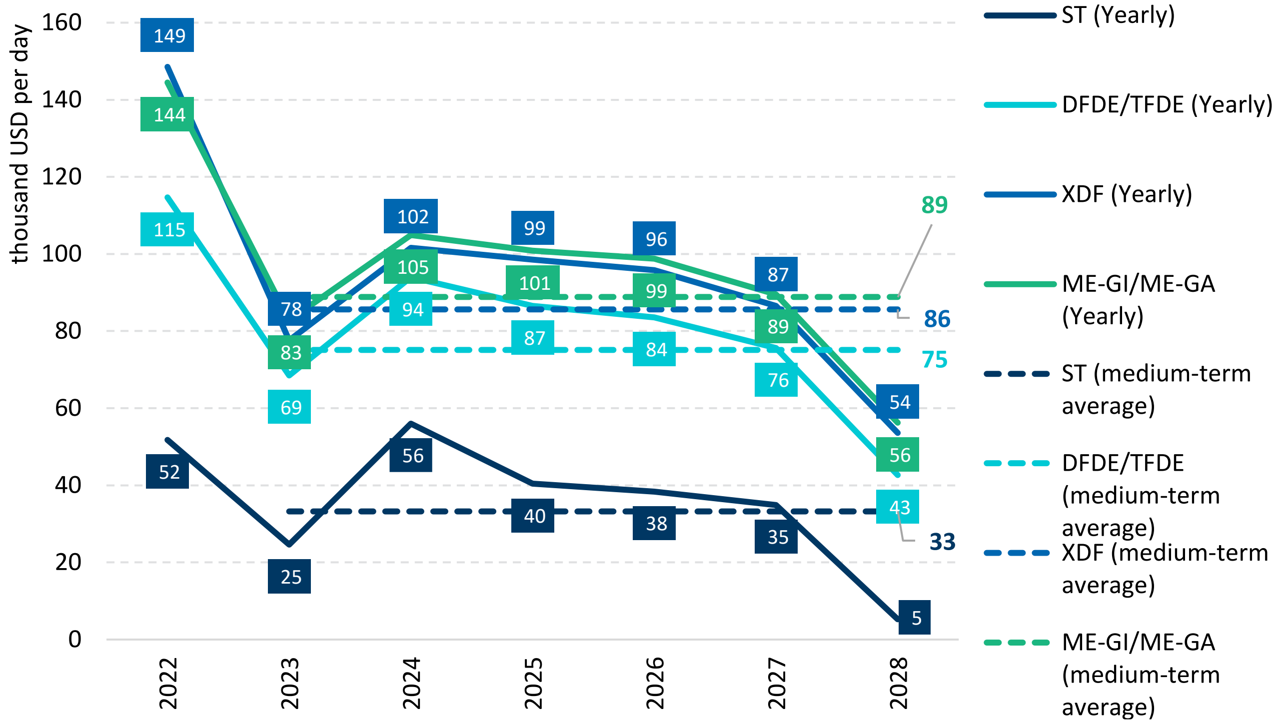
34. The model has a considerable fit with historical charter rates for the three main technologies: ST, DFDE/TFDE and XDF vessels, over the historical period 2015 to 2022.[10]

4.3. Forecasts from the model

35. Looking forward, the model provides annual freight rates by propulsion engine technology for the period 2023-2028, as well as a medium-term average of these freight rates by technology representing a medium-term average freight rate based on opportunity costs.

[10] ME-GI/ME-GA not represented in the back cast as it is very close to XDF and less representative.

Figure 14. Average freight rates by propulsion technologies by year and medium-term average for the period 2022-2028, in real 2023 USD per day



Source: FTI analysis

Note: The medium-term average considers the period of 2023 to 2028

36. The trend in annual freight rates shows a significant decrease in 2023, followed by an immediate increase, with a gradual reduction until 2028. The reduction in 2023 is a combination of relatively stable shipping demand, coupled with an increase in supply from newly delivered ships. In 2024, new liquefaction capacity adds significant demand to the LNG shipping market. In the following years after 2024, while new liquefaction capacity continues to be added, freight rates decrease due to numerous investments in new ships, confirmed from order books, notably in 2026-2027, and endogenous investments from the model optimisation (to cater for new liquefaction capacity). This result illustrates a stronger excess of supply over demand in late 2020s, which will push some high-OPEX vessels to exit the market through demolition.

