27 May 2021

DNB MARKETS

# FINANCING 2°C SHIPPING

## Financial risk of future regulations

We have worked with KLP and other partners in the Green Shipping Programme to assess the risk for financial stakeholders in various shipping technologies within the VLCC, Capesize and 10k TEU container segments. We find: 1) relative attractiveness of short-dated assets with scrubbers; 2) high uncertainty among newbuild alternatives in an uncertain regulatory environment; 3) that current IMO targets seem within reach in our base case; and 4) that further tightening of regulations is needed to align shipping with the Paris Agreement. We find the current outlook favours LNG-fuelled vessels for newbuilds, but that $CO_2$ costs above USD275/tonne prompt a shift to potential carbon-free NH3 technology. Our findings support a bullish long-term view, especially for dry bulk when coupled with a record low orderbook of 5.6% and strong near-term market.

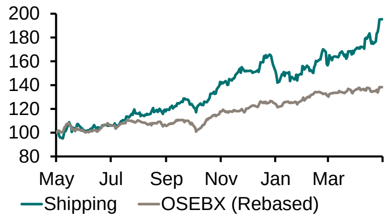
**Study developed as part of the Norwegian Green Shipping Programme.** This study was developed by KLP and DNB Markets in the Norwegian Green Shipping Programme (GSP) as part of the 'Financing Paris-aligned shipping' pilot with valuable input from partners including DNV, the Norwegian Shipowner Association, Norsk Hydro, Equinor, Teekay, Wartsilla and The Ministry of Climate and Environment in Norway, DNB, Massterly.

**Attractive older vessels sheltered from regulatory risks.** Comparing IRRs for various ship types in VLCCs and Capesize segments, we find that the older 2010-built vessels on the water are the preferred financial investment, and especially when fitted with a scrubber. This follows that an existing vessel's remaining economic lifetime is limited mainly to the period prior to stricter regulations being enforced, most notably with blending requirements and $CO_2$ pricing from 2030.

**Regulatory ambition to dictate newbuild vessel of choice.** We find considerable uncertainty among newbuilding technology alternatives depending on the level of environmental stringency to reach emissions-reduction targets. In our base case, LNG-fuelled vessels prevail as the technology of choice, but $CO_2$ costs above USD275/t shift the preference to ammonia as the preferred fuel and our high-case proves detrimental to the traditional propulsion technology where we reach carbon-neutrality by 2050.

**Dry bulk screens highly attractively against the above results.** Expected demand growth coupled with continued downward pressure on speeds, an all-time low orderbook of 5.6%, and high uncertainty about future vessel technology leave us encouraged for the outlook in dry bulk and the Capesize segment. The combination of aged vessels and scrubber coverage would favour Star Bulk (BUY, TP USD24.3) and Genco (BUY, TP USD18.9) in our coverage universe, which have scrubber-fitted their entire Newcastlemax and Capesize fleets, consisting of 41 (average age of 8.4 years) and 17 (10.5) vessels, respectively.

Shipping vs OSEBX (12m)




Source: Factset

Note: Unless otherwise stated, the share prices in this section are the last closing price

**ANALYSTS**
Jørgen Lian
jorgen.lian@dnb.no
+47 24 16 91 88

Mats Bye
mats.bye@dnb.no
+47 24 16 91 86

Markus Tryggvason Lanesskog
Markus.Tryggvason.Lanesskog@dnb.no
+47 24 16 91 68

# Contents



| Company | Cur | Rec | Target Price | Share Price | P/E 21e | P/E 22e | P/E 23e |
|---|---|---|---|---|---|---|---|
| 2020 Bulkers | NOK | BUY | 125.0 | 103.0 | 7.1 | 8.0 | 6.6 |
| A. P. Møller Mærsk | DKK | HOLD | 16200 | 16795 | 5.5 | 13.9 | 18.1 |
| Avance Gas | NOK | BUY | 60.00 | 44.28 | 10.1 | 11.1 | 13.6 |
| BW LPG | NOK | BUY | 86.00 | 65.60 | 8.7 | 13.8 | 19.1 |
| DHT Holdings | USD | HOLD | 6.20 | 6.20 | nm | nm | 10.3 |
| Dorian LPG | USD | BUY | 17.00 | 14.46 | 7.1 | 12.4 | 9.2 |
| Eagle Bulk Shipping | USD | BUY | 53.30 | 47.00 | 7.1 | 12.1 | 7.9 |
| Euronav | USD | HOLD | 9.20 | 9.79 | nm | nm | 18.5 |
| Flex LNG | NOK | BUY | 142.0 | 118.5 | 6.1 | 4.8 | 3.9 |
| Frontline | NOK | HOLD | 68.00 | 71.04 | nm | 25.0 | 7.5 |
| GasLog | USD | HOLD | 5.80 | 5.84 | 4.7 | 4.1 | 4.1 |
| Genco Shipping & Trading | USD | BUY | 18.90 | 15.45 | 7.6 | 10.2 | 6.8 |
| Golar LNG | USD | BUY | 18.00 | 11.99 | nm | 49.7 | 43.3 |
| Golden Ocean | NOK | BUY | 95.00 | 80.70 | 8.4 | 9.5 | 6.8 |
| Hunter Group | NOK | HOLD | 3.10 | 3.17 | nm | 53.7 | 11.0 |
| MPC Container Ships | NOK | HOLD | 16.70 | 16.60 | 9.8 | 7.8 | 14.1 |
| Ocean Yield | NOK | BUY | 36.00 | 29.78 | 8.7 | 9.5 | 10.1 |
| Odfjell SE | NOK | BUY | 33.00 | 30.20 | nm | 6.5 | 4.6 |
| Safe Bulkers | USD | BUY | 4.50 | 3.87 | 4.8 | 8.2 | 7.3 |
| Scorpio Tankers | USD | HOLD | 19.00 | 21.61 | nm | 4.6 | 4.2 |
| SFL Corporation Ltd | USD | HOLD | 8.60 | 8.70 | 14.1 | 16.1 | 8.3 |
| Star Bulk | USD | BUY | 24.30 | 20.33 | 6.1 | 7.5 | 5.5 |
| Stolt-Nielsen | NOK | BUY | 145.0 | 127.8 | 15.9 | 6.3 | 4.2 |
| Teekay Tankers | USD | HOLD | 15.00 | 15.09 | nm | 19.7 | 4.1 |
| Wallenius Wilhelmsen ASA | NOK | BUY | 38.00 | 32.92 | 14.3 | 4.3 | 3.5 |
| Wilh. Wilhelmsen Holding | NOK | BUY | 243.0 | 185.0 | 7.2 | 4.3 | 3.8 |

Source: DNB Markets

# Highlights

## Main findings in the study

We find several similarities among the different segments, while we have also uncovered some meaningful differences worth highlighting.

### Older vessels sheltered from regulatory risks an attractive investment

Comparing IRRs for various ship types in the VLCCs and Capesize segments, we find that the older 2010-built vessels on the water are the preferred financial investment, especially when fitted with a scrubber. This follows that an existing vessel's remaining economic lifetime is limited mainly to the period prior to stricter regulations being enforced, most notably with blending requirements and $CO_2$ pricing from 2030. This is particularly true for VLCCs, considering the shorter lifespan of such vessels, which is reflected in the higher sensitivity of such second-hand Capesize vessels in the high-case scenario. For the container vessels, we find that the early implementation of near-term regulations in the segment negatively affects the older assets and the scrubber-fitted resale is the preferred vessel, potentially with LNG retrofit.

### Our base-case assumptions get pretty close to the IMO's current ambition…

Underlying shipping demand growth varies between the crude tanker and dry bulk in our forecasts and affects the results on aggregate emissions when compared to IMO's stated ambitions of 50% cuts by 2050. Carbon-intensity targets are reached in our base case for both segments, but the aggregate emissions in dry bulk still exceed the 50% ambition while our forecasts for VLCCs are within the targets.

### …but more is needed to align shipping with the Paris Agreement

In our high-case scenario, we achieve carbon neutrality in both VLCCs and Capesizes by mid-century, which aligns these segments with the 1.5°C goals under the Paris Agreement. Thus, we conclude that stricter regulations than our base-case outlook are needed in order to reach net-zero shipping by 2050 – but it definitely seems within reach.

### Traditional technology is grandfathered under more stringent ambitions

The traditional engine technology, i.e. ICE burning HFO(scrubber)/VLSFO/MGO, is highly sensitive to changes in environmental regulations. While acceptable returns are achieved in our base case closely aligned to current IMO ambitions, Paris Agreement-aligned shipping would be detrimental to financial returns. However, retrofitting to alternative fuel could still be a viable solution.

### LNG is the 'not too hot, nor too cold' of shipping today

LNG propulsion has proven to be considerably less sensitive to changing environmental regulations and increased fuel/$CO_2$ costs than traditional technology. We find that if $CO_2$ costs are kept roughly between USD75–275/tonne, the LNG vessel becomes the asset of choice. The 'LNG window' relates to the up to 23% $CO_2$ savings from the technology, which offsets moderate cost increases for $CO_2$ relative to traditional vessels.

### NH3 the most future-proof solution, but runs risk of lax regulations near-term

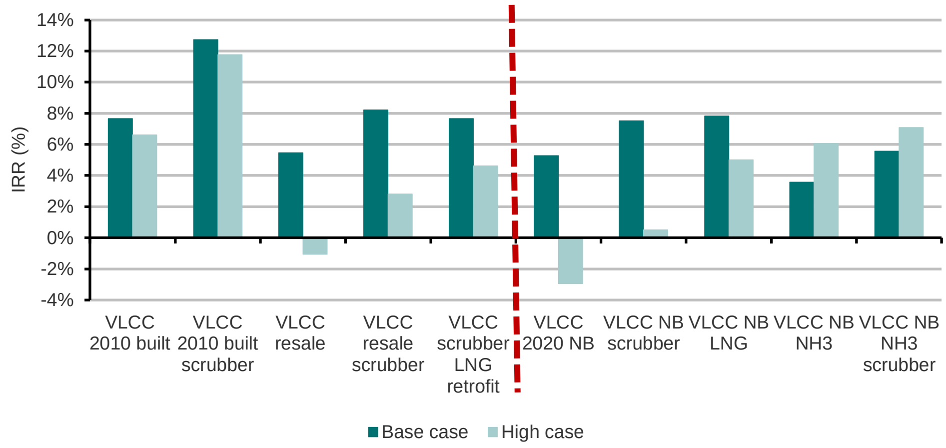
While more stringent regulations and higher $CO_2$ costs are needed for ammonia-fuelled vessels to be economically viable, they are the asset least sensitive to shifting regulations. This makes the technology the most future-proof in our assessment, and the front-runner for bringing shipping in line with the Paris Agreement, should the IMO lift its ambition.

## VLCC case study

The short life span of a VLCC (we model 20 years) translates into the existing 2010-built vessel being scrapped before fuel blending and $CO_2$ pricing make an impact. Thus, on a purely financial basis, this proves to be the most attractive investment today considering regulatory risks. The scrubber-fitted alternative is the best solution, and also preferred among traditional resales and newbuilds. However, the LNG design remains the most attractive solution among newbuilds in our base-case scenario (marginally ahead of the scrubber-fitted alternative), and also holds up reasonably well in the high-case scenario. Under the high-case scenario, the traditional fuels show very poor financial returns, while the ammonia-fuelled vessel is the preferred option.

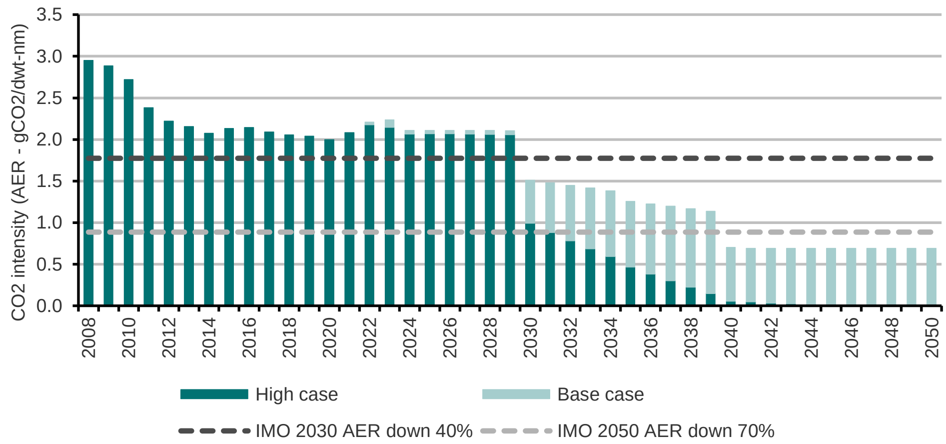
Due to limited expected demand growth, our base case is well within the IMO's current ambitions, while the high-case scenario results in carbon-neutrality for VLCCs by early 2040.

### Base and high-case IRRs for various technology VLCCs



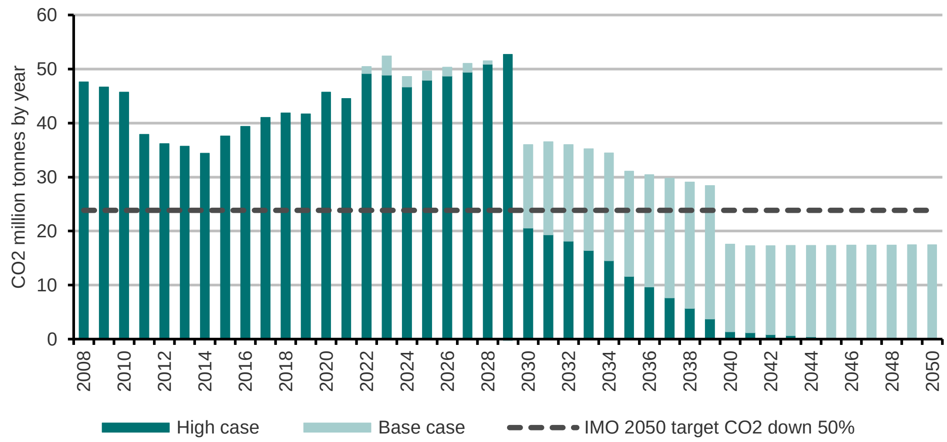

Source: DNB Markets

### Our forecast CII for VLCCs in both scenarios




Source: DNB Markets

### Our forecast aggregate $CO_2$ emissions for VLCCs in both scenarios



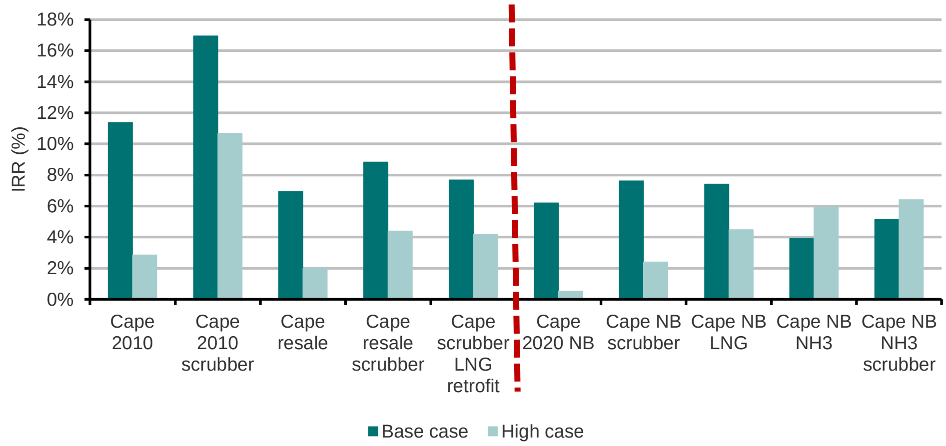

Source: DNB Markets

## Capesize case study

Capesizes are modelled to last 25 years, and thus stricter regulations show a slightly larger impact on the expected financial returns. However, the scrubber-fitted 2010 design remains the preferred investment based on today's outlook. As for VLCCs, this translates to potential upside for the value of such second-hand vessels versus the resales and newbuilds in order to close the gap. For newbuilds, the traditional vessel with scrubber marginally remains the best investment today under our base case, but this is set to change in the coming years as regulations draw closer. Adjusting for potential risks to more stringent regulations, we believe the LNG-fuelled vessel offers better risk/reward. However, the ammonia-fuelled design wins out in our modelling if IMO were to raise its ambitions to meet the Paris Agreement for shipping.

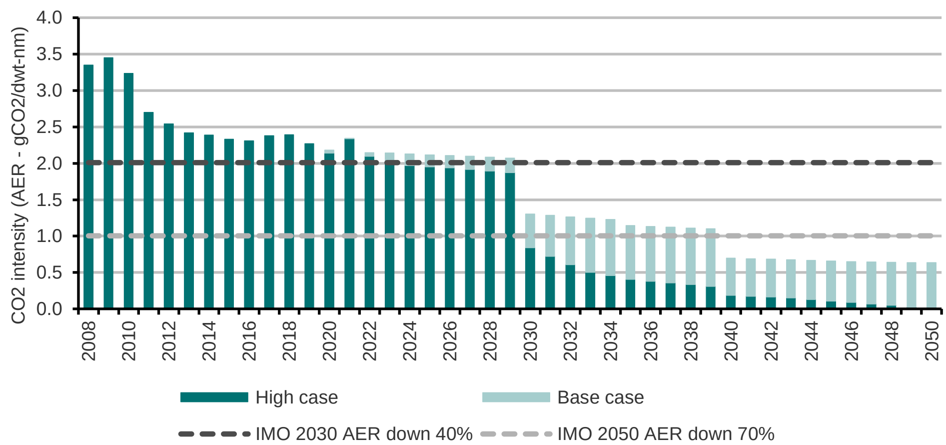
We believe the dry bulk fleet will struggle to meet IMO's ambitions due to expected shipping demand growth. Owing to increased volumes and declining speeds (due to higher fuel costs), we calculate the Capesize fleet would need to grow from 1,800 vessels today to 3,700 vessels in 2050 to meet demand. This translates into substantial investments and drives up aggregate emissions, although efficiency is improved to well within IMO-stated ambitions under base- and high-case scenarios. In the base case, aggregate emissions are still above 50% cuts by 2050, while the high-case results in carbon-neutral shipping by 2050 – in line with Paris Agreement 1.5°C targets.

**Base- and high-case IRRs for various technology Capesize vessels**



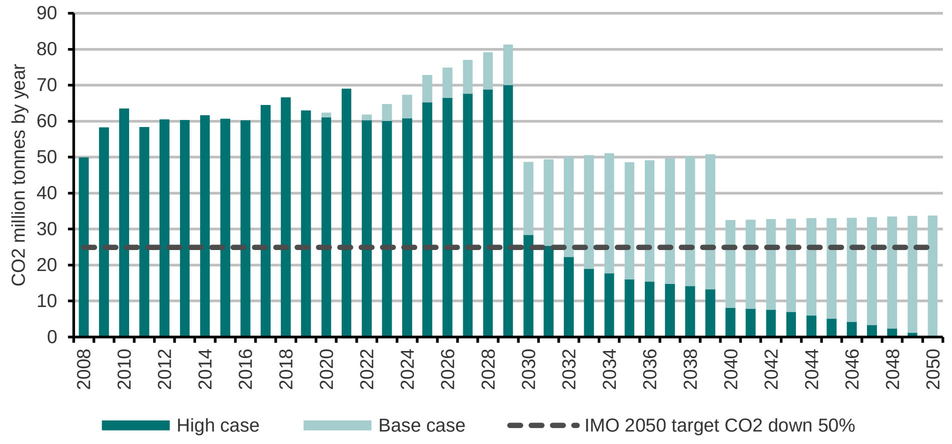

Source: DNB Markets

**Our forecast CII for Capesize in both scenarios**




Source: DNB Markets

**Our forecast aggregate $CO_2$ emissions for Capesize in both scenarios**

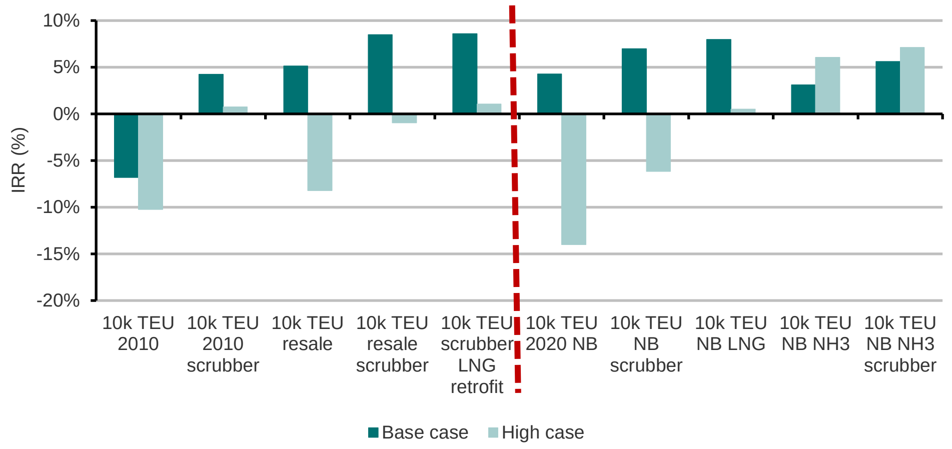



Source: DNB Markets

## 10kTEU case study

Higher consumption numbers, substantial improvement in vessel designs and slow-steaming in recent years, along with early adoption of EEXI regulations, leave the container segment more exposed to regulatory changes than the other two segments, in our view. Thus, the result from the study also differs, with resale vessels with scrubber (potentially retrofitted to LNG) proving to be the leading design of existing vessels. For newbuilds, LNG is the best choice under the base-case scenario, but any financial return would be eradicated for vessels other than ammonia-fuelled designs if our high-case scenario materialises. The cost burden from dramatic increases in fuel and emissions costs simply become too substantial on a relative basis. Thus, modern and preferred technology of today could be outdated should regulators up the stakes for future ambitions.

**Base- and high-case IRRs for various technology 10k TEU vessels**




Source: DNB Markets

# Implications for shipping equities

## Highly attractive backdrop, especially for dry bulk

This study has highlighted the substantial risks and uncertainty facing shipping investors and presents several interesting results that we expect to factor into our thinking and evaluation of shipping equities going forward. On sector and company-specific levels, the findings are highly relevant, and indicate the potential magnitude of future regulations on the supply & demand balance. The general increased uncertainty from unknown future regulations will in our view continue to weigh on the contracting of new vessels, especially for the dry bulk space and Capesizes with the longest life span and regulatory exposure. This uncertainty, coupled with downward pressure on optimal speeds and anticipated demand growth, makes for a highly attractive investment case for the long term, in our view.

**Dated scrubber-fitted assets preferred…**

Based on our findings, the initial takeaway is the assets with shorter remaining economic life provide the best risk/reward characteristics. In particular, the existing assets fitted with scrubbers seem to be attractive investments. As such, from an environmental risk perspective, and somewhat counterintuitively, we prefer older vessels and see a disconnect in the relative valuation of such assets that could provide NAV valuation support for relevant companies.

**…but in cash-generating markets as near-term earnings important**

However, investing indiscriminately in older assets does not account for actual market conditions and outlook. Considering the recent tough tanker markets and our view that a sustainable recovery could be delayed, investing in a dated fleet could mean meaningful cash burn in the coming months and be detrimental to the investment case. On the other hand, strong earnings potential near-term in the dry bulk segment and an optimistic fundamental outlook provide strong support for investing in relatively low-priced older assets to reap the largest benefit and returns, in our view.

**More complexity and uncertainty in shipping = lower fleet growth**

The complexity of shipping increased dramatically when IMO 2020 formed a two-tier market with scrubber vessels, demanding premium rates on fuel savings from dirty fuel. Looking ahead, this complexity is set to increase several-fold as additional technologies are included in the fleet mix such as dual-fuel designs for using LNG or ammonia along with traditional bunker fuel. Coupled with unrivalled regulatory uncertainty, this makes for a difficult investment decision for shipowners, which – all else equal – should continue to limit contracting for some time.

**Cutting optimal speeds by 10–15% and limiting supply**

Due to increasingly stringent regulations, and most notably the added $CO_2$ price and carbon-neutral fuel blending requirements from 2030, the increased costs weigh on vessels' optimal speeds. We see downside to speeds by 10–15% from 2020 levels to 2030 in our base case for the VLCCs and Capesizes. Such downward pressure on speeds would limit supply and tighten freight markets if not met by meaningful deliveries and fleet growth.

**Dry bulk screens highly attractively against the above results**

We have modelled for limited demand growth in the VLCC segment beyond 2030 but find support for optimism in the dry bulk space. Potential for demand growth coupled with continued downward pressure on speeds, an all-time low orderbook of 5.6%, and high uncertainty to future vessel technology, have left us encouraged for the outlook in dry bulk and the Capesize segment.

**As such, Star Bulk and Genco match the profile for a sound eco-risk investment**

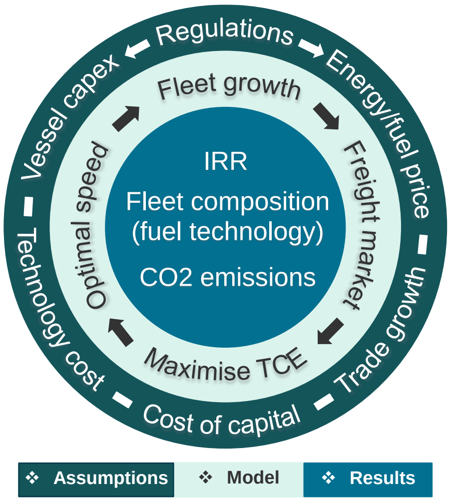
According to our analysis, the highest IRR is seen for a 2010-built scrubber-fitted Capesize in our base- and high-case scenarios. Within our dry bulk peer group, the relative outperformers would be Star Bulk (BUY, TP USD24.3) and Genco (BUY, TP USD18.9), which has scrubber-fitted their entire Newcastlemax and Capesize fleets, consisting of 41 (average age of 8.4 years) and 17 (10.5) vessels, respectively.

# Model overview

In this note, we present our modelling framework to determine which vessel technology should be the preferred investment at any given time. By doing so, we can construct a feasible fleet composition based purely on rational economic incentives (i.e. investors seeking to maximise financial returns on their investment). As the fleet composition changes over time (as older vessels are scrapped and newbuilds of the preferred technology are ordered), we can then estimate the emissions from the fleet and how they might change.

The figure below gives an overview of the inputs. Regulations concerned with decarbonisation are the main backdrop. First, they affect energy markets and fuel prices directly (e.g. $CO_2$ surcharges) and indirectly (e.g. higher cost of capital limiting fuel production and supply). Second, technical requirements add to vessel capital expenses for compliance, and incorporate the cost of various clean technologies. We also factor in expectations of transport demand growth and a reasonable cost of capital for calculating financial returns.

### Conceptual model overview




Source: DNB Markets, GSP project group

These assumptions drive our model, which sets an equilibrium freight market on a USD/tonne basis and translates into USD/day (time charter equivalent – TCE) earnings for the shipowner net of expenses including fuel etc. To maximise TCE, vessels optimise speed to limit fuel expenses, which again provides the basis of fleet growth and the number of vessels needed to handle the expected transport demand for any given year. By running the model on an annual basis, we can determine the most attractive vessel at any given time as the preferred newbuild vessel, and accordingly over the lifetime of the assets determine earnings per vessel type and derive absolute financial returns for various vessels while forecasting aggregate $CO_2$ emissions and fleet carbon efficiency.

To achieve this, certain simplifications need to be made. First, we limit ourselves to a single shipping sector (e.g. tankers, dry bulk, containers) and subsegment by vessel size (e.g. VLCC, Capesize, 10k TEU). Then, we simplify the number of vessel types by vintage (assumed 10-year intervals between each design shift) coupled with relevant propulsion technology for each vessel type. By doing so, we lose some of the distinctions between vessel designs, but overall the results are closely aligned with actual estimates for $CO_2$ emissions. Finally, we use the model output to determine the financial returns for each asset with a given technology for an investment made today, and illustrate the sensitivity of varying regulations and price scenarios for the various vessel types.

In short, we rely on a two-step framework that we cover in detail below:

- A per-vessel freight rate optimisation model.
- A market equilibrium model, minimising freight costs for the charterer.

The model is run annually to estimate returns on assets' lifetimes. Based on various input assumptions, it allows for a quantitative and relative assessment of the attractiveness of investing in different vessel types and technologies. We have included a base-case scenario and a high-case scenario – the latter to stress-test for a high energy and carbon price environment to determine the impact of changes to our underlying assumptions.

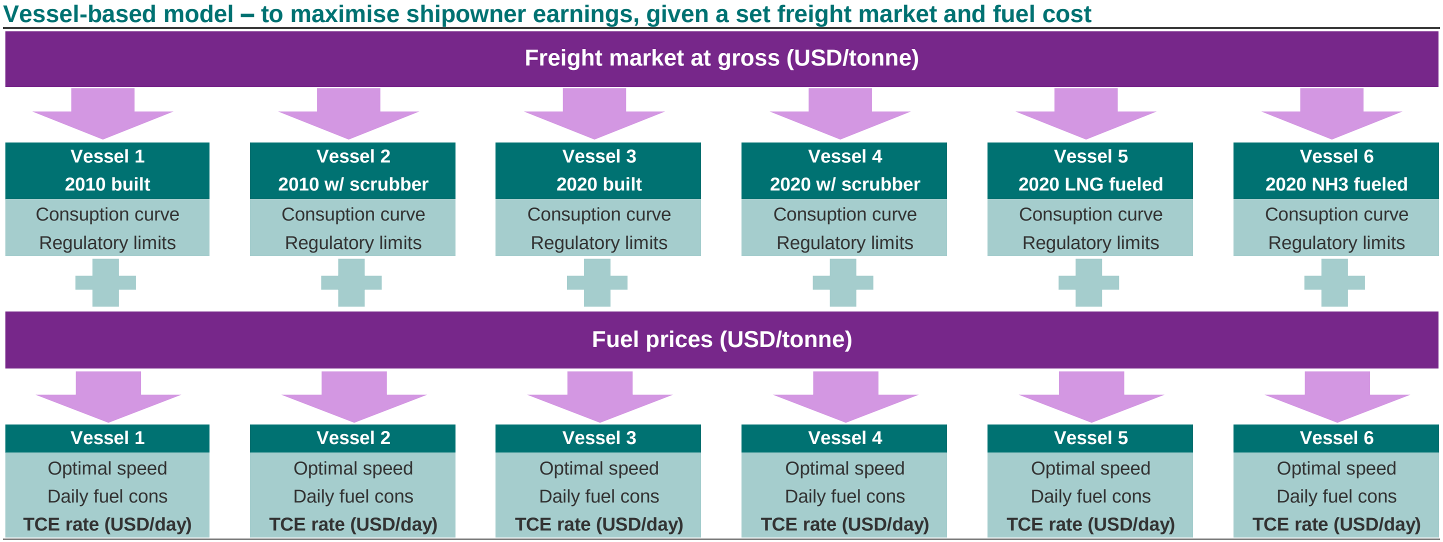
It is important to note the risk of investing in shipping assets given the rapidly evolving regulatory backdrop. We believe this could affect industry stakeholders' investment decisions and increase awareness of the factors driving shipping's supply-side fundamentals.

## Vessel-based freight rate optimisation model

The first component of our two-step framework is a predefined number of generic vessel types and their varying vessel specifications in terms of propulsion technology (i.e. fuel type) and fuel efficiency (i.e. speed/consumption curves). By defining these, we can approximate the aggregate fleet composition on factors such as optimal speed, emissions, carrying capacity, propulsion technology, etc. This allows us to investigate the impact of a changing fleet composition over time. Likewise, for any given time and freight market we can estimate generic earnings for the shipowner for ships with different propulsion technologies, allowing us to forecast what vessel types are the preferred investments (future newbuild deliveries) and divestments (scrapping). This also affects the future fleet composition, as we plot the fleet to expected shipping demand growth in the various segments.

Based on endogenous equilibrium freight markets (see below under step two) and exogenous price assumptions for fuel and blending fuel, the model optimises the individual vessels' speed and consumption to maximise revenue for the shipowner. This is done using a voyage calculation for the segment in question, preferably a dominant trade route reflecting a representative sailing route for a given ship segment. We constrain the optimisation model to comply with expected regulatory limitations on carbon intensity indicators – essentially limiting vessel speed where applicable. Finally, the model generates vessel-specific timecharter equivalent (TCE) freight rates for each asset, which are used in the final assessment of potential investment returns.

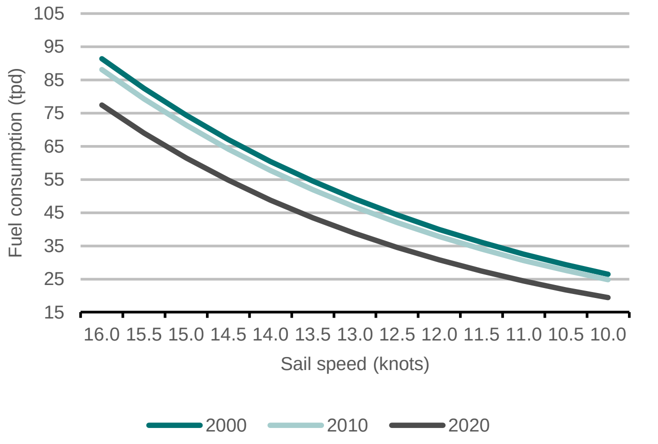
**Vessel-based model – to maximise shipowner earnings, given a set freight market and fuel cost**




Source: DNB Markets

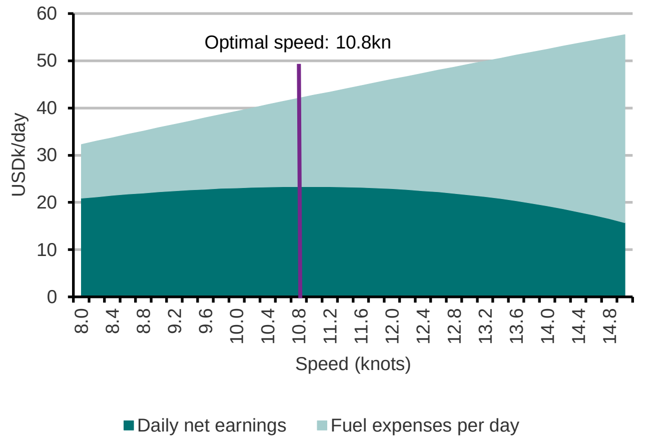
As detailed below, we have differentiated the generic vessels by vintage, relating to prevailing vessel technology and hydrodynamics, and engine fuel compatibility to approximate fuel efficiency. From fleet data, we have pinpointed large technological shifts at certain periods with the most prominent one being to eco vessel designs in 2010–2020. Hence, our main differentiated vintages are a generic 2010 vessel design (ordered during peak shipping activity before the financial crisis) and a generic eco vessel built in 2020. The two vintages represent the typical second-hand and resale/newbuilding alternatives to vessels in the fleet, which in our view represent the bulk of shipowners' investment possibilities in today's market.

**Illustrative speed/consumption curves for Capesize vessels**




Source: DNB Markets

**Capesize speed optimisation visualisation**




Source: DNB Markets

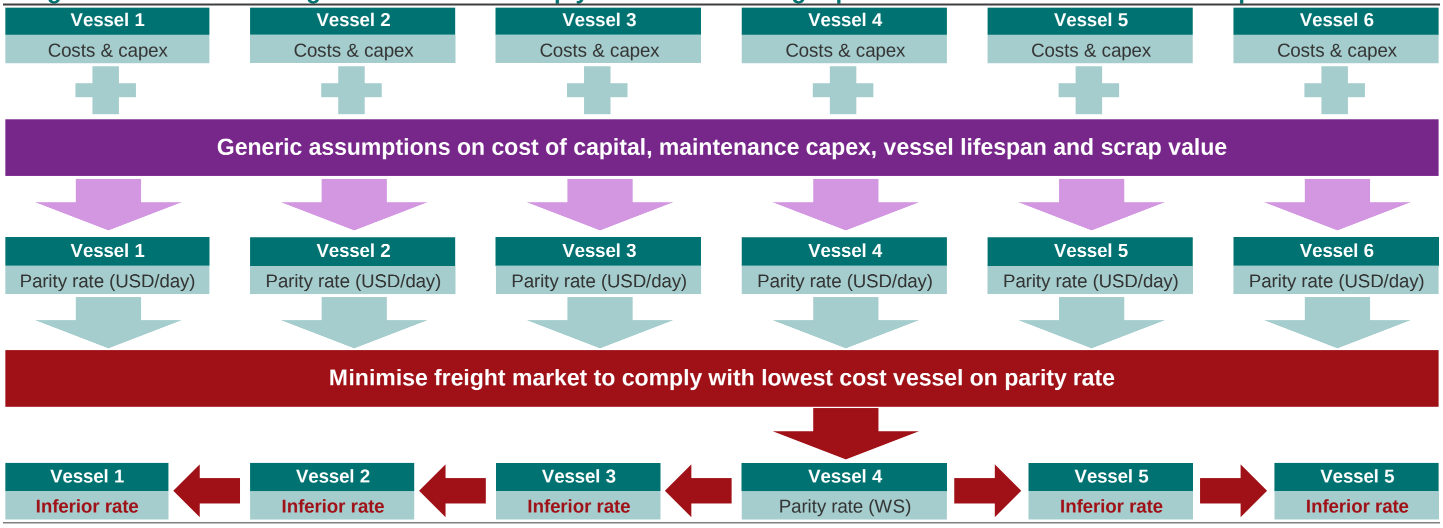
The second dimension is fuel type, and we have included VLSFO (standard ship), HFO (scrubber-fitted vessel), LNG, and ammonia dual-fuel engines (for details, see the vessel types and technology section). The 2010 vintage is limited to VLSFO and HFO, while for resale 2020 vessels we also include LNG retrofitting (assumed in 2030) and a 2020-design newbuild (assumed 2-year lead time) that can also include dual-fuel ammonia propulsion, with or without a scrubber, in addition to the aforementioned options. The fuel type naturally dictates the fuel cost in the optimisation model, but also modelled emissions that could affect the regulatory limitations on a vessel by vessel basis (e.g. CII and EEXI regulations).

## Freight market equilibrium model

The second component of our two-step approach encompasses the wider freight market and formation of an equilibrium freight market based on the underlying modelling assumptions (e.g. fuel price, regulations, etc). Assuming a highly competitive market – for which shipping is notorious – we expect the marginal freight provider to be making target returns on the most cost-efficient vessel investment, resulting in inferior rates and returns for other vessel types. The target returns are depicted as parity time charter equivalent (TCE) rates per vessel type based on vessel-specific assumptions highlighted in the vessel types and technology section.

In layman's terms, we assume shipowners fiercely underbid each other for cargo until there is only one vessel (type) that can make the required TCE freight rate in USD/day to defend the investment in the vessel (dictated by an 8% ROI over a vessel's lifetime). For the charterer, this translates into a freight cost in USD/tonne that it would indiscriminately be willing to pay any shipowner to ship its goods. However, for inferior vessel types with higher costs (e.g. fuel due to consumption) this would translate into a TCE below the required rate to achieve 8%.

**Freight market model: Freight minimised to comply with low-cost freight provider and incentivise rational capital allocation**




Source: DNB Markets

## Model output and rationale

As input factors such as fuel and carbon prices change, the superior technology (i.e. the generic vessel type able to make sufficient returns) varies from year to year and drives investment appetite for the leading vessel option to meet future expected transport demand needs. This implies a prospective shipowner would order a certain vessel type (such as a scrubber-fitted VLCC) over another (such as the more expensive LNG-fuelled VLCC) based purely on expected financial returns. To shift the preference to LNG, the earnings potential of the vessel would need to improve on a relative basis to at least offset the increased cost of such a vessel, for instance by regulations raising the $CO_2$ price sufficiently. We next consider the expected vessel lifespan of a newbuild vessel ordered today, which results in an outlook towards 2050. Hence, the leading technology at any point in time should in our view be the preferred vessel for contracting at the yards.

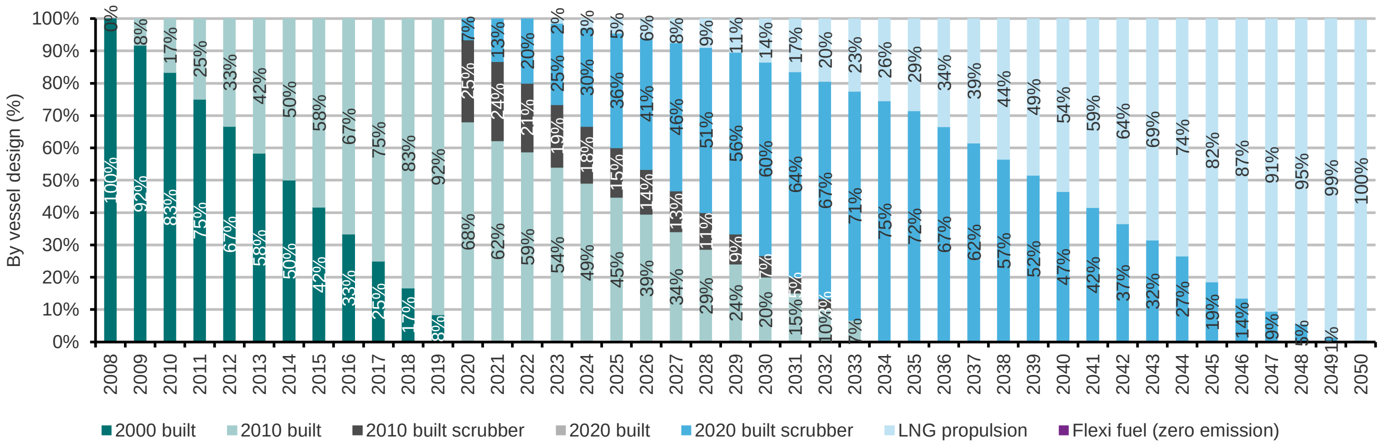
**Illustrative overview of market-setting Capesize vessel (blue) in forecast years 1–10 (i.e. 2021–2030), base case**

| TCE rate (000 USD/day) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Cape 2010 | 17 | 14 | 13 | 14 | 14 | 14 | 14 | 14 | 14 | 13 |
| Cape 2010 scrubber | 21 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 15 |
| Cape resale | 20 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 17 |
| Cape resale scrubber | 23 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 |
| Cape scrubber LNG retrofit | 23 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 22 |
| Cape 2020 NB | | | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 17 |
| Cape NB scrubber | | | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 |
| Cape NB LNG | | | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 22 |
| Cape NB flexi | | | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 17 |
| Cape NB flexi scrubber | | | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 18 |

Source: DNB Markets

As older vessels are scrapped and new ones ordered, this rational channelling of investment capital means the fleet composition evolves over time and differs between our scenarios. Based on the individual vessel metrics and fleet composition we can forecast several fleet metrics, including $CO_2$ emissions by transport work and in aggregate, allowing us to compare our outlook to the comparative metrics and ambitions proposed by the IMO and related to the Paris agreement.

**Illustrative fleet composition for Capesize vessels in base-case scenario by vessel technology**




Source: DNB Markets

The resulting output should thus be closely aligned to realistic expectations for fleet changes provided the underlying assumptions hold true and rational investment decisions are made. However, as the regulatory outlook remains highly uncertain and other soft factors can affect near-term decision-making, one might expect greater diversity in contracting behaviour than in our stylised forecasts. Simplifications in the model, including limiting the number of generic asset types and technology combinations, uncertainty surrounding fuelling infrastructure and availability, and a vast array of trade routes, all limit the practical applications of the results. That said, we consider the results highly relevant in these uncharted waters, and illustrate quantitatively the current qualms with investing in shipping assets at a time of unprecedented regulatory and operational uncertainty.

# Modelling approach and assumptions

## Constructing a climate risk scenario

A key component of climate-risk assessment is determining plausible scenarios. The scenarios are constructed using a future-forwards approach, where present-day IMO regulation and energy prices are the starting point for considering how they might change in the future. In other words, the scenarios should be plausible given where we stand today.

We make assumptions on energy prices, fuel and technology type, changes to existing IMO regulations, and the introduction of new IMO regulation. Based on all this, we can estimate $CO_2$ emissions and the financial impact of shipowners' investment decisions on newbuilds.

We have included two scenarios in this note:

- **Base-case.** Here we assume energy prices and regulatory stringency that we consider the most plausible given the current IMO GHG strategy.
- **High-case.** Here we assume energy prices and regulatory stringency that surpass the current ambition of a 50% reduction by 2050 at the IMO.

The aim is to give insight in terms of assisting shipping stakeholders to:

- Identify possible threats and opportunities that affect the profitability of ship investments.
- Assess the profitability of different ship engine technologies in the scenarios.
- Identify possible triggers that can help to assess whether parts of a scenario will hold true.
- Help to deepen knowledge on – and monitor – emerging climate risks.

We have constructed these scenarios using various data sets (e.g. recognised databases and published literature such as the DNV Energy Transition Outlook) and expert judgement where secondary data is not available. We detail the assumptions we use, along with the input factors and how they have been constructed, below.

## Fuel price trajectories

Marine engine technology economics are highly dependent on energy price variables. The future estimated price for MGO, HFO, LNG and ammonia – together with investment cost – determine the economic competitiveness of marine engine technologies. The table below shows the forecast trajectories of fuels we include. These are based on relevant literature and input from GSP project partners. The most important price variable is the future oil price, and changes in LNG, MGO and HFO pricing is linked to changes in the oil price. Prices are real prices.

Our base-case scenario assumes an oil price close to the market future curve, while our high-case scenario uses a higher oil price due to higher costs for production and exploration owing to tighter environmental regulation to reach goals in the Paris agreement. We assume a sharp increase in the marine fossil fuel price from 2030, as we use global $CO_2$ pricing on marine fuels in both scenarios.

First, a few words about ammonia. It is produced mainly from natural gas (brown ammonia) and is thus not a zero-emission fuel. We assume the cost of ammonia is linked to the cost of natural gas and $CO_2$. Historically ammonia pricing has varied between USD200 and USD700 per ton, depending on the natural gas cost. US producers have in recent years delivered brown ammonia to the market for USD220 per ton, due to the low US gas price. However, green and blue ammonia are zero-emission fuels. Green ammonia is produced through zero-emissions electricity, while blue ammonia is produced from natural gas where the $CO_2$ is captured and safely stored. The cost of green ammonia is cUSD600–700 per ton, but projects for green and blue ammonia are being developed aiming to cut this to USD400 per ton. Green and blue ammonia would thus be competitive with brown ammonia at a $CO_2$ price of around USD100 per ton.