37. FTI Consulting models different equilibria between supply and demand over the years, which drive the prices variation:

- Years 2022 to 2027 are "tight" in the sense that the reserve margin between total supply capacity and total demand is lower than the historical standard reserve margin, which is expected to lead to some scarcity pricing, driven by level of reserve margin and gas price[11].
- Conversely, 2028 is relatively "loose" where the newbuild ships entering the market outstrip demand growth. In a relatively "loose" year, there is accordingly a significant excess of supply over demand, and the least efficient vessels are not used to deliver LNG, driving lower freight rates which are based on marginal higher efficiency ships. The lower freight rates modelled for 2028 is in line with past relatively "loose" years of 2015 to 2017.

38. The price of the LNG shipping voyage from Gladstone, Australia to Tokyo, Japan is calculated using the shipping price (USD/MMBtu) for the Gladstone-Tokyo route distance. Below is our calculation, relying on the dominant new propulsion technology, XDF, for the price of shipping from Gladstone to Tokyo, in USD per MMBtu, for the years 2023 to 2028.

39. In general, the freight rate estimates are higher than those in FTI Consulting's previous report with analysis from December 2022 (published February 2023). This is primarily due to the upward revision of estimated future LNG demand, and changes in macroeconomic factors, such as the inflation rate and future gas and oil prices.

[11] In the "tight" mode, the reserve margin is below the threshold determined by historical data, resulting in prices that follow a regression of historical data, while in the relatively "loose" mode, the model's reserve margin is above the threshold and prices are set as the Short Run Marginal Cost (SRMC) of the least efficient technology required to meet demand.

Table 1. Calculation of the shipping price from Gladstone to Tokyo and back for the XDF propulsion technology for the period 2022-2028, in real 2023 USD prices

	Source	Unit	2022	2023	2024	2025	2026	2027	2028
FTI Annual Charter Rates XDF		thousand USD	**4,063**	**2,123**	**2,779**	**2,696**	**2,621**	**2,367**	**1,465**
FTI Daily Freight rates XDF	FTI	thousand USD/day	149	78	102	99	96	87	54
Number of days for the round trip Gladstone-Tokyo(1)	ICIS, FTI analysis	day	27.35	27.35	27.35	27.35	27.35	27.35	27.35
Fuel		**thousand USD**	**105**	**96**	**96**	**95**	**94**	**93**	**92**
HFO price	IEA Stated Policies Scenario	USD/tonne	733	660	651	641	632	623	614
MDO price	IEA Stated Policies Scenario	USD/tonne	642	656	669	682	695	708	721
HFO consumption	Maran Gas Maritime	ton/day	5	5	5	5	5	5	5
MDO consumption	Maran Gas Maritime	ton/day	1	1	1	1	1	1	1
Number of days at sea (2)	ICIS, FTI analysis	day	24.35	24.35	24.35	24.35	24.35	24.35	24.35
Boil off		thousand USD	**4,452**	**1,687**	**2,101**	**2,075**	**2,111**	**2,147**	**2,183**
LNG consumption	HRP	ton/day	108	108	108	108	108	108	108
Gas price (3)	ICIS EAX, ICIS medium-term price forecasts, IEA	USD/tonne	1507	571	711	702	715	727	739
Port fees		thousand USD	**269**	**269**	**269**	**269**	**269**	**269**	**269**
Load fee	HRP	USD	200,119	200,119	200,119	200,119	200,119	200,119	200,119
Discharge fee	HRP	USD	68,912	68,912	68,912	68,912	68,912	68,912	68,912
Other fees		thousand USD	**12**	**12**	**12**	**12**	**12**	**12**	**12**
FTI Total price of the voyage XDF		thousand USD	**8,901**	**4,187**	**5,257**	**5,147**	**5,108**	**4,889**	**4,022**
Average ship capacity		MMBtu	3,491,021	3,491,021	3,491,021	3,491,021	3,491,021	3,491,021	3,491,021
FTI Total price of the voyage XDF		USD / MMBTU	2.55	1.20	1.51	1.47	1.46	1.40	1.15
HRP Total price of the voyage XDF		USD / MMBTU	2.16	1.27	1.38	1.36	1.34	1.35	1.37
FTI medium-term average		**USD / MMBTU**		**1.37**					