Regardless of the decarbonisation pathway, we consider it likely that biofuels will be key to hitting regulation requirements. We assume bio-MGO and bio-methanol will be used as drop-in fuels. Biofuels are trading at a high premium to fossil fuel alternatives due to production cost and availability. As the marine industry will need to compete for these fuels with other industries where blending requirements are being introduced, we assume biofuels will continue to trade at a premium to their fossil fuel alternatives. The future introduction of global $CO_2$ pricing should put a premium on bio alternatives, thereby benefiting the producers.

**Price trajectories of fuels and CO2 in our modelling**

| Primary source | Scenario | 2021 | 2030 | 2040 | Unit |
|---|---|---|---|---|---|
| Crude oil | High<br>Base | 59 | 80<br>60 | 80<br>60 | USD/Barrel |
| Natural Gas | High<br>Base | 6.5 | 8.8<br>6.6 | 8.8<br>6.6 | USD/MMBtu |
| HFO<br>HFO | High<br>Base | 325 | 440<br>330 | 440<br>330 | USD/Ton |
| VLSFO<br>VLSFO | High<br>Base | 421 | 540<br>430 | 540<br>430 | |
| Spread HFO/VLSFO | | 96 | 100 | 100 | |
| Clean Electricity energy for Green Ammonia | | | 30 | 30 | Eur/MWh |
| CO2 Price | High<br>Base | 30 | 300<br>100 | 300<br>100 | USD/Ton |
| Brown NH3 | High<br>Base | 250 | 910<br>450 | 910<br>450 | USD/Ton |
| Green NH3/Blue NH3 | | | 400 | 400 | USD/Ton |
| Bio Diesel | High<br>Base | 900 | 2,010<br>1,220 | 2,010<br>1,220 | USD/Ton |

Source: GSP project group

# Regulations

While certain IMO regulations have already been adopted or approved, we see a need for additional political intervention to steer emissions from the international fleet towards a 50% reduction (base-case) or greater reduction in $CO_2$ levels (high-case) by 2050. Moreover, we believe the ambitions of the IMO's GHG strategy could well be raised at the scheduled revision in 2023. Since future policy changes are inherently uncertain, we interviewed experts in the field, ranging from industry experts to those central in the IMO negotiations. Based on their input, we have derived one policy assumption to be used in both our scenarios.

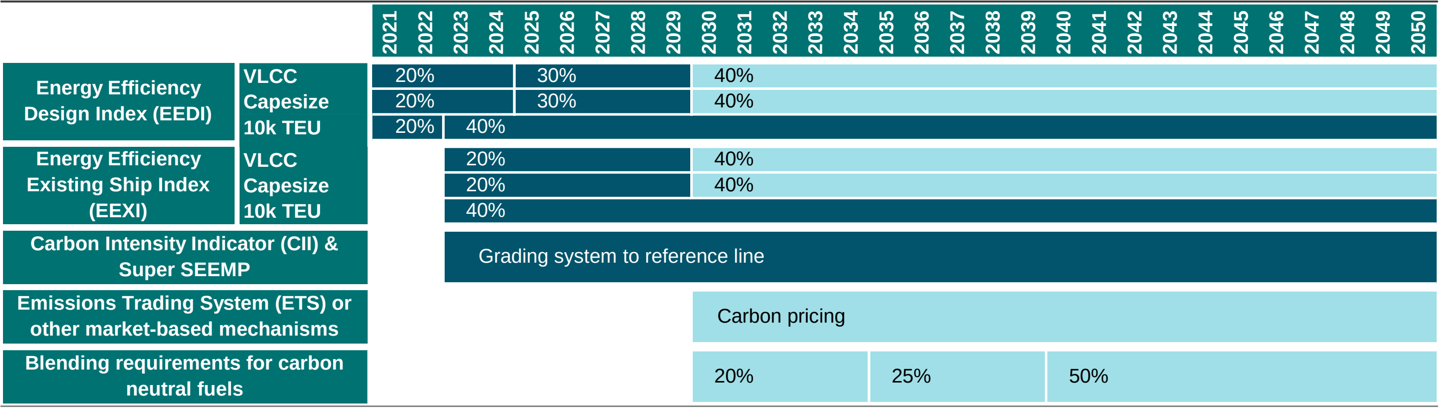
Here, we have assumed a timeline for the introduction and amendment of the policy instruments from the IMO, by looking at industry sources and assuming an interplay between the EU and the IMO, where the EU is a first-mover in implementing key regulation that has not yet progressed fully in the IMO negotiations, notably carbon price and zero-emissions fuel blending requirements. The logic is the introduction of green policies in the EU coupled with the observation that the EU has far fewer member countries than the IMO, enabling it to move more nimbly. Also, we note the EU has pushed the IMO on climate regulation before, such as the introduction of the MRV requirement on $CO_2$.

We used three main components to construct future policy for regulation in shipping:

- **Design and operational requirements.** We expect the current and more recent IMO regulation to be continued with increasingly stringent requirements. This implies energy efficiency requirements for newbuilds will become more progressive, as will requirements on existing ships. Relevant regulations include the existing Energy Efficiency Design Index (EEDI), the proposed Energy Efficiency Existing Ship Index (EEXI) and the implementation of an operational Carbon Intensity Indicator (CII) & Super-SEEMP.

- **Carbon price.** We assume the IMO will seek market-based mechanisms for carbon pricing, and a similar system to the European Emission Trading System (ETS) is likely. The scenario incorporates a carbon price that comes into force in 2030. For simplicity's sake, we assume an unchanged carbon price up to 2050.
- **Carbon-neutral fuel requirements.** With technological advancements and increased availability in zero-emissions and carbon-neutral fuel technologies, we consider it likely that blending requirements will be introduced for shipping – as they have for road diesel and petrol. We assume such blending requirements from 2030, with the blending requirement growing over time.

**Regulatory timeline with existing or imminent regulations in dark blue, future likely regulations in light blue**

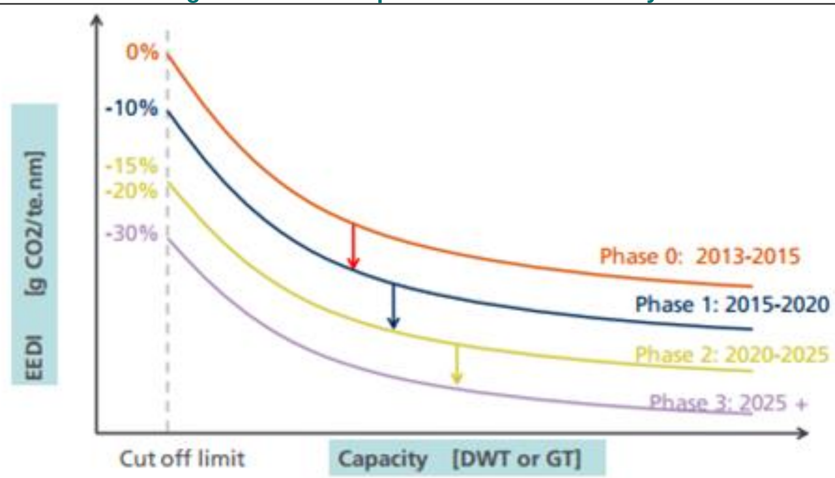



Source: GSP project group

## Energy Efficiency Design Index (EEDI)

In 2011 MARPOL Annex VI was amended to include energy-efficiency requirements, including the Energy Efficiency Design Index (EEDI) for all new ships and a mandatory Ship Energy Efficiency Management Plan (SEEMP) to be kept on all vessels. These requirements came into force in 2013. The EEDI is being implemented in phases, generally 5-year periods with tightened requirements for the energy efficiency of newbuilds. We are in phase 2 (since 1 January 2020), prescribing a 20% reduction from the 'reference line'.

**Illustration of EEDI regulations and impact on vessel efficiency**




Source: DNV

At the MEPC 75 committee at the IMO recently, the EEDI phase 3 requirements were significantly strengthened, to be introduced in April 2022 (previously 2025) for several vessels, including gas carriers, general cargo ships and LNG carriers. For a typical 10k TEU container vessel, the requirements from 2022 will be a 40% reduction (compared to the current 20% for bulkers and tankers until 2025, and 30% thereafter). The current regulations are limited to phase 3 from 2025, but an investigation into a potential phase 4 is under way. See the above regulation timeline for planned and assumed EEDI requirements for the segments covered in this report. While these regulations affect only newbuilds, the changes to EEDI have implications for the proposed EEXI regulations.

## Energy Efficiency Existing Ship Index (EEXI)

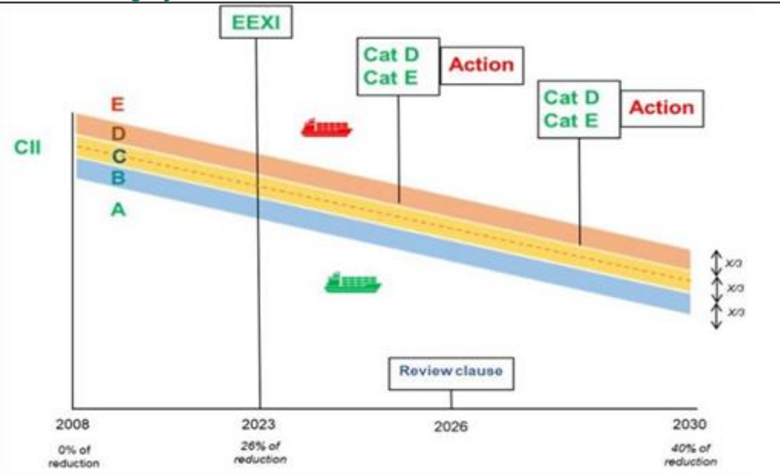
The EEXI regulations were proposed to the MEPC 75 in late 2020, are due to be put forward for adoption at MEPC 76 in June 2021, and are likely come into force on 1 January 2023. The regulation is a technical ‘licence to operate’ for existing ships relating to mandatory surveys where each vessel needs an approved EEXI document to ensure its energy efficiency is within set limits. The current structure of the EEXI would align existing ships with the prevailing EEDI standards for newbuilds, but is set to be reviewed by the IMO by 1 January 2026, whereby the requirements could be strengthened and, in our view, likely realigned with the prevailing updated EEDI requirements. For the shipping segments in this note, this would entail a 20% reduction for existing VLCCs and Capesizes, while 40% for the 10k TEUs compared to the reference line, and an expected tightening to bring VLCCs and Capesizes to 40% from 2030 in our modelling/scenario. All vessels would need to verify compliance at their first annual survey following implementation, which would ensure all vessels comply with the regulation within a year. While there are several potential solutions and installations to improve the efficiency of existing vessels, the dominant approach is likely to be limiting engine power (i.e. lowering operational speeds).

## Carbon Intensity Indicator (CII) and Enhanced SEEMP (Super-SEEMP)

The CII would be the corresponding operational requirement to the EEXI as a technical requirement. The timeline for the CII regulations follows that of the EEXI and would be applicable from 2023. It would require all vessels to calculate an annual operational CII (i.e. target carbon emissions per transport work), which determines the annual reduction factor needed to ensure continuous improvement of the ship’s operational carbon intensity within a specific rating level (see below) to achieve the IMO’s GHG strategy targets, e.g. 40% reduction in carbon intensity by 2030. The actual annual operational *achieved CII* (i.e. the vessel’s actual carbon emissions per transport work) would be required to be documented and verified against the *required CII*. This would enable the operational carbon intensity rating to be determined with the intention of driving fleet-wide energy efficiency improvements on an operational level, as opposed to the EEXI technical documentation.

Hence, there are two new measures: 1) the technical requirement to reduce carbon intensity, based on a new Energy Efficiency Existing Ship Index (EEXI); and 2) the operational carbon intensity reduction requirements, based on a new operational carbon intensity indicator (CII). This dual approach aims to address technical (how a ship is retrofitted and equipped) and operational measures (how a ship operates with varying speeds, weather, loads, etc). The rating would be on a scale – operational carbon intensity rating A, B, C, D or E – indicating major superior, minor superior, moderate, minor inferior, or inferior performance. The performance would be recorded in the ship’s Ship Energy Efficiency Management Plan (SEEMP). A ship rated D for three consecutive years, or E, would have to submit a corrective action plan, to show how the required rating (C or above) would be achieved. Administrators, port authorities and other stakeholders are encouraged to provide incentives to ships rated A or B.

**Illustration of CII rating system and enhanced SEEMP**




Source: DNV

## Carbon pricing – time of implementation

The IMO is looking at market-based mechanisms to incorporate the cost of emissions in its regulations for shipping. While some in the industry have proposed a carbon levy as a solution, we believe the IMO is considering introducing a framework similar to the EU's emissions trading system (ETS) and linking the carbon price to the ETS. Thus, the market would price carbon emissions according to demand and shipping would have to integrate such costs in its business. This would potentially ensure a level playing field for the industry at a fair cost in comparison to other polluting industries. As emissions quotas are tightened over time, the resulting cost increase should spur investments and abatements in the most rational manner. Implementing such mechanisms is further out in time – we assume 2030 onwards in our scenarios.

## Fuel-blending requirements

Another policy that has direct implications on emissions from fuel, is carbon-neutral or zero-carbon fuel-blending. Such regulations already exist for road fuel where diesel and petrol are blended with various biofuels. This lowers the carbon intensity of existing fuels against an expected price increase due to the scarcity and cost of biofuel alternatives. Electro fuels as drop-in fuels will therefore likely be part of the solution. We do not specifically consider electro fuels for diesel and LNG in this note, but we assume they trade on a par with their biofuels alternatives for diesel and LNG as drop-in alternatives.

Concerns have been raised about the true impact of certain biofuels on carbon emissions in full life-cycle analysis (LCA). However, assessing the effect of biofuels in climate change mitigation is beyond the scope of this report and we have implemented blending requirements from 2030 of a general biofuel component. This affects carbon emissions significantly, as we implement a requirement reaching 50% from 2040 and we do not account for potential sourcing issues for such fuel. Besides lowering the aggregate carbon factor of fossil fuels, the added biofuel component also lifts fuel costs and contributes to slowing the fleet, which again runs through to lower consumption and emissions.

# Vessel types and engine technology

## Engine technology

The global fleet is being powered mainly by diesel combustion engines running on VLSFO/HFO. About 200 vessels are powered by LNG, while LPG is emerging for LPG carriers.

Long-distance freight puts limits on engine technologies that are economically viable to serve an engine for 30+ days at open sea. We have excluded hydrogen engines from this note due to the complexity and significant space the bunker fuel would occupy. Batteries are not a viable option for long-distance freight due to the associated investment, weight and power storage limitations. Other than traditional internal combustion engines powered by diesel/HFO/VLSFO, we have therefore has focused on LNG and ammonia as probable fuel alternatives for use in

ICE technology. Note that ammonia engines are being developed, along with the required infrastructure. Ongoing industry developments on ammonia engine systems could well be viable in the near future and well within the timelines used in this note.

We assume LNG and ammonia engine technology can be dual-fuel, i.e. able to switch between using VLSFO and HFO. Biofuels have been used as drop-in fuel to comply with regulation on blending requirements as they can be used in traditional internal combustion engines as an alternative to fossil diesel/HFO/VLSFO. We assume the technology and fuel are readily available when being adopted.

**Overview of engine technologies and relevant fuels**

| **Engine System / Fuel Type** | HFO | VLSFO MGO | LNG | NH3 |
|---|---|---|---|---|
| Internal Combustion Engine | | ✓ | | |
| Internal Combustion Engine/ with scrubber | ✓ | | | |
| Dual fuel LNG ICE | | ✓ | ✓ | |
| Dual fuel Ammonia ICE | | ✓ | | ✓ |
| Dual fuel NH3 ICE w/scrubber | ✓ | | | ✓ |

Source: GSP project group

## Vessel type and capex assumptions

To assess the IRRs of ships with different engine technology, we need to know the cost of ordering or retrofitting. The cost of newbuilds in tank, container and bulk is transparent when it comes to MGO/HFO engine technology, but cost estimates for LNG, dual-fuel and particular ammonia engines can deviate from our assumptions in this note. Also cost estimates for retrofitting MGO/HFO vessels to new engine technologies vary between ships in same asset class, depending on origin of yard, tanks, age and general state.

The table below shows the capex assumptions used for newbuilds and the cost of retrofits. The cost estimates are done to the best of our knowledge, but if one new engine technology becomes dominant there could be scope to shrink the cost gap to traditional MGO/HFO engines.

**Capital expenditure assumptions (in USDm)**

| Vintage | Fuel | VLCC | Cape | 10kTEU |
|---|---|---|---|---|
| 2010 | VLSFO | 46 | 23 | 48 |
| 2010 | scrubber | 49 | 25 | 52 |
| 2020 | VLSFO | 90 | 49 | 96 |
| 2020 | scrubber | 92 | 51 | 100 |
| 2020 | LNG retro | 92+25 | 51+20 | 100+20 |
| 2020 NB | VLSFO | 90 | 49 | 96 |
| 2020 NB | scrubber | 92 | 51 | 99 |
| 2020 NB | LNG | 105 | 62 | 109 |
| 2020 NB | NH3 | 105 | 62 | 109 |
| 2020 NB | NH3+scrub | 107 | 64 | 112 |

Source: GSP project group

# Conclusions

## Summary

In summary, we assess the financial performance of various engine technologies in our base- and high-case scenarios. We also forecast emissions trends and fleet composition for VLCC (tank) and Capesize (bulk) up to 2050. We then consider the IRRs (second-hand and newbuild) of various engine technologies and ship types in our scenarios. And finally, we detail the main financial risk factors related to decarbonisation regulation and $CO_2$ pricing when making investment decisions on new or old tonnage. Our key conclusions are:

- There is a severe negative financial impact on modern vessels with traditional engine technology running on MGO/HFO/VLSFO in our high-case scenario. Near-zero or negative IRR on the capital being invested is found on all ship types in this scenario.
- LNG engine technology is the preferred engine technology in our base-case scenario for Capesize, VLCC and the 10k TEU container vessel. However in our high-case scenario LNG engine technology carries rather similar financial risk as traditional diesel combustion engines as their $CO_2$ footprint is only 17–23% lower. Thus, LNG looks to serve as a bridging technology on the path to tighter regulations and decarbonisation ambitions, such as aligning shipping with the Paris agreement.
- IRRs are lower for ammonia than MGO/HFO engine technology in our base-case scenario, but ammonia generates acceptable IRRs in our high-case scenario where traditional engines have poor IRRs. Thus, ammonia looks more financially robust considering the uncertainty of future policies in that it could move towards our base- or high-case scenario.
- The IMO target for emissions reduction is broadly within reach with existing engine technology for VLCC and Capesize, but 50% blending of zero-emissions fuel and further speed reductions would be needed.
- Older vessels have a better risk/return, as they will leave the fleet before the modelled introduction of a more stringent regulatory regime.

## Crude tankers – VLCC case study

The following charts show the IRRs in our base- and high-case scenarios for VLCCs using various engine technologies. Current uncertainty and expectations of growing regulatory pressure suggest a preference for older vessels on the water as exemplified by a 2010-built vessel. Among engine technologies for newbuilds, ammonia is preferred in our high-case scenario, while LNG marginally beats traditional diesel engines in our base-case scenario.

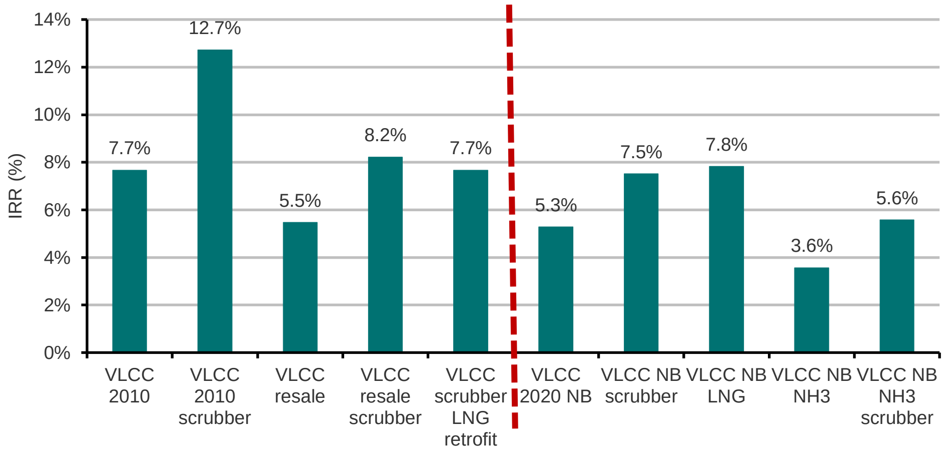
Old second-hand vessels provide a better ROIC than modern vessels (resales or newbuilds). The asset's shorter remaining lifetime considerably outweighs the benefits of modern and efficient vessels near-term, as stringent environmental measures severely hit freight markets beyond 2030e. As changing regulations is a lengthy process, this remains the case in our high-case scenario too. Note that retrofits of existing vessels show consistently lower returns than newbuilds, due to the higher capex associated with installing new engine and tanks.

Thus, we conclude that steeply discounted second-hand asset values should appreciate on a relative basis to newbuild prices and modern asset values (resales) to even out the difference, i.e. the economic value of an old vessel is above the investment cost, and vice versa for the resale or newbuild. For a scrubber-fitted 2010 vessel to match the IRR of a scrubber-fitted resale (i.e. the 2020-built vessel) in our base-case scenario, the asset could add USD9m to its value, or a 18% increase from the modelled USD49m, while resale values are unchanged. Similarly, a USD21m or 43% higher price for a 2010-built VLCC with a scrubber would be needed to match the IRR for a scrubber-fitted resale in our high-case scenario.

While this reveals a preference among existing vessels for older assets on the water, the question remains which type of vessel is preferred among newbuilds to cater for fleet growth to meet an expected increase in transport demand. In this instance, our two scenarios clearly deviate. Our base-case assumptions indicate a marginal preference for LNG propulsion (7.8%

IRR) over a traditional engine with a scrubber (7.5%). As detailed below, this has implications for the composition and emissions of the fleet on our base-case assumptions.

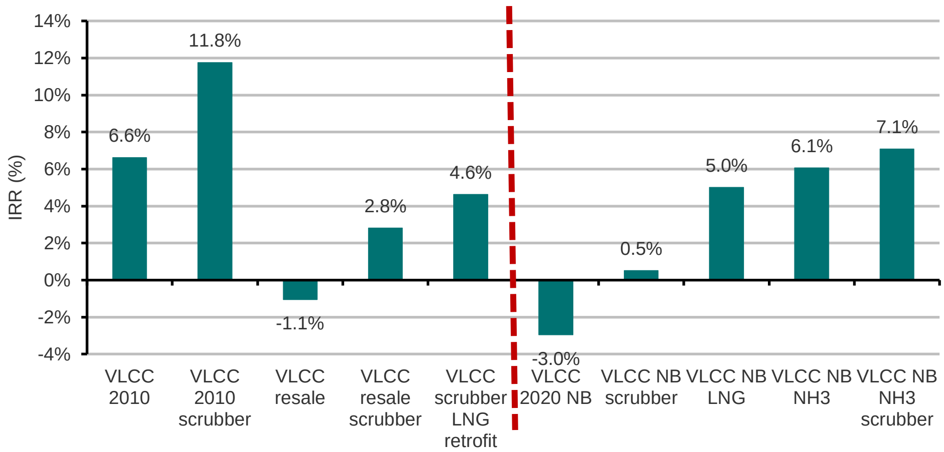
**IRRs of various investments in VLCC technology today on our base-case assumptions**




Source: DNB Markets

However, if fuel – and $CO_2$ – prices head higher, the conclusion is radically different. In such a scenario, incurring the additional capex of an ammonia dual-fuel vessel today becomes the preferred option, over LNG and traditional technology. The results are perhaps unsurprising as they relate to added investment capex for future cost savings on fuel in return, but are nonetheless highly relevant in light of today's investment decisions for the shipowner and related stakeholders. Since LNG propulsion results in only a partial $CO_2$ reduction, financial returns are between those for traditional engine technology and ammonia in a high regulatory environment. The conclusion is thus that LNG propulsion is a viable alternative to existing engine technologies near-term – before a potential tightening of regulations and increased costs affect returns and weaken the investment case for this technology.

**Our high energy price and elevated $CO_2$ price (high-case) scenario enhances the favourability of alternative carbon neutral fuel vessels already**



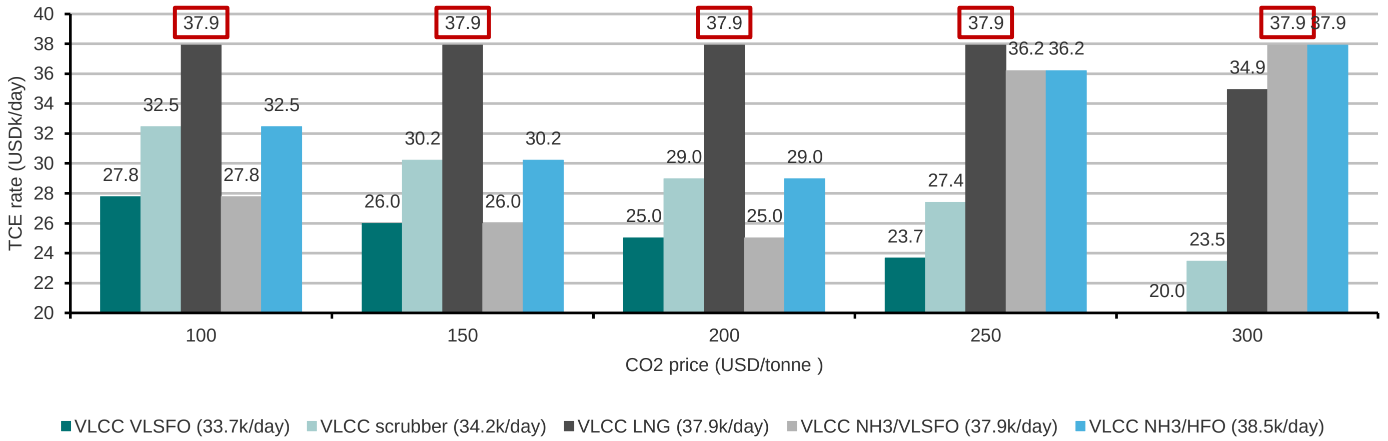

Source: DNB Markets

Analysing the potential impact of carbon emissions pricing in the shipping industry highlights the importance of expected costs for the attractiveness of various propulsion technologies. The chart below shows the impact of $CO_2$ prices ranging from USD100/tonne (base-case) to USD300/tonne (high-case) on potential VLCC vessel earnings assuming the most cost-efficient vessel sets the market at its parity rate. The market setting technologies are marked in red for various price scenarios, and each vessel's parity rate shown in the legend.

For the VLCCs, we find a technology shift from HFO to LNG at cUSD50/tonne, while the shift to ammonia would need a carbon price of USD250–300/tonne. The 'LNG window' of cUSD50–

275/tonne reflects the c25% $CO_2$ savings from using the greener transition fuel, before the cost burden increases sufficiently to favour the potential zero-carbon technology of ammonia.

**Market-setting fleet technology in varying $CO_2$ pricing environments, triggering shift from traditional fuel (HFO) to transitional fuel (LNG) and to zero-carbon fuel (ammonia) as the cost of emissions increases**



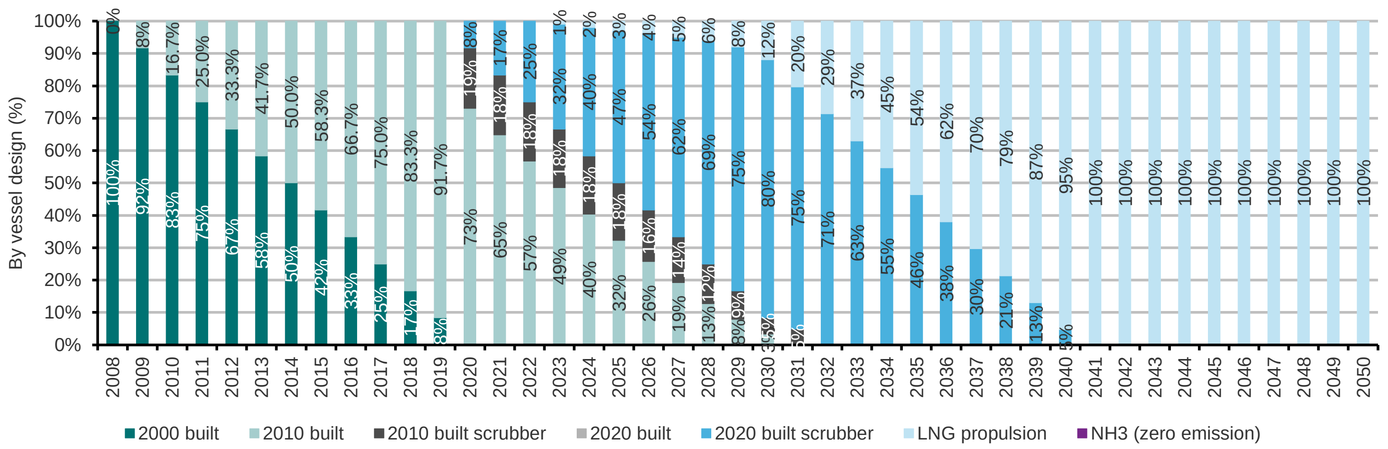

Source: DNB Markets

## Base case scenario implications

Our base-case scenario suggests a preference for traditional vessel technology with scrubbers over newbuild alternatives up to 2030e, when LNG propulsion becomes more attractive. There are already VLCCs in the orderbook with LNG propulsion against long-term contracts and the economics between traditional engines and LNG are marginal in our base-case scenario up to 2030. This underpins recent interest in ordering LNG vessels against long contracts and employment on certain trades to minimise operational challenges of such vessels before the infrastructure is in place for greater optionality.

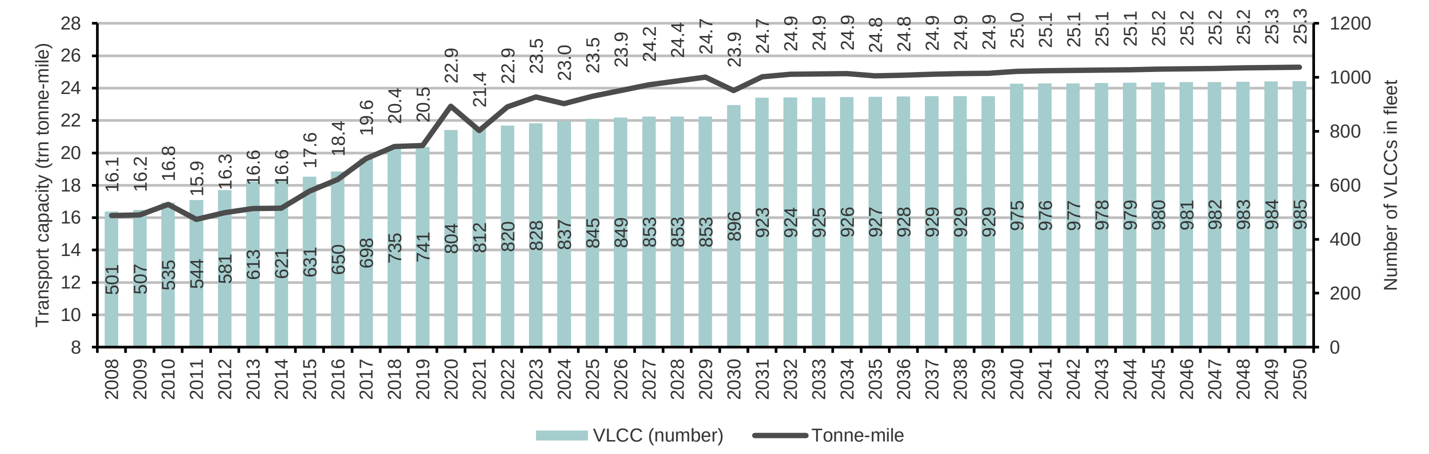
This scenario yields the VLCC fleet composition in the chart below. The historical characteristics of the VLCC fleet indicate an average age just shy of 10 years, indicating a full shift of vessel generations over c20 years. Hence, the average fleet is assumed a 2010-built vessel entering 2020 (~100% of the fleet) with a steady composition change as retrofit scrubbers are installed and newbuild deliveries of scrubber-fitted 2020-built designs are delivered. The 2020-built scrubber-fitted VLCC reaches 50% of the fleet in 2026e and peaks at 80% by 2030e, before interest in LNG accelerates and takes the share of fleet from 12% in 2030e to 100% by 2041e.

**Composition of the VLCC fleet in our base-case scenario, with modern scrubber-fitted vessels being the preferred vessel technology until LNG takes over from 2030e and reaches full penetration by early 2040e**




Source: DNB Markets

## Aggregate fleet trend to match expected future shipping demand growth

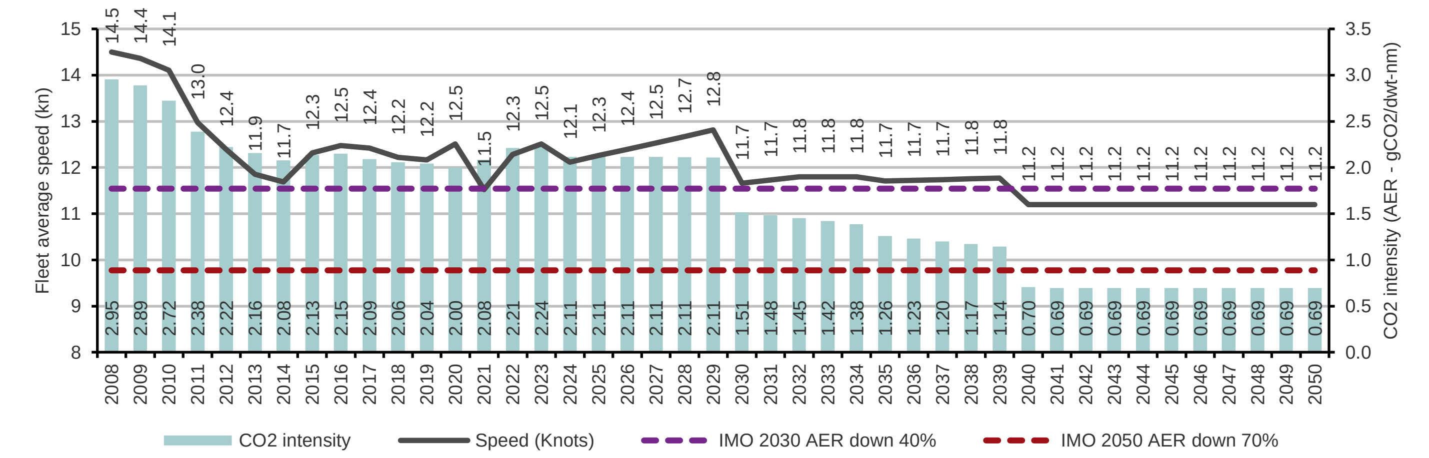



Source: DNB Markets

We assume fleet size matches expected shipping demand, reflecting a modest 0.3% CAGR for 2020–2050e for tankers, to aggregate the impact of the fleet and compare to IMO reduction targets. The fleet should increase from c800 VLCCs in 2020 to nearly 1,000 by 2050e. Determining future shipping demand is beyond the scope of this note, but we have incorporated some growth from 2020 to 2030, with demand reasonably flat thereafter. While peak oil demand could be close according to certain forecasts, the composition of trade and average distance dictates aggregate shipping demand, which complicates the matter. Furthermore, alternative liquid fuels could be transported on tankers in the future, providing additional demand for wet bulk vessels such as the oil tankers. As we are interested in the transport capacity of the fleet, this is dependent on the average sailing speed of the fleet which is shown in the chart below.

Based on our model and optimal speeds, we estimate the average speed of the VLCC fleet should see step changes downwards in periods when new regulations are being implemented, while transitioning to new more-efficient vessels should lead to a steady increase in optimal sailing speeds. This holds until a uniform fleet composition is achieved when only changes to assumed freight markets, fuel costs, or regulations would affect speeds. However, in practice it would be fair to expect tight or loose shipping markets to affect freight rates and thus speeds to in effect smooth the impact year-over-year for the modelled step changes that happen due to regulations (e.g. for 2030 when bio-fuel blending requirements and $CO_2$ pricing is implemented overnight, slowing the fleet from 12.8 knots to 11.7 knots).

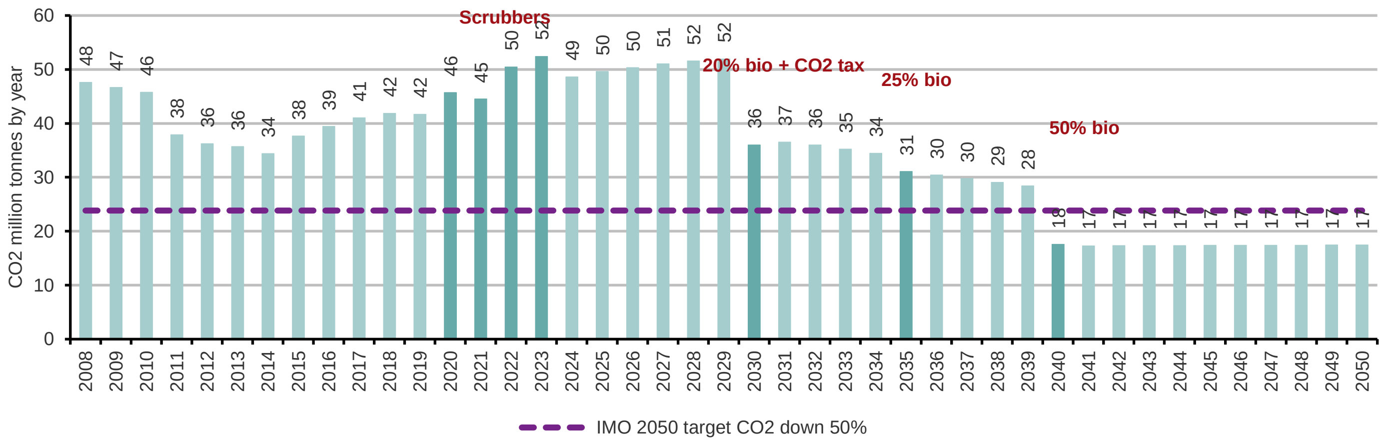
## VLCC fleet average speed trend and emissions efficiency improvements based on AER versus IMO ambitions




Source: DNB Markets

We have calculated an estimated CII based on the annual efficiency ratio (AER) for the VLCC fleet in terms of $CO_2$ emissions per transport work (deadweight tonne-miles) and the estimated ambitions of IMO to reach 40% and 70% efficiency improvements by 2030 and 2050, respectively. In our base-case scenario we are essentially aligned with the existing ambitions for the IMO's initial GHG strategy on these metrics. We also reach IMO's absolute reduction target of 50% cuts from 2008 levels by 2050e as we model for very limited fleet growth coupled with increased environmental efficiency of the fleet. However, further initiatives need to be implemented to reach even more stringent regulations of reach carbon neutrality within the same time frame, assuming our base-case price trajectories hold true.

**Aggregate $CO_2$ emissions from the VLCC fleet versus IMO's ambition of a 50% reduction by 2050**

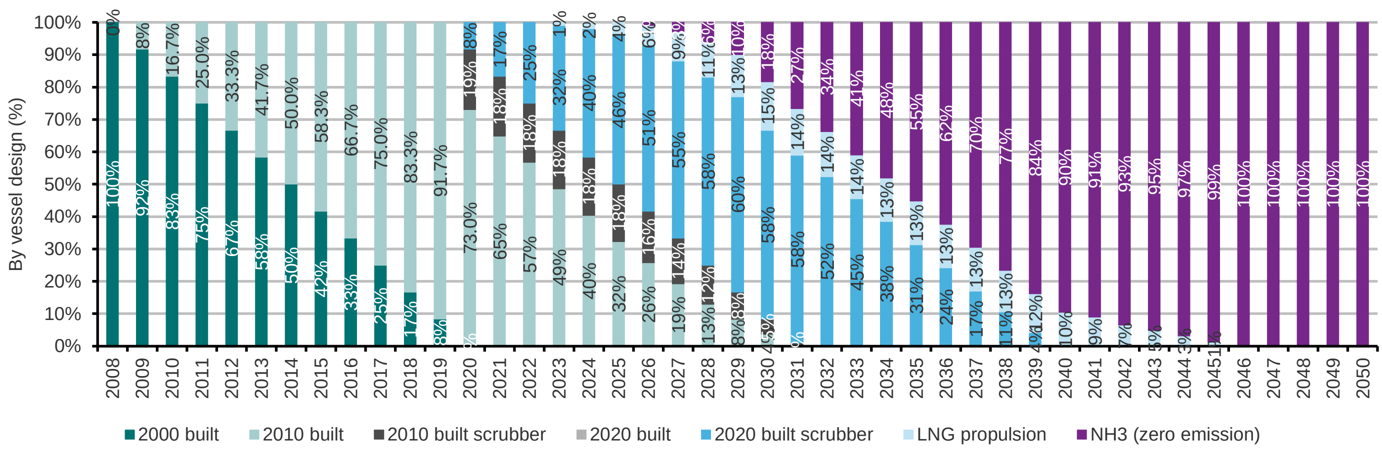



Source: DNB Markets

## High-case scenario implications

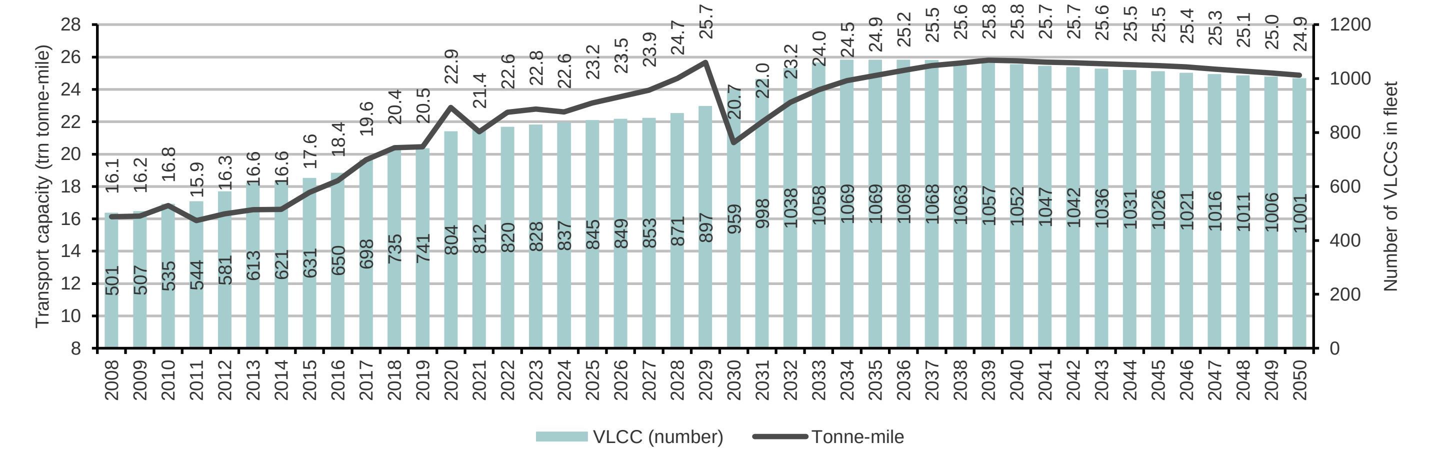
To illustrate the impact of increased energy prices and higher cost for $CO_2$ emissions, we have run our model on our high-case price trajectories too. Given the higher cost of fossil fuels and the USD300/tonne $CO_2$ price, the preferred vessel technology shifts from the 2020-built scrubber-fitted vessel directly to the ammonia-fuelled vessel once the 2030 regulations are enforced. As the orderbook already has orders for some LNG vessels and we believe the economic disadvantage of the LNG technology is not fully deterring additional orders in 2020–2030e, we have modelled LNG vessels reaching 15% of the fleet by 2030e. The ammonia-fuelled vessels reach 50% of the fleet by 2035e, while the 100% shift to potential carbon-free fleet is reached in 2046e.

**Composition of the VLCC fleet in our high-case scenario, with modern scrubber-fitted vessels preferred over ammonia-fuelled vessels until the 2030 regulations are implemented and we see a technology shift to the zero-emission alternative**




Source: DNB Markets

**Aggregate fleet trend to match expected future shipping demand growth**



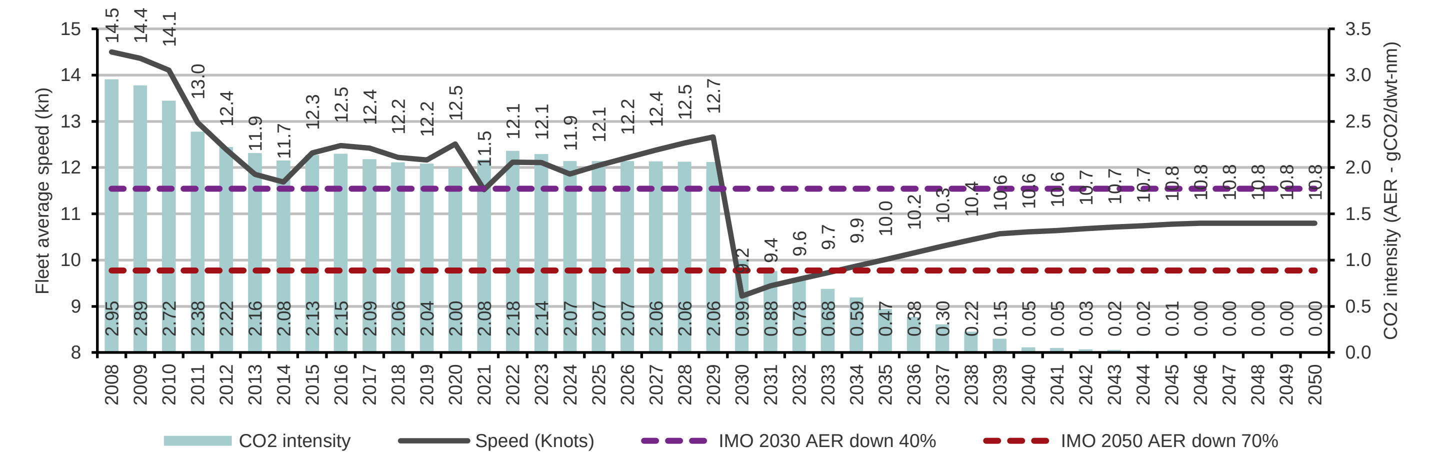

Source: DNB Markets

Due to the steep and stepwise change to fuel costs following the implementation of USD300/tonne $CO_2$ price and fuel blending requirements from 2030, the average speed in the fleet declines dramatically before recovering as older vessels are replaced with more efficient designs.