Sources: ICIS, HRP, FTI analysis, IEA WEO 2022

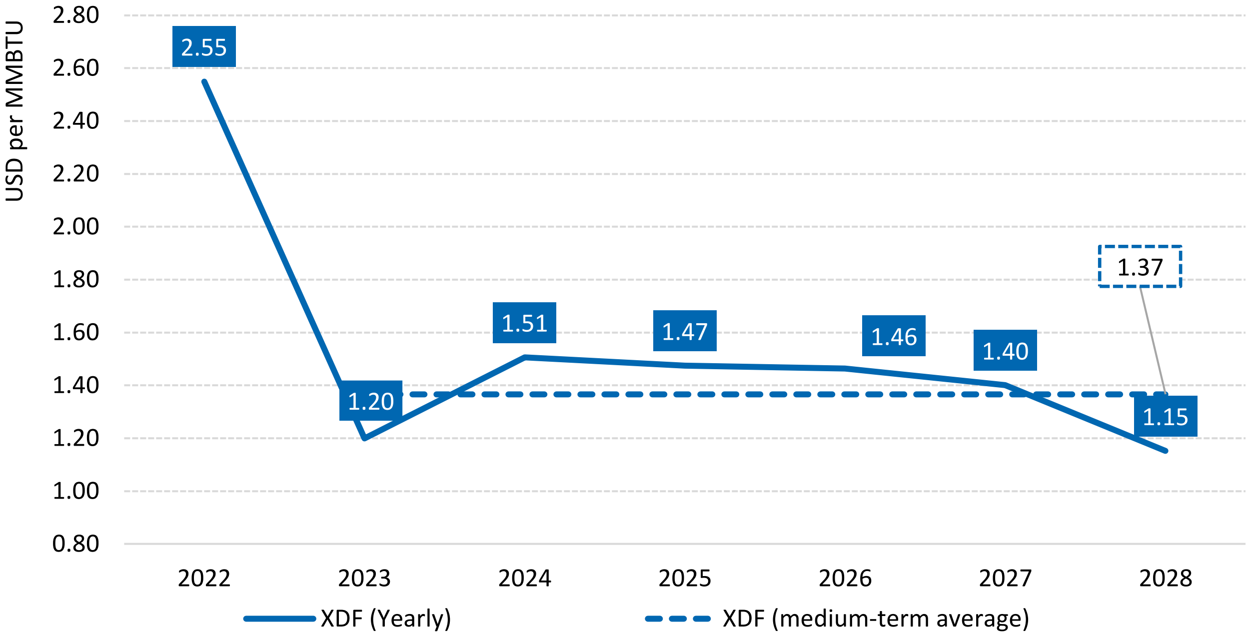
Notes: The total cost of the trip is expressed in real terms using IMF inflation estimates until 2028. The latest update is based on April 2023 World Economic Outlook

(1) *The number of days for the round trip is calculated with a distance of 3,750 nm, a speed calculated as the average speed of all trips in the ICIS database above 851 nm, i.e., the shortest distance between two zones determined by FTI, for the period 2018-2021, and 3 additional days in ports.*

(2) *Same as above but without the 3 additional days in ports.*

(3) *The boil-off cost or the opportunity cost of LNG for the Gladstone-Tokyo route is based on the regional spot price for East Asia (EAX), taken as an annual average for the year 2022. For 2023-2025, the price is based on ICIS medium-term price forecast for Japan-Korea as of 12th June 2023. For the period of 2026-2028, the values are based on interpolating data between the 2025 ICIS medium-term price forecast and the available 2030 IEA Stated Policies Scenario for Japan/East Asia.*

Figure 15. Average price of shipping Gladstone-Tokyo by year and medium-term average for an XDF propulsion technology, for the period 2022-2028, in real USD/MMBtu



Source: FTI analysis
Note: The medium-term average considers the period of 2023 to 2028

40. The results presented show the shipping price for the XDF technology, the soon-to-be dominant propulsion technology. Given the general price equilibrium assumed in the LNG shipping market, all technologies should offer the same price of transport (in USD per tonne-mile) on average globally. Accordingly, the shipping prices from Gladstone to Tokyo in USD/tonne-mile for the other technologies modelled (ST, DFDE/TFDE, ME-GI/ME-GA) are within a range of +/- 2% of the above XDF results.

41. Compared to the previous report, the average shipping price is higher due to the higher value of the LNG boil-off costs, as a result of the persistence of high LNG spot prices. We updated our gas price input assumptions from the IEA long-term scenarios to ICIS average spot prices and 2-year forecasts to better reflect the exceptional volatility observed in the past year, and add shorter-horizon LNG price forecasting. For the IEA long-term scenarios for fuel prices, we updated the scenario basis from "Announced Pledges Scenario" to "Stated Policies Scenario" to better reflect the increasing price trend observed in ICIS current prices and forecasts.

5. Discussion of results - Cross-checks

42. The results obtained from the model are compared with alternative estimates from other sources, either (1) from future freight rate fixtures and forecasts, or (2) derived from current CAPEX of newbuild LNG carrier vessels.

5.1. Freight rates cross-checks

43. We compare the model's forecast of freight rates with two independent sources of medium-term freight rates estimates:

- **HRP data:** Average Medium-term charter fixtures, observed in the past 12 months;
- **ICIS data:** Long-term freight rate, as estimated by ICIS; and

44. The comparison is done with the freight rates of the most representative propulsion technology of the orderbook which is expected to be the most representative of the operational fleet in the medium-term: the XDF propulsion technology.

45. Data provided by HRP include 22 fixtures contracted between 2021 and 2022, which last each in between 4 months and 10 years in the future.

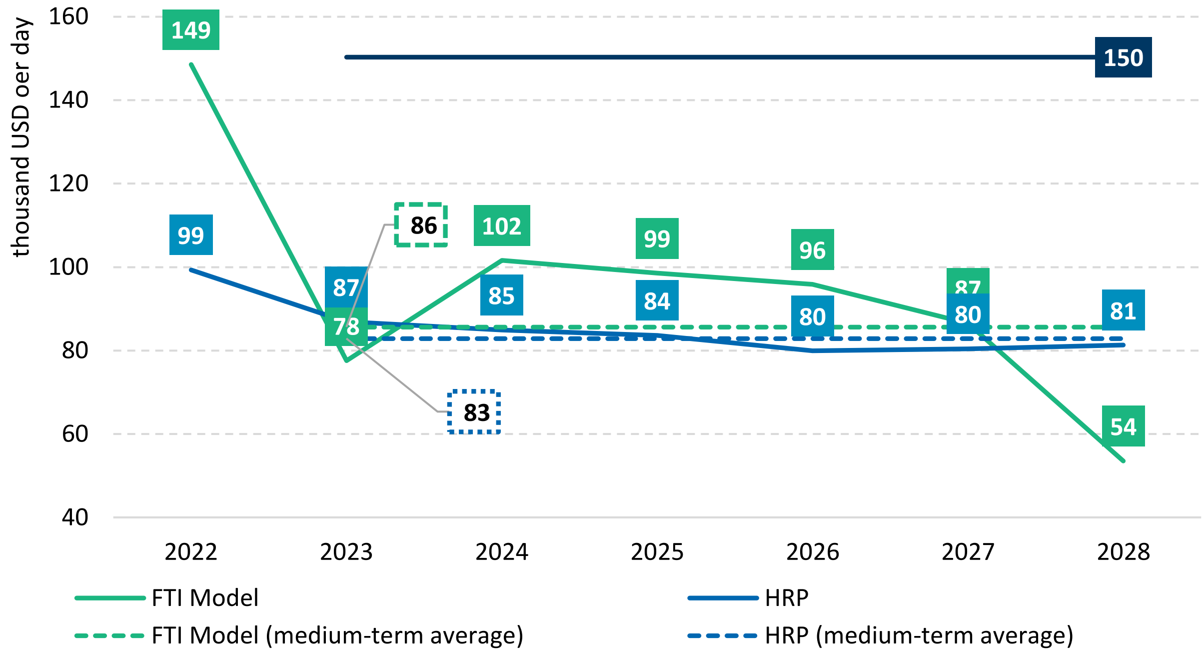
Table 2. Number of fixtures for XDF propulsion LNG carriers observed in the past 12 months, by year included in fixture