The implications of shifting to carbon-free ammonia-fuelled vessels becomes apparent in the assessment of carbon intensity and aggregate carbon emissions from the VLCC fleet. The AER declines by nearly 70% by 2030e and reaches zero in 2046e, compared to the IMO's targets of 40% and 70% reductions, respectively. The aggregate emissions are halved from 2008 levels by 2030e and reach zero in 2046e, compared to the 50% reduction target by 2050 in the IMO's initial GHG strategy.

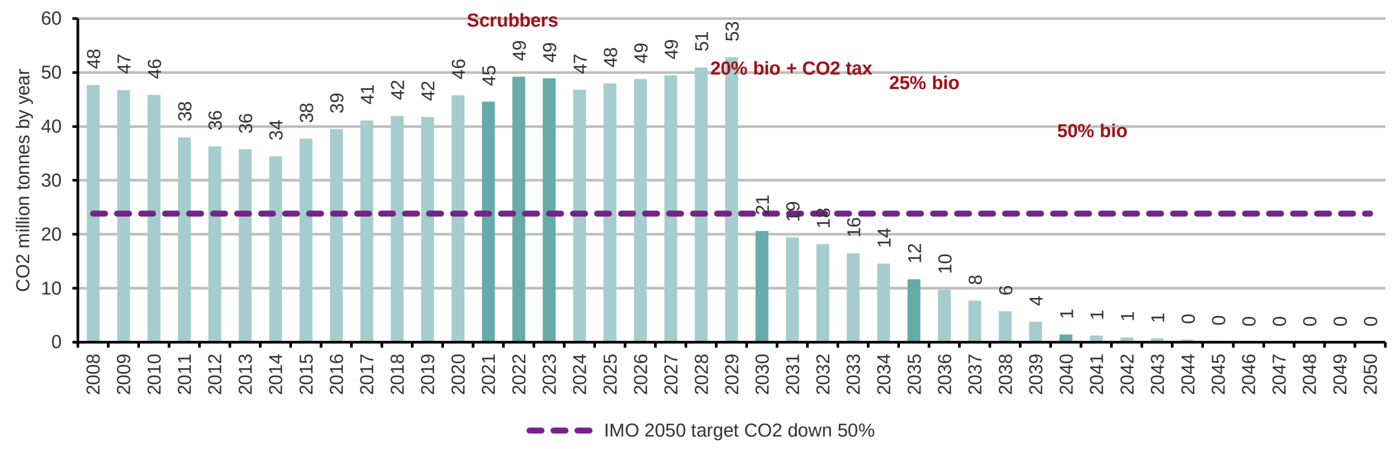
Hence, we believe the high energy price environment coupled with our outlook for regulations being implemented in the future are more than sufficient to reach zero-carbon shipping by mid-century, while the current regulations coupled with our base-case assumptions are within the IMO's stated ambitions.

**VLCC fleet average speed trend and emissions efficiency improvements based on AER versus IMO ambitions**




Source: DNB Markets

**Aggregate $CO_2$ emissions from the VLCC fleet versus IMO ambition of 50% reduction by 2050**



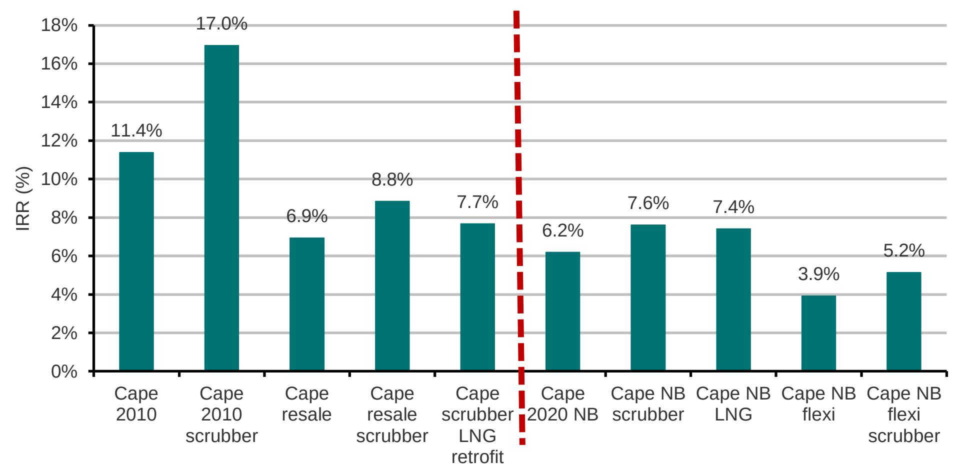

Source: DNB Markets

# Dry bulk – Capesize case study

As for our VLCC case study, our analysis of Capesizes reveals a preference for a 10-year old Capesize with a scrubber, over other potential vessel types. However, the relative advantage of these assets is more sensitive to our high-case scenario, due to longer economic life times and already low speeds, thus leaving less flexibility to offset fuel costs with lower speeds than seems to be the case for VLCCs. In our base case, we calculate the value of a 10-year old scrubber-fitted Capesize needs to appreciate by USD9.5m to USD34m to match the IRR of the scrubber-fitted resale at a cost of USD51m. This suggests nearly 40% potential upside for the asset versus the modelled USD25m. In our high-case scenario, the upside potential would be 26% or USD6.5m.

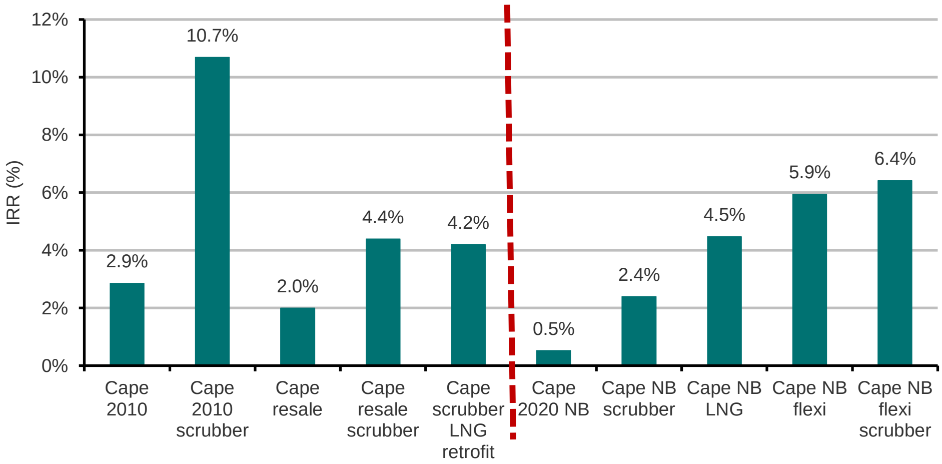
Among the newbuild alternatives we again find significant differences in the two scenarios. Our base-case scenario suggests a marginal preference for a scrubber-fitted newbuild over the LNG alternative, but LNG takes over as the preferred engine for newbuilds for 2030e onwards as higher carbon pricing is introduced from 2030. Our high-case scenario would put the ammonia-fuelled vessel with a scrubber at an advantage to the alternatives. These results are broadly similar to those in the VLCC case study, with slight differences in the preference for LNG versus traditional with a scrubber.

**IRRs of various investments in Capesize technology today in our base-case scenario**




Source: DNB Markets

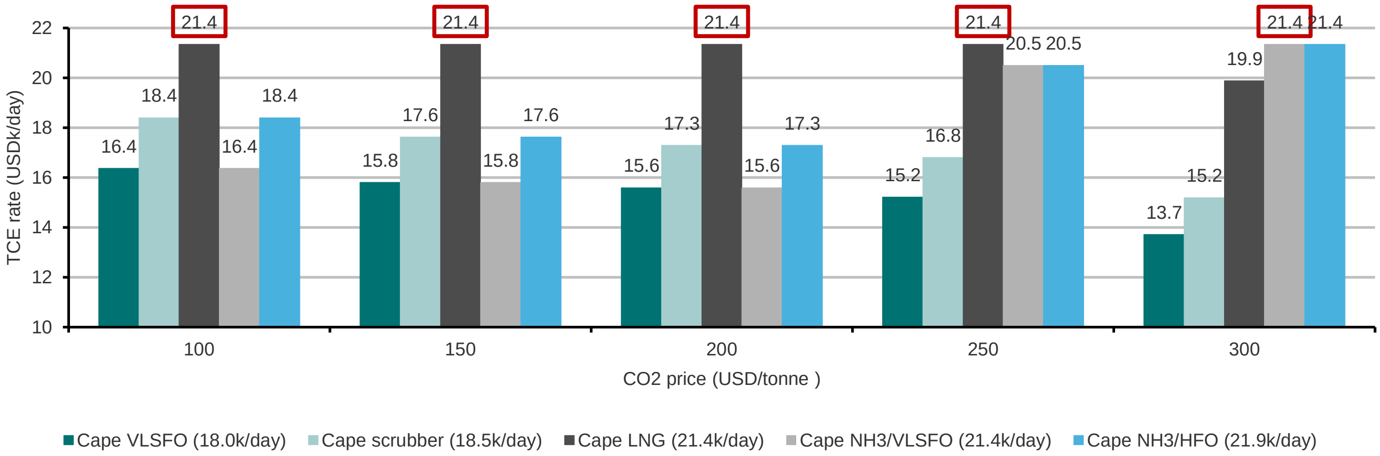
**Our high energy price and elevated $CO_2$ price (high-case) scenario enhances the favourability of alternative carbon neutral fuel vessels already**




Source: DNB Markets

When we analyse the sensitivity of pricing $CO_2$ for Capesize as we did for VLCCs, we find that a USD100/tonne $CO_2$ price would incentivise the switch to LNG fuel in our base-case scenario, while the shift to ammonia would need a price of USD250–300/tonne. Within this range (USD100–275), the estimated savings from the c25% emissions reduction from LNG propulsion is the preferred technology, before the zero-emissions alternative of ammonia is incentivised at levels above this.

**Market-setting fleet technology at varying $CO_2$ pricing environments, triggering shift from traditional fuel (HFO) to transitional fuel (LNG) and to zero-carbon fuel (ammonia) as the cost of emissions increases**

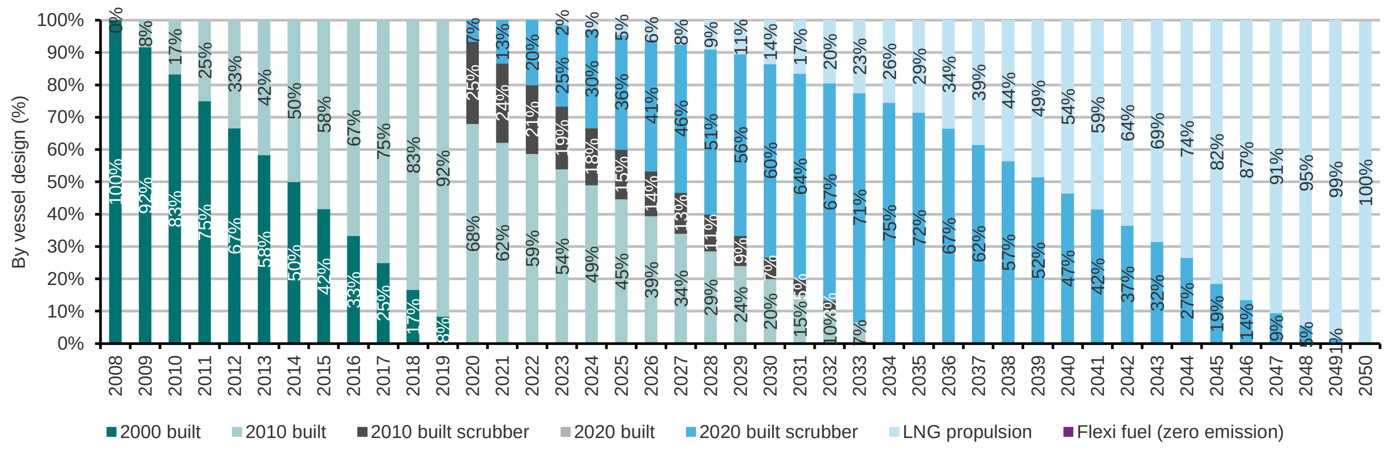



Source: DNB Markets

## Base-case scenario implications

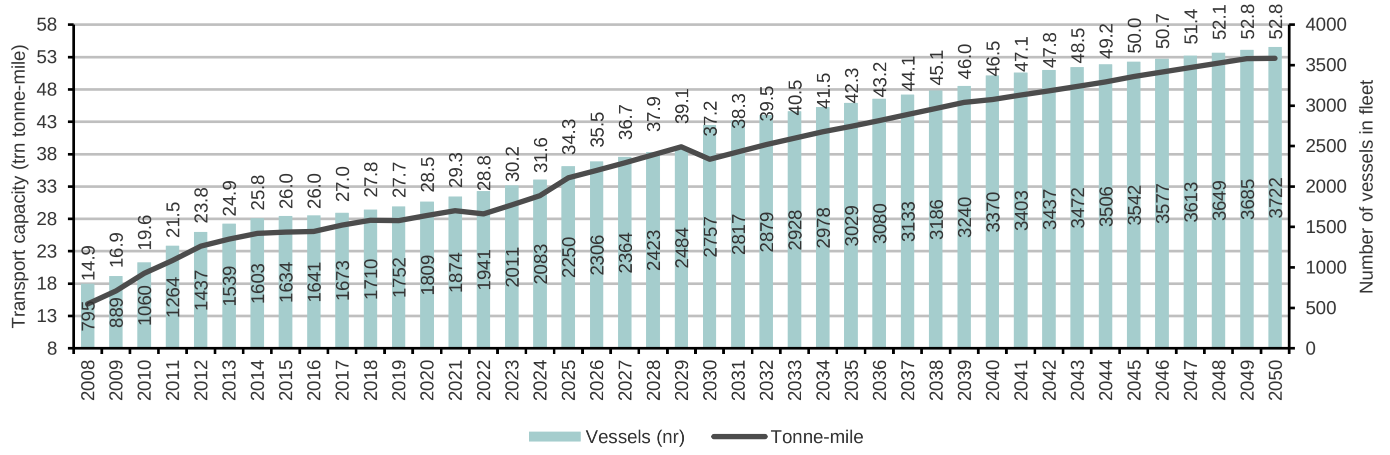
Our base-case scenario suggests traditional scrubber-fitted Capesizes being ordered until 2030, after which LNG propulsion becomes the go-to technology at the yards. Based on recent interest in LNG as a fuel in certain Capesize trades, we factor in a marginal share of such vessels from 2023e. We factor in a 25-year lifespan for the vessels, but including fleet growth the shift in generations of technology occurs at slightly above the 20 years we assumed for VLCCs. The resulting fleet composition suggests the last non-scrubber traditional vessel leaving the fleet in early 2030e, when scrubber-fitted vessels make up c75% of the fleet and LNG-fuelled vessels c25%. By 2050e the entire fleet would then be propelled by LNG-fuelled vessels in our base-case scenario.

## Composition of the Capesize fleet in our base-case scenario, with modern scrubber-fitted vessels the preferred vessel technology until $CO_2$ price pushes the preference to LNG fuel from 2030e




Source: DNB Markets

## Aggregate fleet trend to match expected future shipping demand growth

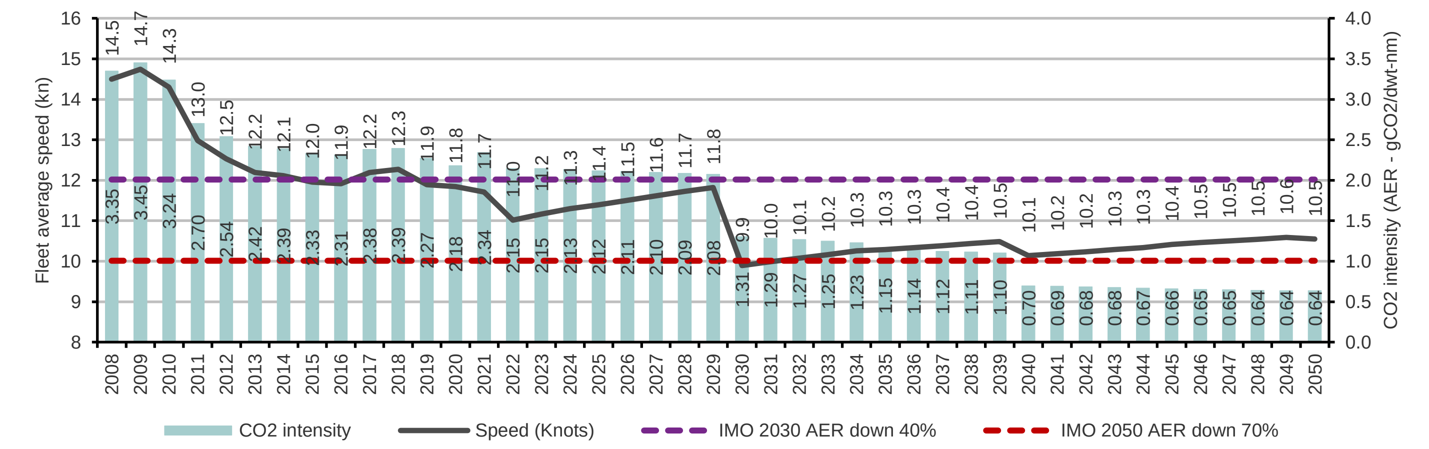



Source: DNB Markets

We assume the fleet size matches expected shipping demand growth for dry bulk of 2.2% CAGR for 2020–2050e, to aggregate the impact of the fleet and compare to IMO reduction targets. The demand growth has been determined by forecasts in various scenarios as published by the IMO in its latest GHG study. The size of the fleet would increase from c1,800 Capesize vessels in 2020 to above 3,700 by 2050e. As we are interested in the transport capacity of the fleet, this is dependent on the average sailing speed of the fleet as shown below.

Based on our model and optimal speeds, we estimate the average speed of the Capesize fleet will see step changes downward in periods of new regulations being enforced, while transitioning to new more efficient vessels will lead to a steady increase in optimal sailing speeds. This holds until a uniform fleet composition is achieved when only changes to assumed freight markets, fuel costs, or regulations would affect speeds. However, in practice it would be fair to expect tight or loose shipping markets to affect freight rates and thus speeds to effectively smooth the impact YOY for the simplistically modelled step changes due to regulations (e.g. for 2030 when both bio-fuel blending requirements and $CO_2$ pricing is implemented overnight slowing the fleet from 11.8 knots to 9.9 knots).

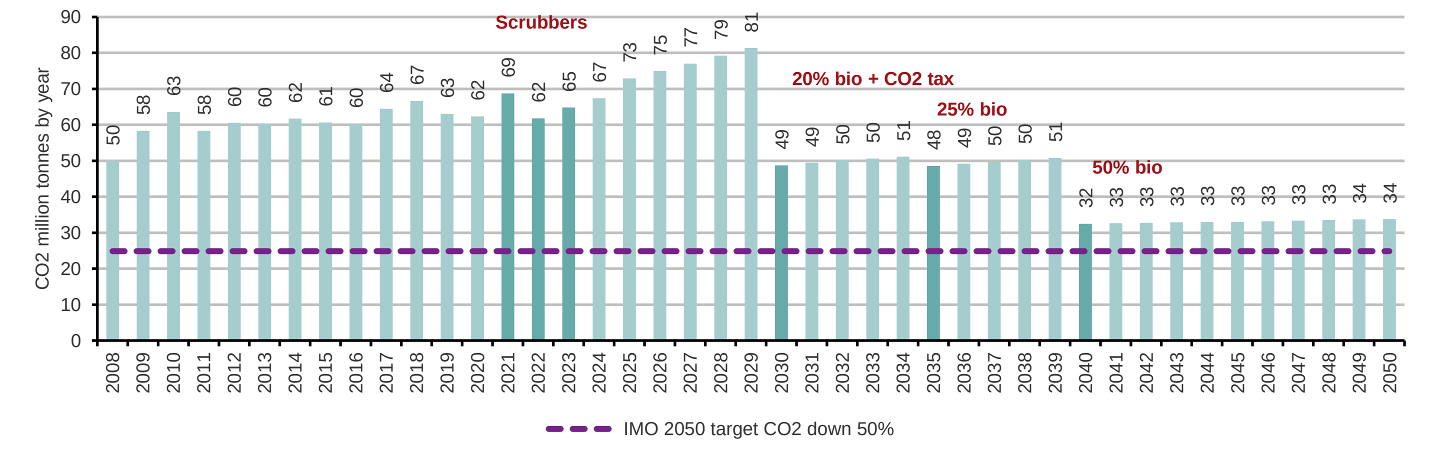
**Capesize fleet average speed trend and emissions efficiency improvements based on AER versus IMO ambitions**




Source: DNB Markets

We have calculated an estimated annual efficiency ratio (AER) for the Capesize fleet in terms of $CO_2$ emissions per transport work (deadweight tonne-miles) and the estimated ambitions of IMO to reach 40% and 70% efficiency improvements by 2030 and 2050, respectively. In our base-case scenario we are below the existing ambitions for the IMO's initial GHG strategy on these metrics. However, we fall short of the IMO's absolute reduction cuts of 50% from 2008 levels by 2050 as we model for fleet growth to meet our forecast demand. Hence, further initiatives would need to be implemented to reach these goals, and even more stringent regulations to reach carbon neutrality within the same time frame, assuming our base-case price trajectories hold true.