Year	2023	2024	2025	2026	2027	2028
XDF	28	27	23	21	19	17

Sources: HRP, FTI analysis

46. We present below the annual average of the HRP fixtures for XDF, as well as the ICIS long-term freight rate estimate.

Figure 16. Model results and cross-checks for freight rates of XDF propulsion vessel for the period 2022-2028, in real 2023 USD/day



Sources: ICIS, HRP, FTI analysis

Note: The medium-term average considers the period of 2023 to 2028

47. The model average result (86k USD/day) is 4% higher than the HRP estimate 83k USD/day and much lower (43%) than the ICIS long-term estimate of 150k USD/day.

48. We note that the model results are more volatile than the cross-checks data, as the model is an annual optimisation assuming perfect information of the different stakeholders, which may differ from a limited sample of fixtures based on expectations of some market players for various future periods, as HRP collects and ICIS estimates. We however note that strong annual price variations are in line with historical price behaviours on the LNG shipping market (cf. Figure 13).

49. The long-term LNG freight rate estimate from ICIS is based on a single value, leading to a flat forecast, representing “fixtures for a chartering period of between one and seven years, with delivery to start within two years of the transaction date”[12]. As such, it represents a variety of periods which all start at a delay from current year, which is different from the medium-term horizon we compute. By including this delay, ICIS may also overweight fixtures based on newbuild LNG carrier vessels that are typically set several years in advance. The actual price information

[12] ICIS, Global LNG Markets Methodology, 23 June 2021, p.19: https://cjp-rbi-icis-compliance.s3.eu-west-1.amazonaws.com/wp-content/uploads/2021/06/23112517/Global-LNG-Markets-Methodology-23-June-2021.pdf

used by ICIS to produce its long-term freight rate estimate is not disclosed by ICIS. We note that the ICIS long-term freight rate estimate available in June 2023 is 12% lower than that in December 2022, which in turn is nearly three times as high as the ICIS estimate we presented in August 2022.