**Aggregate $CO_2$ emissions from the Capesize fleet versus IMO's ambition of 50% reduction by 2050**

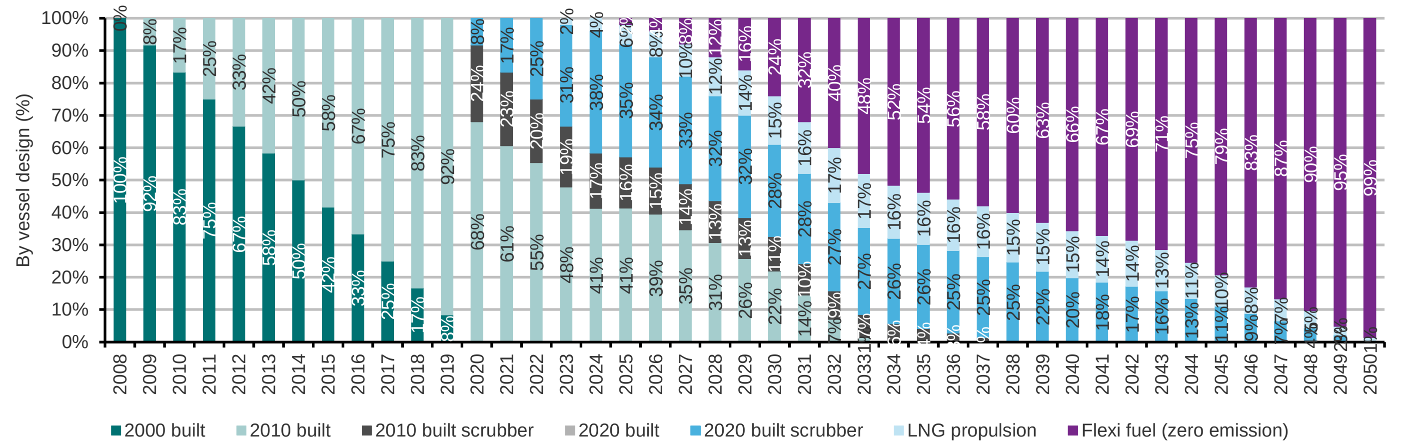



Source: DNB Markets

## High-case scenario implications

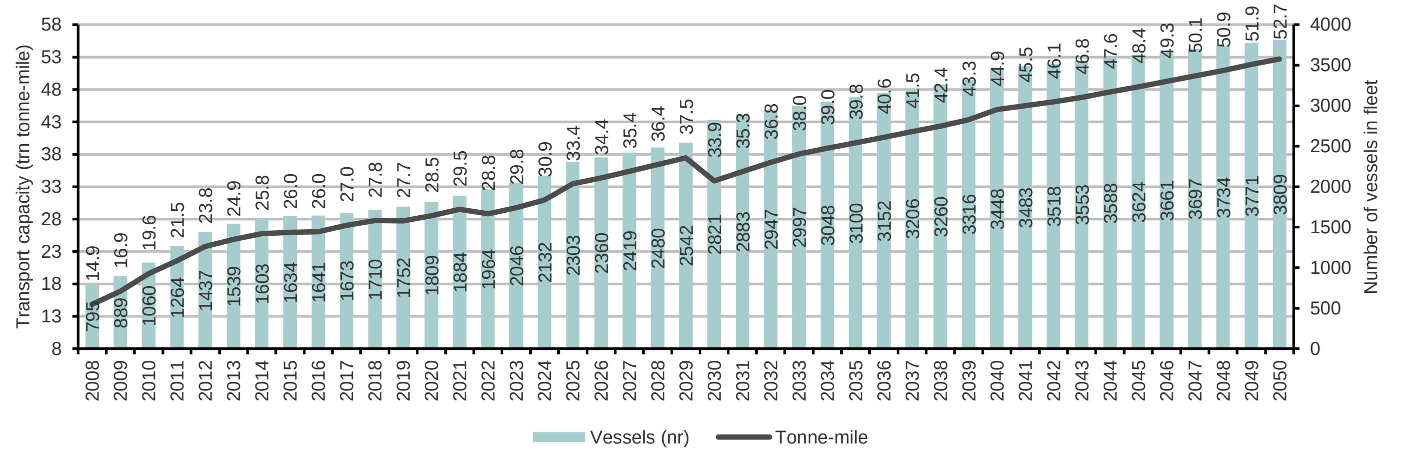
To determine the impact of increased energy prices and higher cost for $CO_2$ emissions, we have run our model on our high-case price trajectories too. Given the higher cost of fossil fuels and the USD300/tonne $CO_2$ price, the preferred vessel technology shifts from the 2020-built scrubber-fitted vessel directly to the ammonia-fuelled vessel once the 2030 regulations are implemented. This matches the findings in the VLCC case study in our high-case scenario. The ammonia-fuelled vessels reach 50% of the fleet by 2034e, while nearly 100% shift to potential carbon-free fleet is reached in 2050e.

**Composition of the Capesize fleet in our high-case scenario, modern scrubber-fitted vessels the preferred option until the 2030 regulations are implemented when ammonia-fuelled vessels become the leading technology**




Source: DNB Markets

**Aggregate fleet trend to match expected future shipping demand growth**



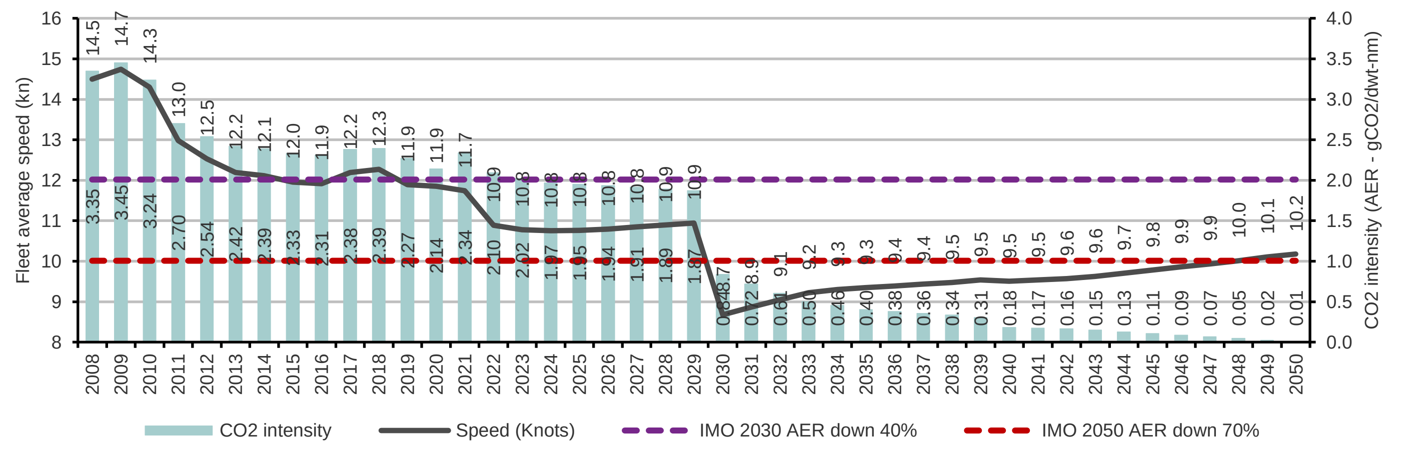

Source: DNB Markets

Due to the steep and stepwise change to fuel costs following implementation of USD300/tonne $CO_2$ price and fuel blending requirements from 2030, the average speed in the fleet declines dramatically before recovering as older vessels are replaced to a lower level than in our base-case scenario.

The implications of shifting to carbon-free ammonia-fuelled vessels becomes apparent in the assessment of carbon intensity and aggregate carbon emissions from the Capesize fleet. The AER declines to below the 70% reduction target by 2030e and reaches near zero by 2050e compared to stated IMO targets of 40% and 70% reductions, respectively. The aggregate emissions are halved from 2008 levels by 2031e and eventually reach zero in 2050e compared to the 50% reduction target by 2050 in IMO's initial GHG strategy.

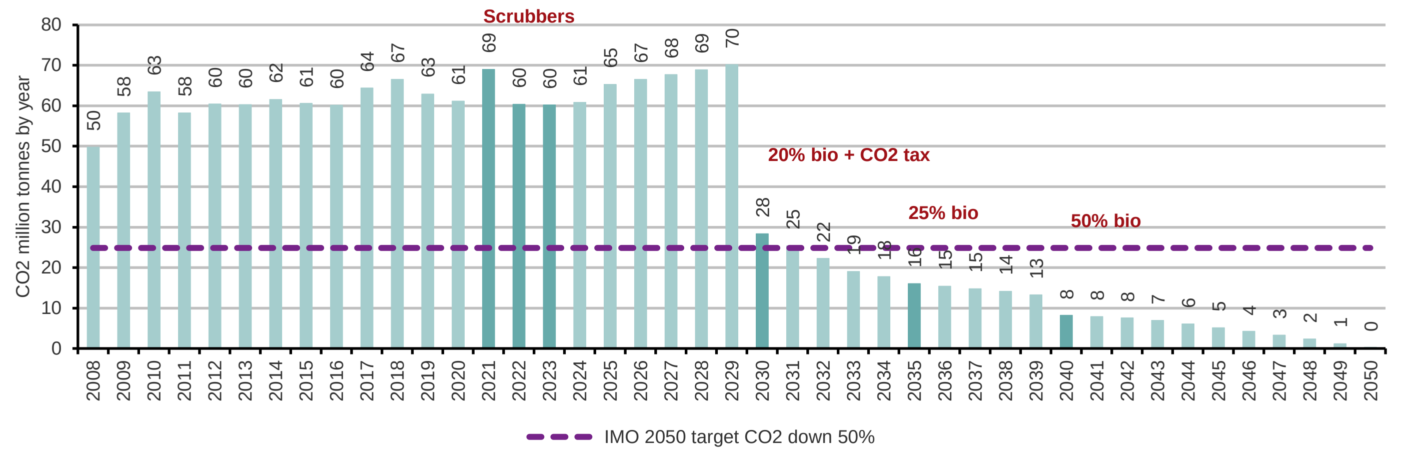
Hence, we believe the high energy price environment coupled with our outlook for regulations being implemented in the future looks sufficient to reach zero-carbon shipping by mid-century, while the current regulations coupled with our base-case assumptions approach the IMO's stated ambitions.

**Capesize fleet average speed trend and emissions efficiency improvements based on AER versus IMO ambitions**




Source: DNB Markets

**Aggregate $CO_2$ emissions from the Capesize fleet versus IMO ambition of 50% reduction by 2050**




Source: DNB Markets

## Container – 10k TEU vessel case study

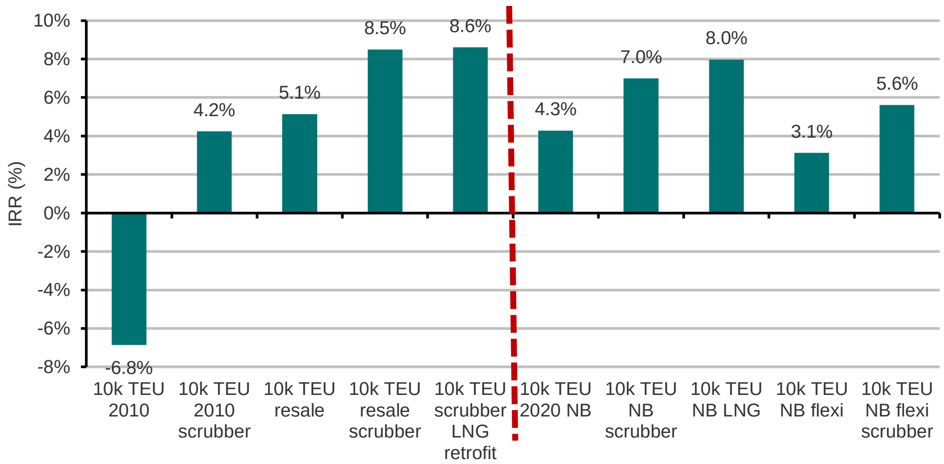
While the mechanics of freight market formation are, theoretically, straightforward in the fragmented crude tanker and dry bulk markets, the container market is dictated by integrated logistics networks and service offerings provided by largely consolidated liner companies and alliances between companies. Hence, the model applicability to this segment is slightly constrained, but from the view of a tonnage provider still relevant to illustrate the relative attractiveness of viable vessel technologies for potential investment.

Using our model for a 10k TEU container vessel in our base-case scenario, we arrive at a different result from the previous segments. The preferred vessel in our base-case scenario is now the modern resale with either a scrubber installed or a future retrofit to LNG propulsion. This clearly differs from the preference for older vessels with shorter remaining economic life in the case of VLCCs and Capesizes. This is explained by the stringent requirements in the planned regulations and early implementation for this segment (EEXI with 40% reduction from 2023). The forced reduction in sailing speed severely affects the economics of the vessel, and the fuel economics of modern container vessels becomes an immediate advantage. Looking at the newbuild alternatives we discover that LNG propulsion would be the vessel of choice, ahead of the scrubber-fitted alternative.

In our high-case scenario, the impact is detrimental for all assets but the ammonia-fuelled designs running on carbon-free ammonia. This is a direct result of the high consumption figures on these assets and the massive cost burden associated with expensive fuel and cost of emissions. Thus we can infer that relatively recent containership technology looks exposed to rapidly shifting regulatory requirements.

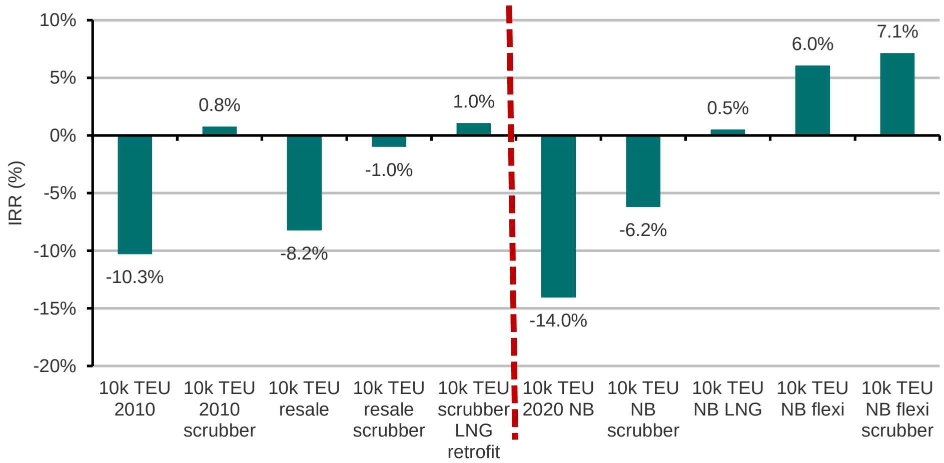
We assess the sensitivity for carbon pricing on the 10k TEU segment and arrive at similar conclusions as in the other two segments. On our base-case fuel price assumptions we need to see the price of $CO_2$ emissions exceed USD250/tonne to accelerate the shift to zero-carbon technology with ammonia-fuelled vessels.

**IRRs of various investments in 10k TEU containership technology today in our base-case scenario**



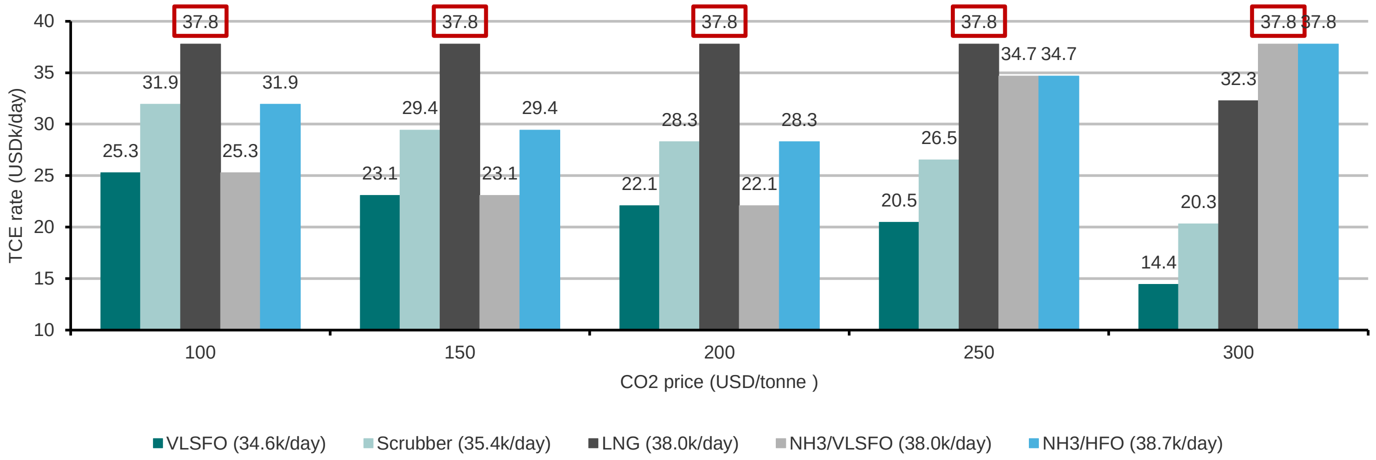

Source: DNB Markets

**Our high energy price and elevated $CO_2$ price scenario enhances the favourability of alternative carbon neutral fuel vessels already**




Source: DNB Markets

**Market-setting fleet technology at varying $CO_2$ pricing environments, with shift from LNG to zero-carbon fuel (ammonia) as the cost of emissions exceeds USD250/tonne**




Source: DNB Markets

# Important Information

This report has been prepared by DNB Markets, a division of DNB Bank ASA. DNB Bank ASA is a part of the DNB Group. This report is based on information obtained from public sources that DNB Markets believes to be reliable but which DNB Markets has not independently verified, and DNB Markets makes no guarantee, representation or warranty as to its accuracy or completeness. This report does not, and does not attempt to, contain everything material which there is to be said about the Company. Any opinions expressed herein reflect DNB Markets' judgement at the time the report was prepared and are subject to change without notice.

Any use of non-DNB logos in this report is solely for the purpose of assisting in identifying the relevant issuer. DNB is not affiliated with any such issuer.

This report is for clients only, and not for publication, and has been prepared for information purposes only by DNB Markets, a division of DNB Bank ASA.

This report is the property of DNB Markets. DNB Markets retains all intellectual property rights (including, but not limited to, copyright) relating to the report. Sell-side investment firms are not allowed any commercial use (including, but not limited to, reproduction and redistribution) of the report contents, either partially or in full, without DNB Markets' explicit and prior written consent. However, buy-side investment firms may use the report when making investment decisions, and may also base investment advice given to clients on the report. Such use is dependent on the buy-side investment firm citing DNB Markets as the source.

**Risk warning – generally high risk**
The risk of investing in financial instruments is generally high. Past performance is not a reliable indicator of future performance, and estimates of future performance are based on assumptions that may not be realised. When investing in financial instruments, the value of the investment may increase or decrease, and the investor may lose all or part of their investment. Careful consideration of possible financial distress should be made before investing in any financial instrument.

**Recommendation structure and risk classification**
DNB Markets recommendations are based on absolute performance:

| | |
|---|---|
| Buy | - indicates an expected return greater than 10% within 12 months |
| Hold | - indicates an expected return between 0 and 10% within 12 months |
| Sell | - indicates an expected negative return within 12 months |

Price targets are based on a combination of several valuation methods such as discounted cash flow, pricing based on earnings multiples, multiple on book value, net asset value and peer comparison. Substantial material sources for coverage of this company include historical financial figures and communication with the company, and relevant third party information. If you would like further information on the valuation, methodology or underlying assumptions used in this note, please contact the analyst (contact details on front page).

Recommendation distribution and corporate clients for the last 12 months

| | Buy | Hold | Sell | No_rec | Total |
|---|---|---|---|---|---|
| Number | 149 | 93 | 17 | 21 | 280 |
| % of total | 53% | 33% | 6% | 8% | |
| DNB Markets client | 24% | 11% | 3% | 4% | 117 |

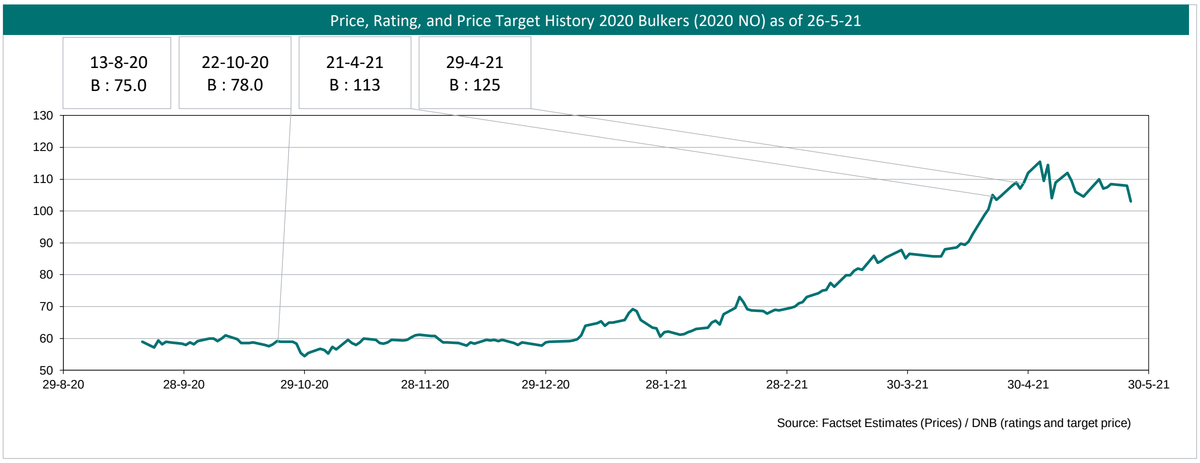
**2020 Bulkers**

DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 500 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

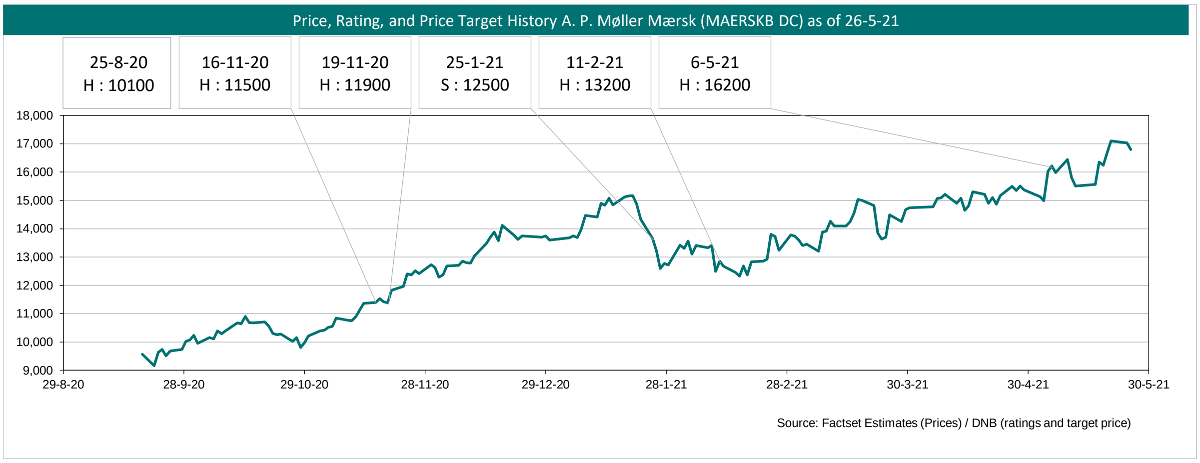


### A. P. Møller Mærsk

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




### Avance Gas

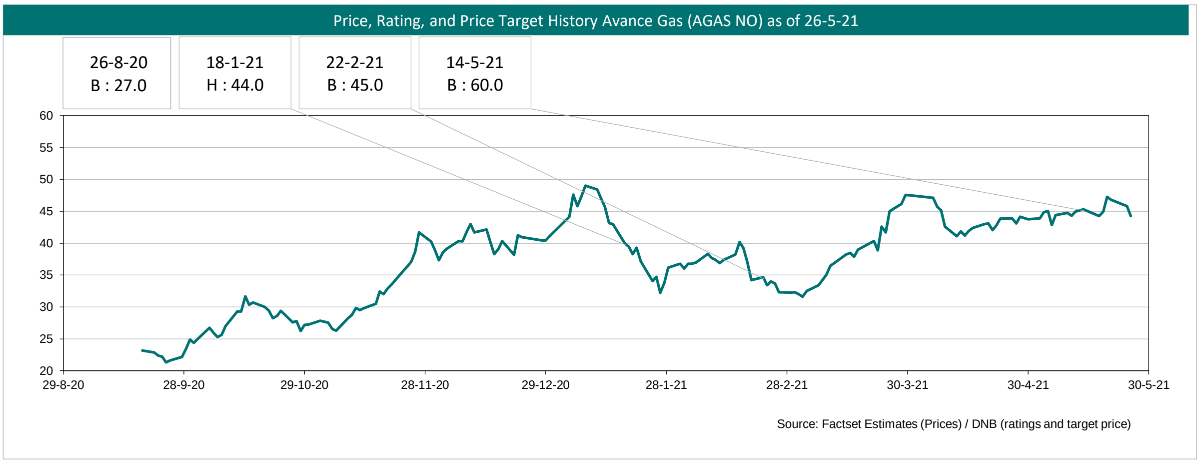
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 265 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