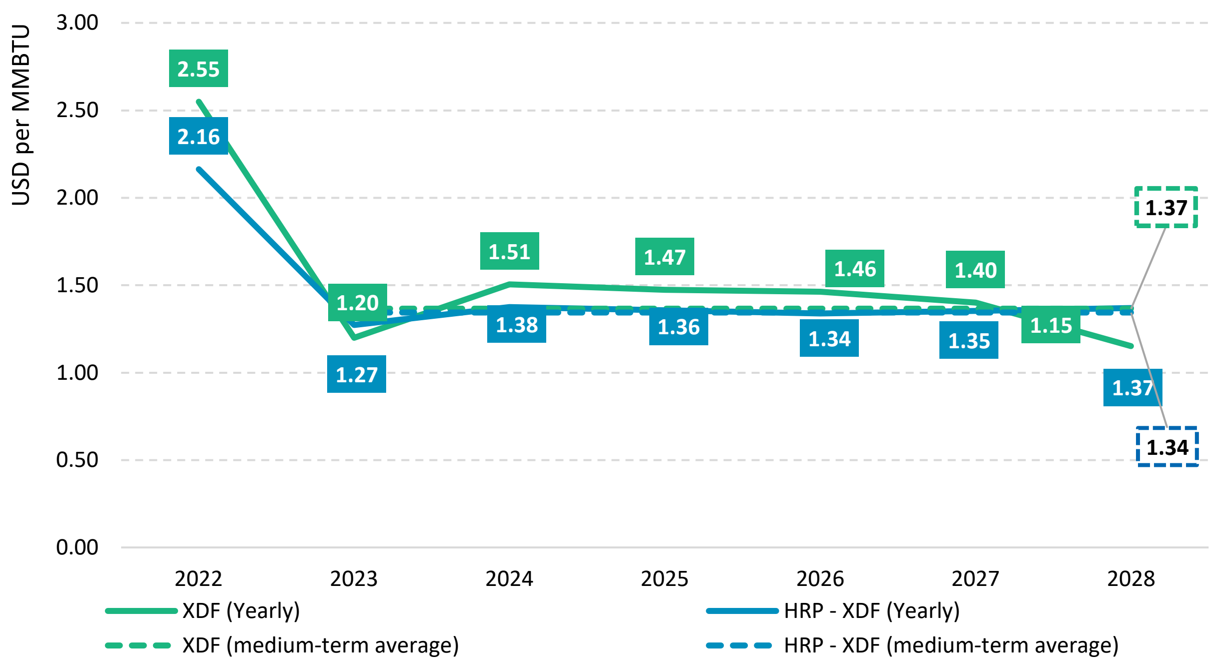
50. The average of HRP fixtures is computed by averaging all available HRP's freight price data (from the duration of 4 months to 10 years), which may not be representative of the trades that will take place in future annual markets. This sample however represents actual transaction data. We note that the average of HRP fixtures increased by 12% between June 2023 and those observed in December 2022.

51. We note a significant difference between the ICIS estimate and the average of HRP fixtures, with the former being x1.8 times the latter. This suggests an absence of consensus on the medium-term LNG freight rate from market observers, amidst important spot freight rates movements in H2 2022[13], which may limit the relevance of cross-checks in the present report.

5.2. Gladstone-Tokyo route cross-checks

52. A comparison of the price of LNG transport from Gladstone, Australia, to Tokyo, Japan obtained with the model is made with HRP data (which we find may be a more relevant cross-check than ICIS, as it is based on actual transaction prices communicated to us).

Figure 17. Model forecast results and cross-checks for price of LNG transport Gladstone-Tokyo for the period 2022-2028, in real USD/MMBtu



[13] According to ICIS, spot LNG freight rates were multiplied by x5 between June and November 2022.

Sources: ICIS, HRP, FTI analysis
Note: The medium-term average considers the period of 2023 to 2028

53. The results show comparable prices for HRP data and the outputs from FTI model, with a modelled average price over medium-term average of LNG shipping at 1.37 USD/MMBtu and an HRP fixtures average estimate at 1.34 USD/MMBtu which are both higher than previously estimated. The difference is driven mainly due to the higher valuation of the LNG boil-off as described in paragraph 41.