### BW LPG

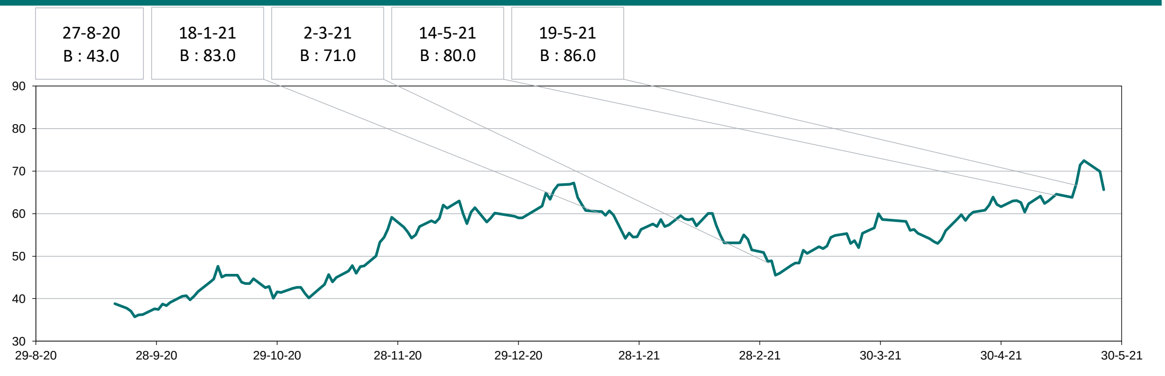
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 145 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

Price, Rating, and Price Target History BW LPG (BWLPG NO) as of 26-5-21



Source: Factset Estimates (Prices) / DNB (ratings and target price)

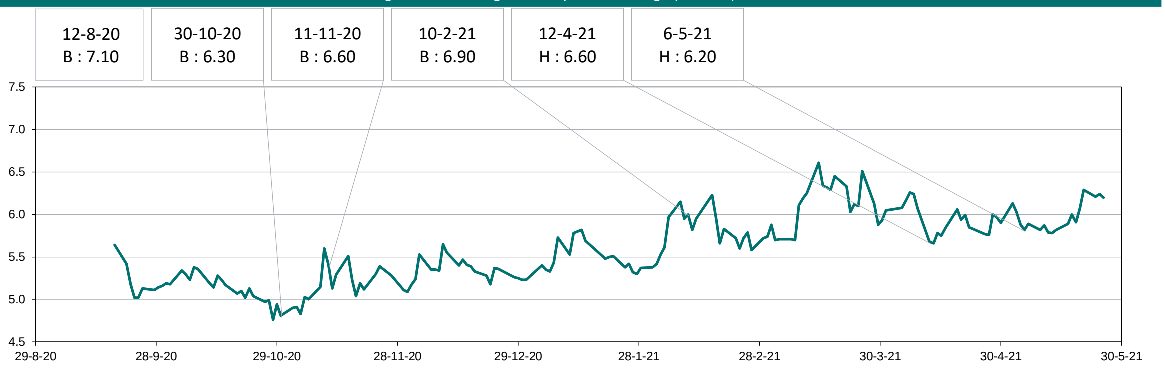
**DHT Holdings**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

Price, Rating, and Price Target History DHT Holdings (DHT US) as of 26-5-21



Source: Factset Estimates (Prices) / DNB (ratings and target price)

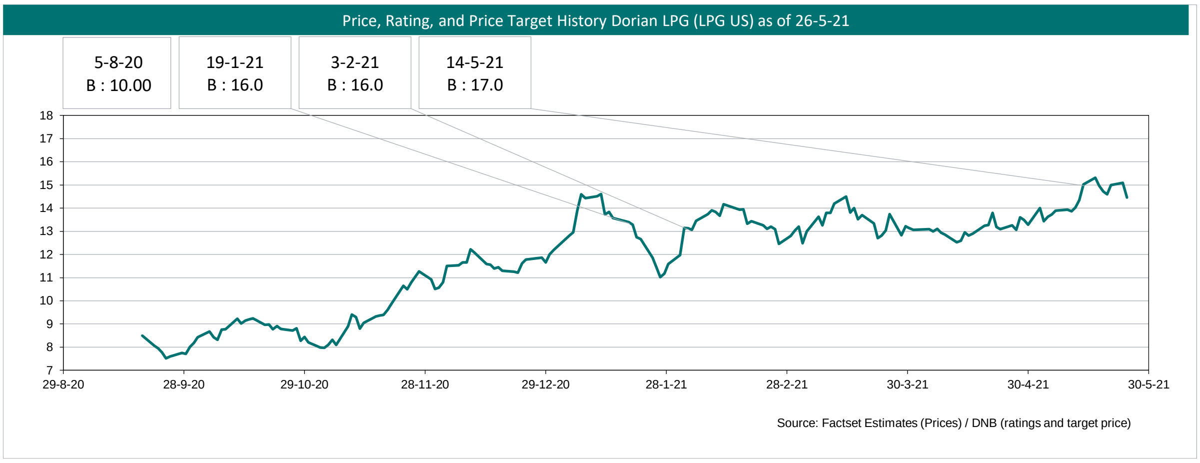
**Dorian LPG**

DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

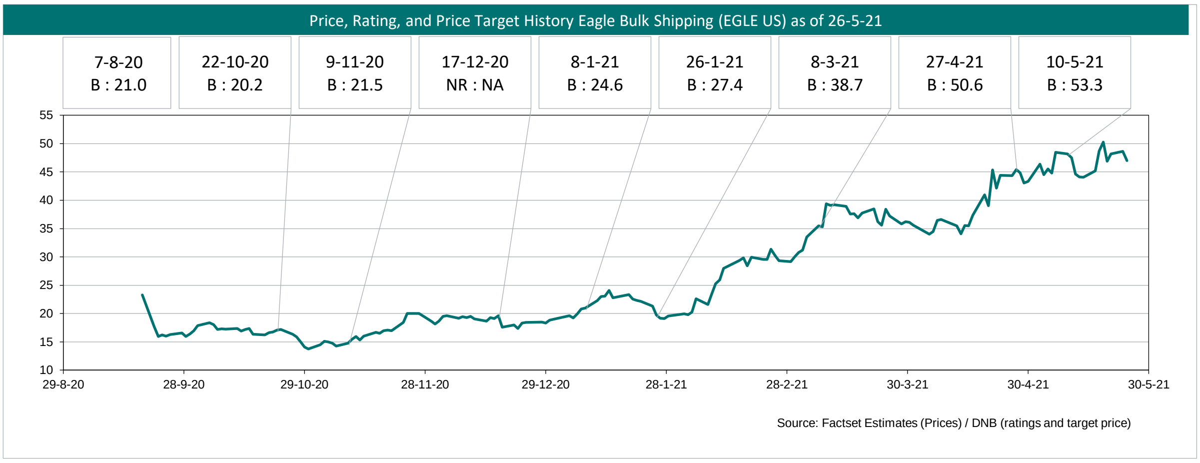



**Eagle Bulk Shipping**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

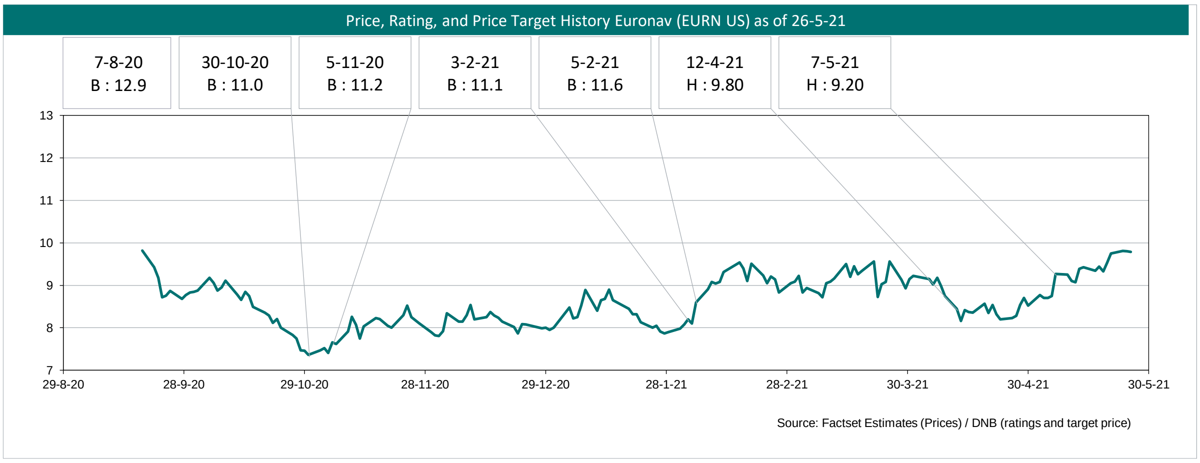



**Euronav**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.



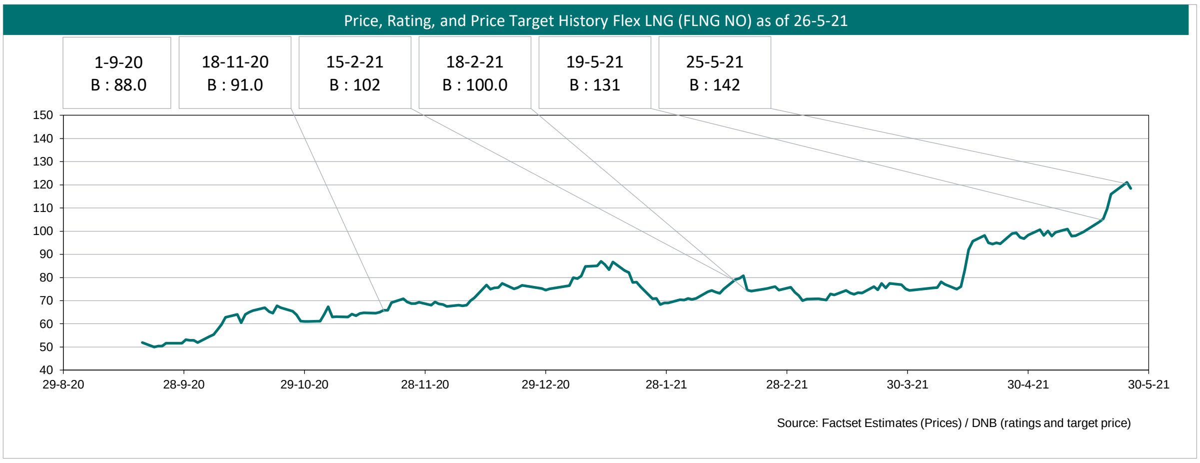

### Flex LNG

DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

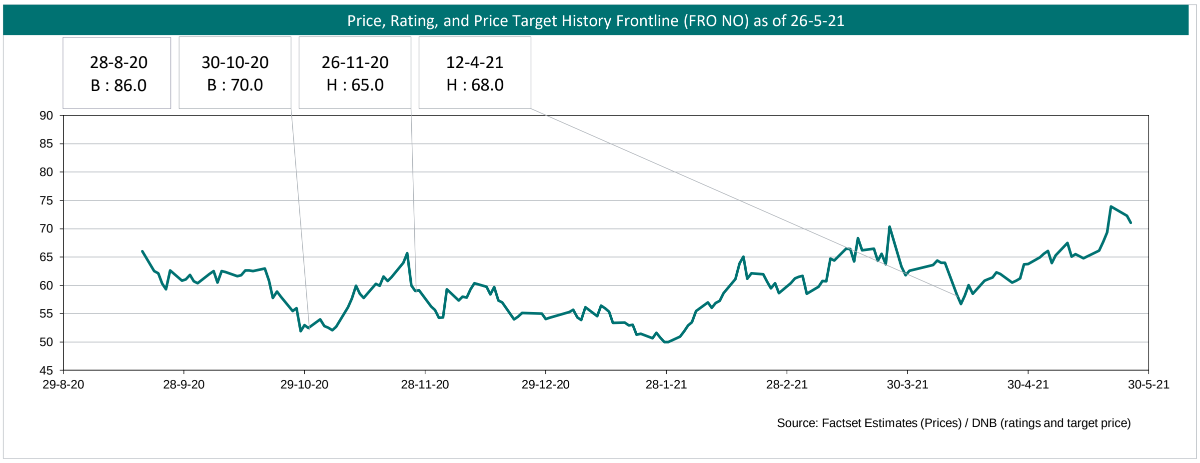



### Frontline

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 250 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

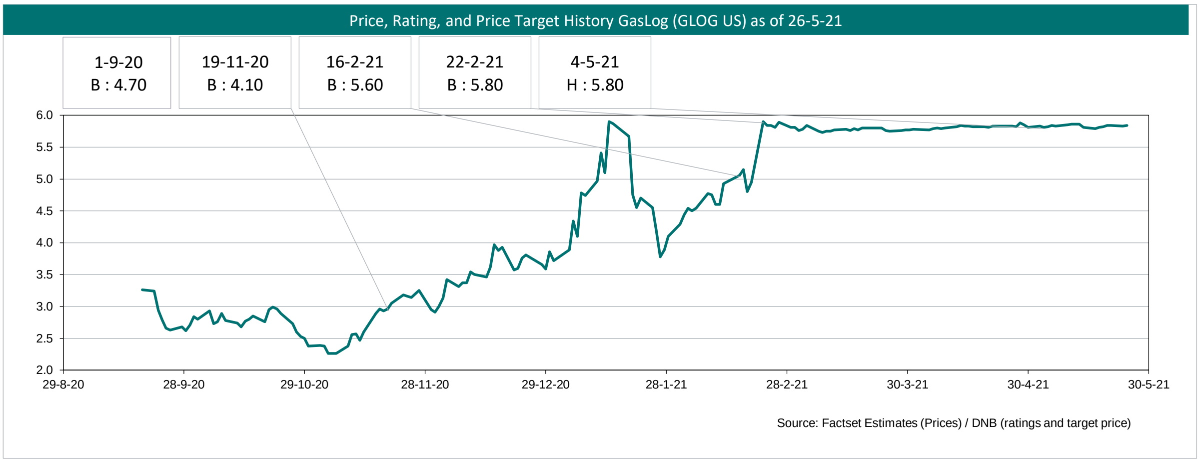



**GasLog**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

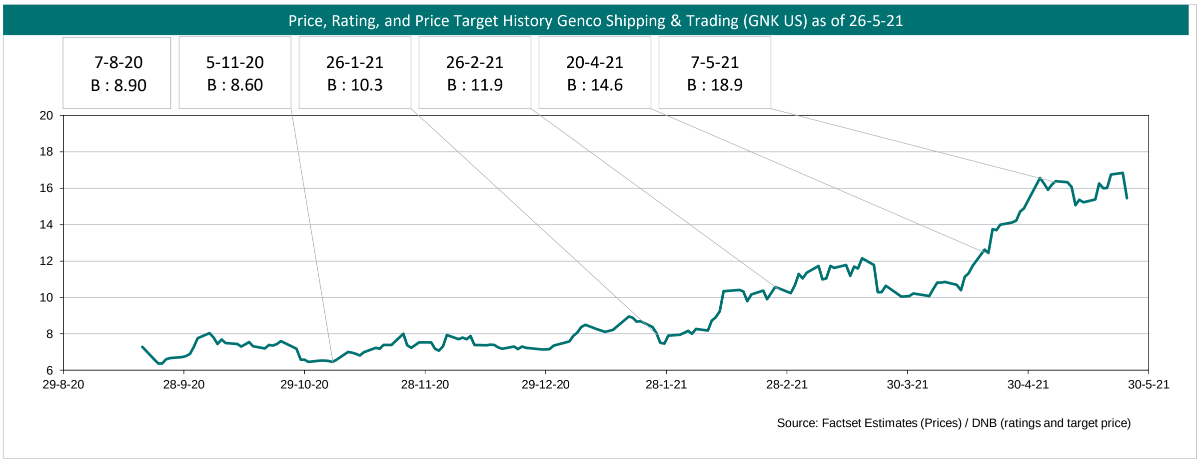



**Genco Shipping & Trading**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




### Golar LNG

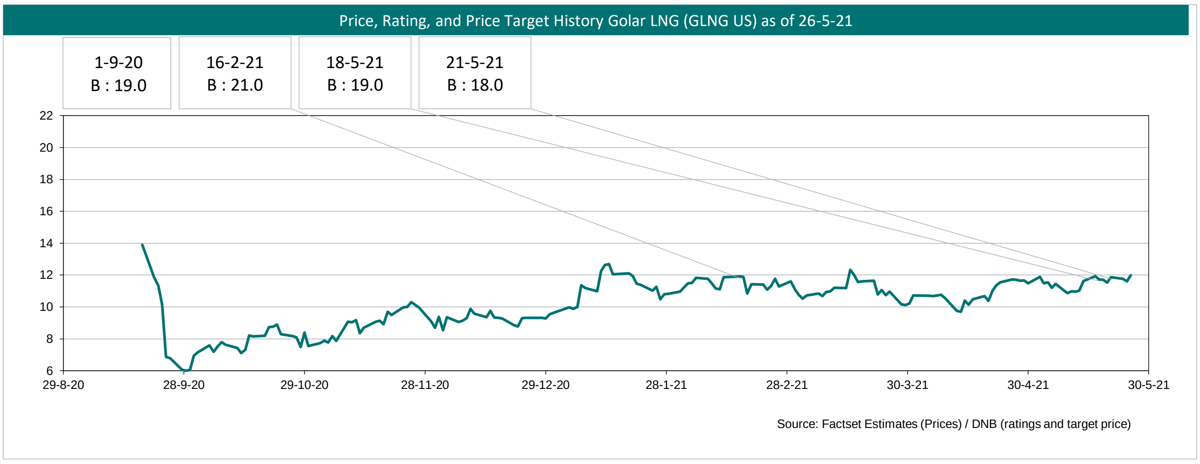
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




### Golden Ocean

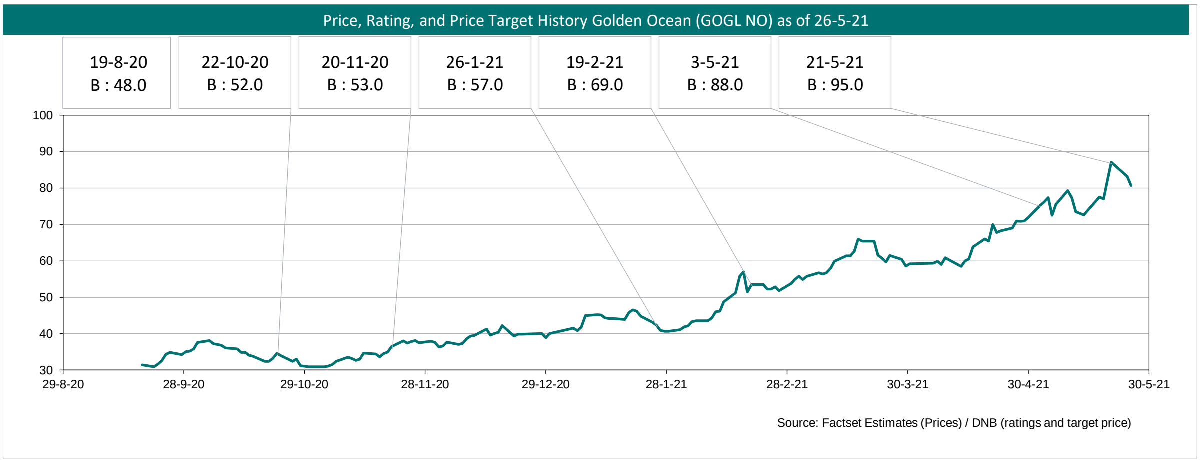
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

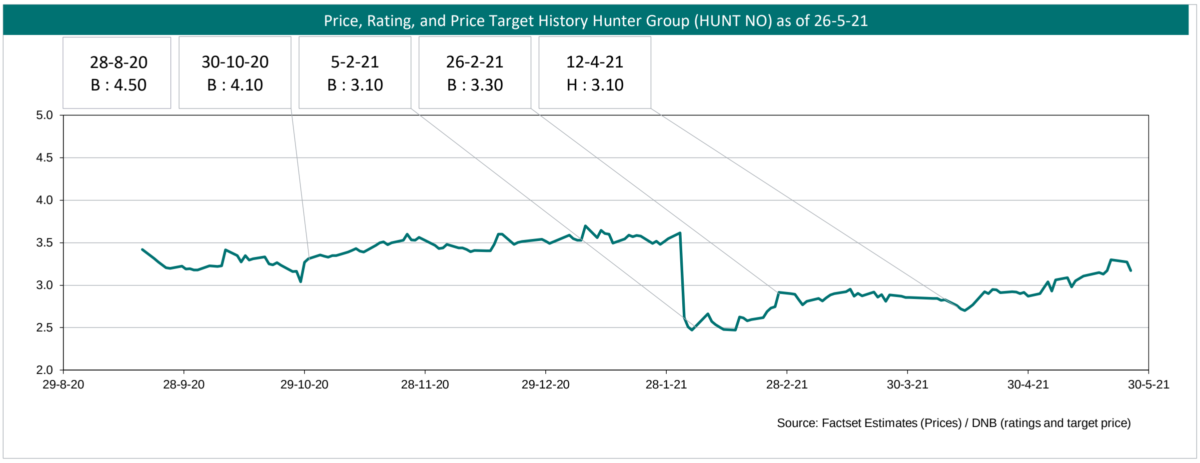



**Hunter Group**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 60000 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**MPC Container Ships**

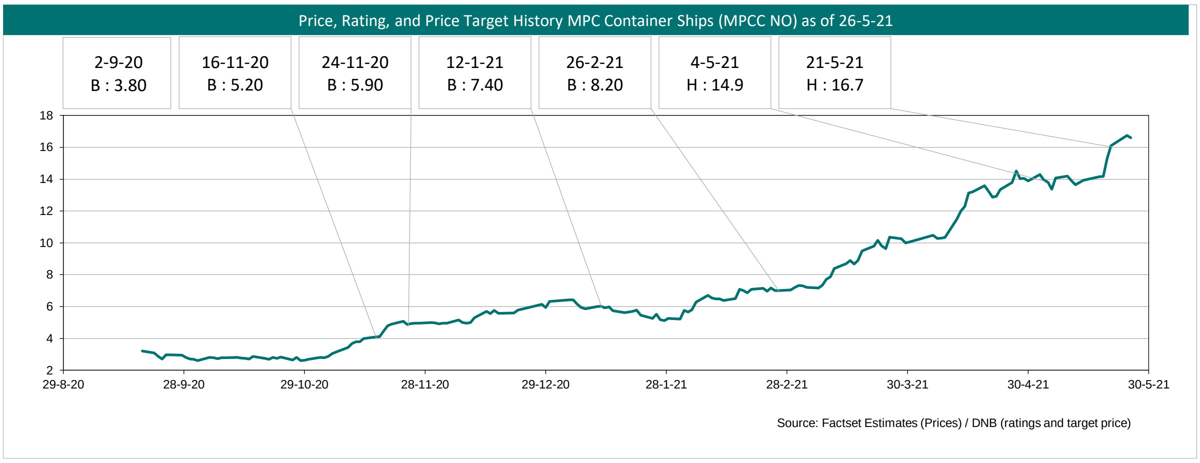
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.