54. Here the shipping costs are derived from freight rates, and the trends in variation are therefore similar.

5.3. CAPEX cross-check

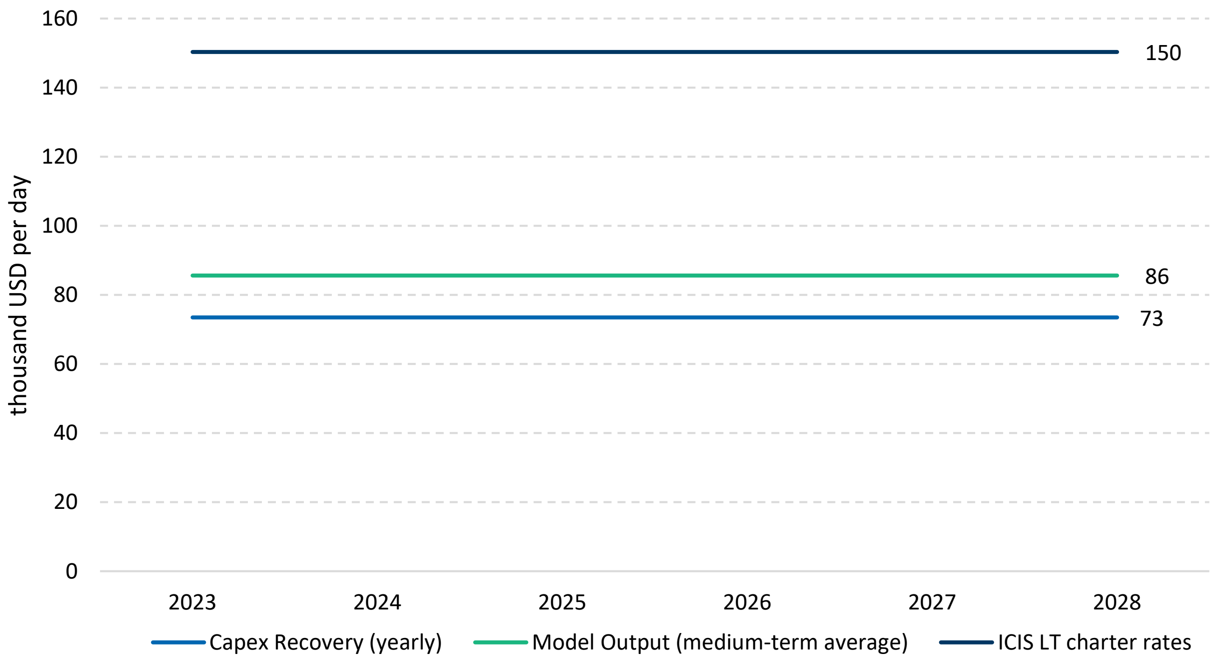
55. The CAPEX cross-check computes an indicative freight rate required to allow for the recovery of an investment in a new build LNG carrier at current CAPEX prices. Current LNG prices are estimated based on observed CAPEX for a newbuild XDF LNG carrier vessel contracted in the last 6 months, provided by HRP. Using an indicative estimate of industry Weighted Average Cost of Capital (WACC) and related time horizon[14], we define an annual CAPEX recovery payment, and add OPEX to determine the expected freight rate that can be expected for a newbuild. According to HRP, there are however significant variations in WACC at different periods of time and across shipowners, as well as different time horizons for CAPEX recovery; accordingly, this CAPEX-based freight rate cross-check should be seen as indicative and not necessarily representing current average financing conditions, which would require specific further study to be determined robustly.

56. Indicatively, we thus find a yearly CAPEX recovery freight rate of 73k USD/day which is lower compared to FTI's model-based forecast of the XDF freight rates, which has a medium-term average of 86k USD/day. These new figures, respectively increased by 1.3% and 12% from our previous report, are in line with the rising building cost of the shipyard with the latest newbuilt dual strokes orders exceeding USD 263 million (+5% as compared to our previous report)[15].

[14] Indicative industry Weighted Average Cost of Capital (WACC) of 5.9% (nominal) and investment horizon of 25 years, as provided by Hellenic Shipping News (link)

[15] Source: HRP.

Figure 18. Long-term charter rates, model results, and CAPEX recovery yearly freight rate of newly built XDF vessels in the period 2023-2028, in real 2023 USD/day



Sources: HRP, Hellenic Shipping News, FTI analysis
Note: ICIS long-term charter also represented as that of a similar long-term nature as CAPEX recovery charter rate
The medium-term average considers the period of 2023 to 2028