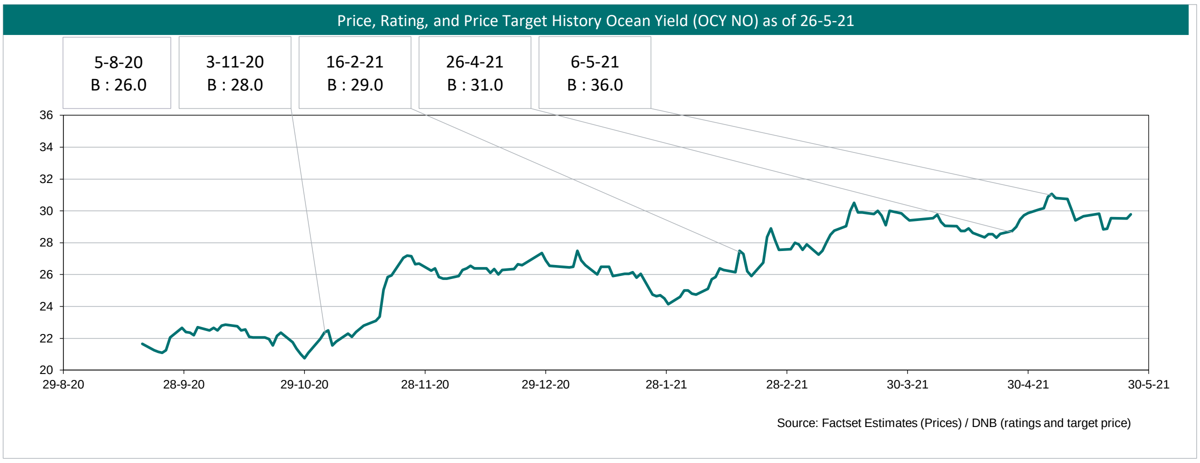

**Ocean Yield**

DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**Odfjell SE**

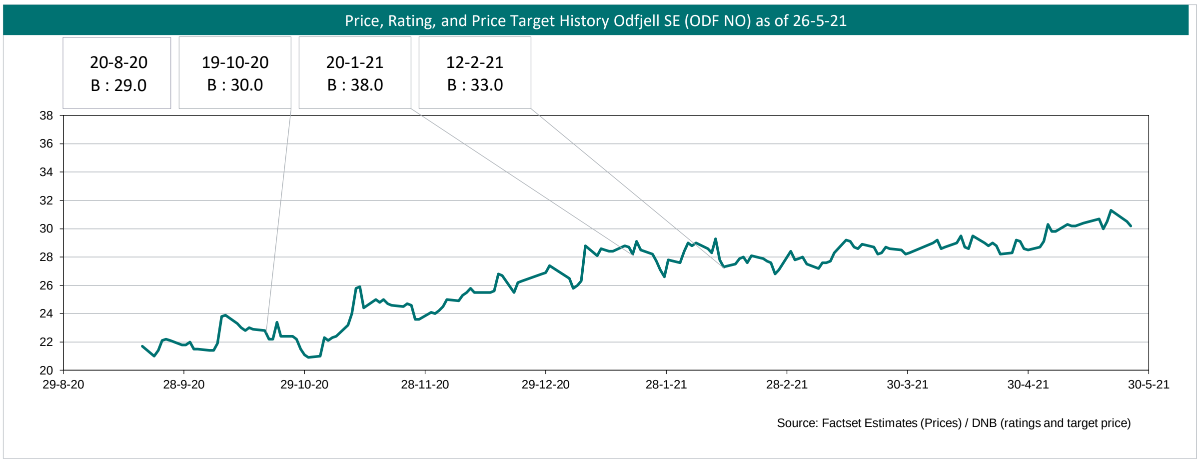
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.



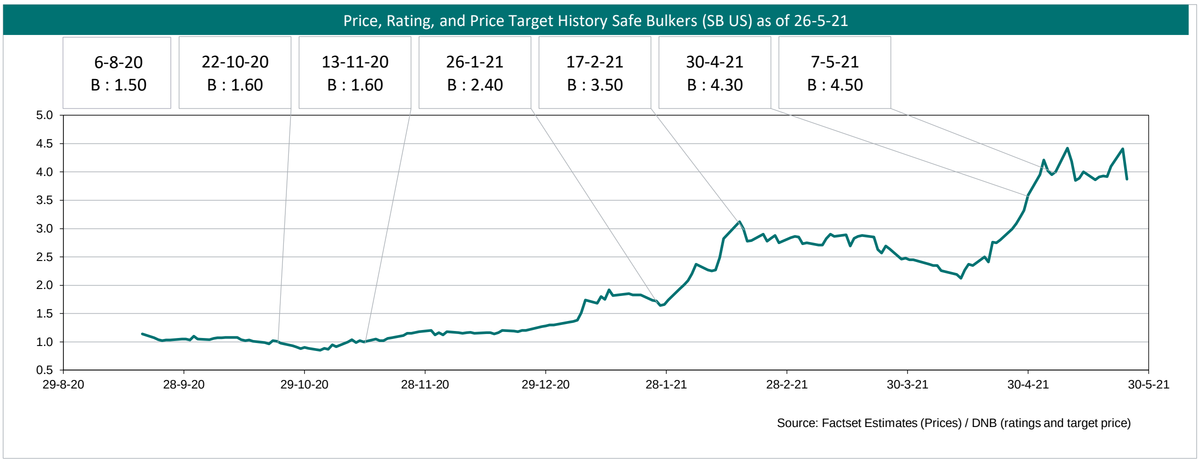

**Safe Bulkers**

DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

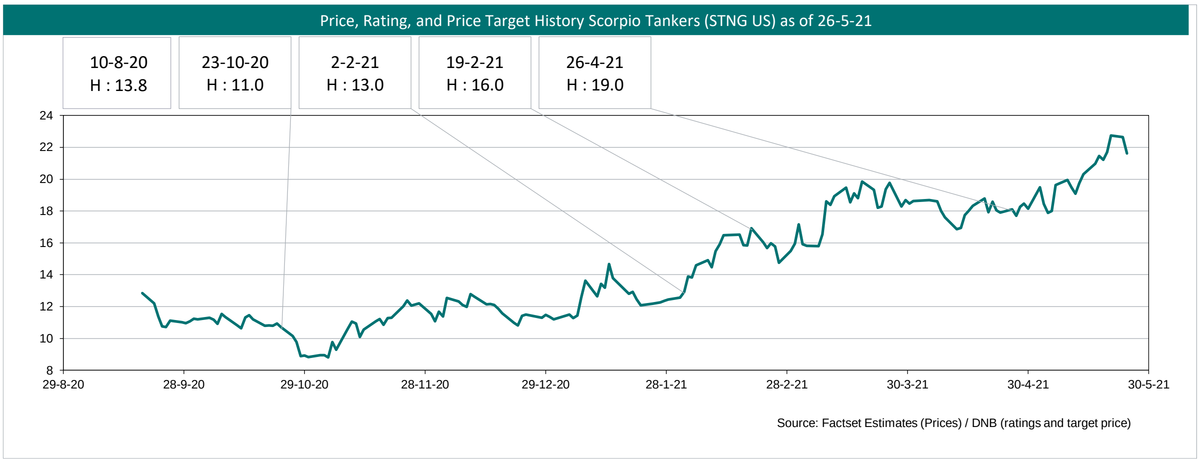



**Scorpio Tankers**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**SFL Corporation Ltd**

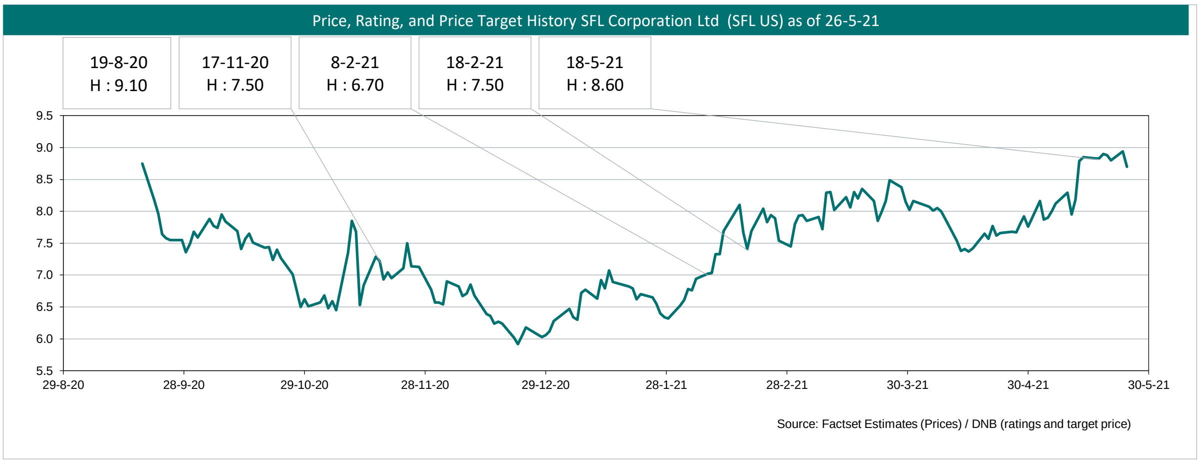
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

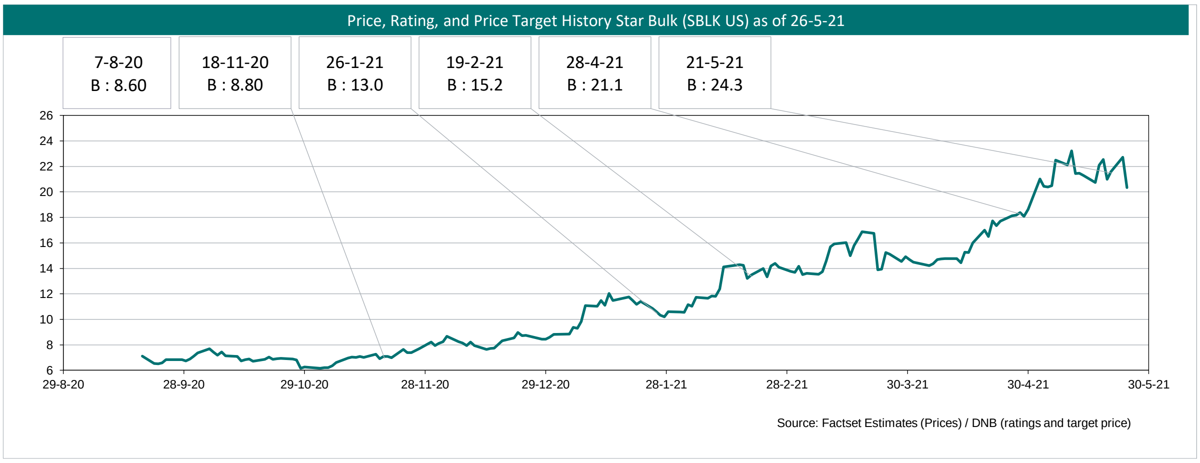



**Star Bulk**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**Stolt-Nielsen**

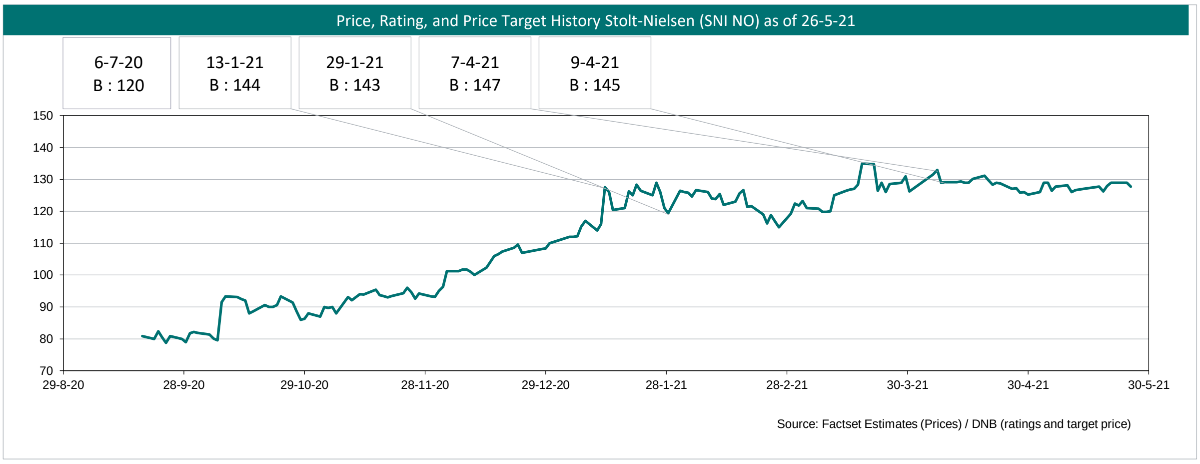
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 2000 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

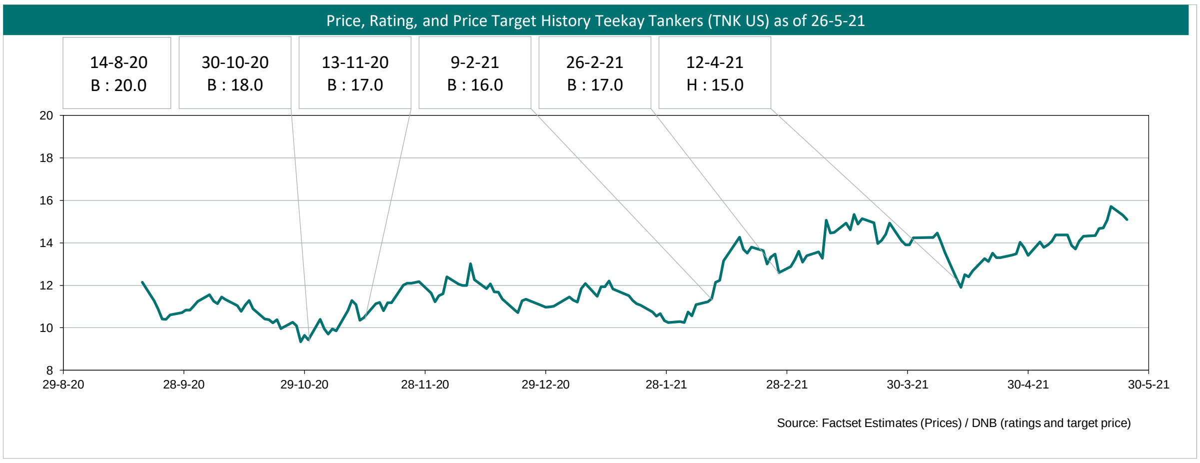



**Teekay Tankers**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 0 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**Wallenius Wilhelmsen ASA**

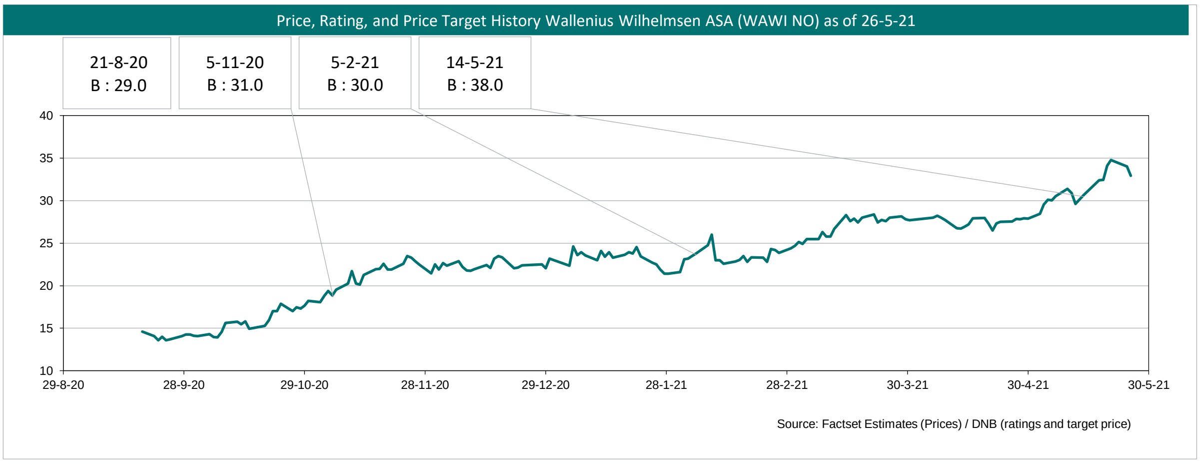
DNB Markets has provided investment services and/or ancillary services to the company and received compensation for it during the past 12 months.

DNB Markets has been lead or co-lead manager related to an Investment Banking assignment for the company and received compensation for it during the past 12 months.

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 1600 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.

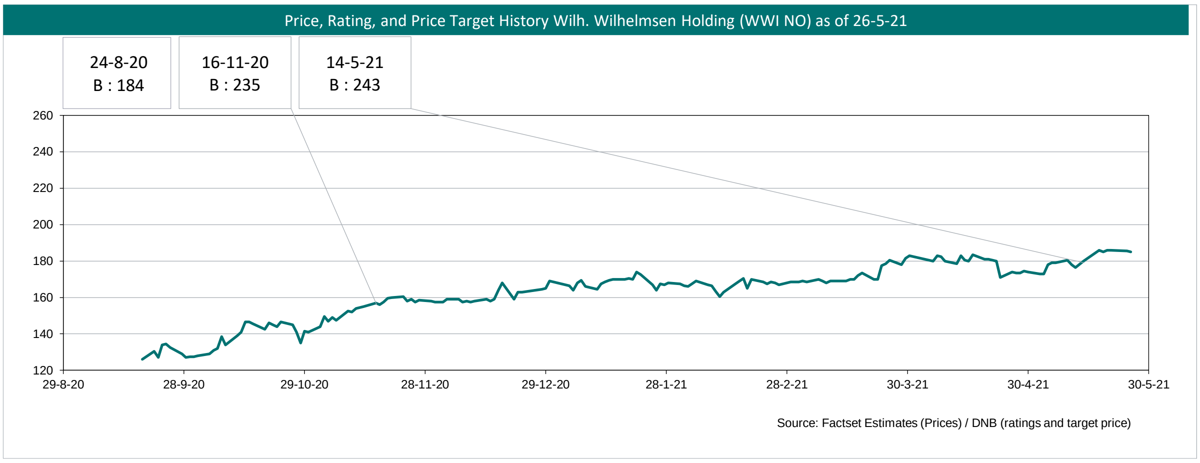



**Wilh. Wilhelmsen Holding**

Readers should assume that DNB Markets may currently or may in the coming three months and beyond be providing or seeking to provide confidential investment banking services or other services to the company/companies

| Share positions in the company: | Analyst* | Employees** | DNB*** |
|---|---|---|---|
| Number of shares | 0 | 77 | 0 |

*The analyst or any close associates. **Share positions include people involved in the production of credit and equity research, including people that could reasonably be expected to have access to it before distribution.
***Share positions as part of DNB Group. Holdings as part of DNB Markets investment services activity are not included.




**Legal statement**
This Report is a research report within the meaning of Regulation (EU) NO 596/2014 on market abuse (Market Abuse Regulation), and has been prepared in accordance with rules set out in relevant industry standards issued by The Norwegian Securities Dealers Association. This Report has been prepared as general information and is therefore not intended as a personal recommendation of particular financial instruments or strategies, and does not constitute personal investment advice as defined the Norwegian securities trading act (Norwegian verdipapirhandelloven).

The analyst hereby certifies that (i) the views expressed in this report accurately reflect that research analyst's personal views about the company and the securities that are the subject of this report, and (ii) no part of the research analyst's compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed by that research analyst in this report. DNB Markets employees, including research analysts, may receive compensation that is generated by overall firm profitability. Confidentiality rules and internal rules restricting the exchange of information between different parts of DNB Markets/DNB Bank ASA or the DNB Group are in place to prevent employees of DNB Markets who are preparing this report from utilizing or being aware of information available in the DNB Group that may be relevant to the recipients' decisions. DNB Markets and the DNB Group have incorporated internal rules and regulations in order to avoid any potential conflicts of interest.

The Report has been prepared by DNB Markets, a division of DNB Bank ASA, a Norwegian bank organized under the laws of the Kingdom of Norway and under supervision by the Norwegian Financial Supervisory Authority, The Monetary Authority of Singapore, and on a limited basis by the Financial Conduct Authority and the Prudential Regulation Authority of the UK, and the Financial Supervisory Authority of Sweden. Details about the extent of our regulation by local authorities outside Norway are available from us on request.

It is issued subject to the General Business Terms for DNB Markets and information about the terms is available at www.dnb.no. For requests regarding the General Business Terms of the Singapore Branch of DNB Bank ASA, please contact +65 6212 6144. Information about the DNB Group can be found at www.dnb.com. DNB Markets is a member of The Norwegian Securities Dealers Association, which has issued recommendations and market standards for securities companies. The Association's Internet address where the recommendations and market standards can be found is: www.vpff.no. This report is not an offer to buy or sell any security or other financial instrument or to participate in any investment strategy. No liability whatsoever is accepted for any direct or indirect (including consequential) loss or expense arising from the use of this report. Distribution of research reports is in certain jurisdictions restricted by law. Persons in possession of this report should seek further guidance regarding such restrictions before distributing this report. Please contact DNB Markets at 08940 (+47 915 08940) for further information and inquiries regarding this report.

**Additional information for clients in Singapore**
The report has been distributed by the Singapore Branch of DNB Bank ASA. It is intended for general circulation and does not take into account the specific investment objectives, financial situation or particular needs of any particular person. You should seek advice from a financial adviser regarding the suitability of any product referred to in the report, taking into account your specific financial objectives, financial situation or particular needs before making a commitment to purchase any such product. You have received a copy of the report because you have been classified either as an accredited investor, an expert investor or as an institutional investor, as these terms have been defined under Singapore's Financial Advisers Act (Cap. 110) ("FAA") and/or the Financial Advisers Regulations ("FAR"). The Singapore Branch of DNB Bank ASA is a financial adviser exempt from licensing under the FAA but is otherwise subject to the legal requirements of the FAA and of the FAR. By virtue of your status as an accredited investor or as an expert investor, the Singapore Branch of DNB Bank ASA is, in respect of certain of its dealings with you or services rendered to you, exempt from having to comply with certain regulatory requirements of the FAA and FAR, including without limitation, sections 25, 27 and 36 of the FAA. Section 25 of the FAA requires a financial adviser to disclose material information concerning designated investment products which are recommended by the financial adviser to you as the client. Section 27 of the FAA requires a financial adviser to have a reasonable basis for making investment recommendations to you as the client. Section 36 of the FAA requires a financial adviser to include, within any circular or written communications in which he makes recommendations concerning securities, a statement of the nature of any interest which the financial adviser (and any person connected or associated with the financial adviser) might have in the securities. Please contact the Singapore branch of DNB Bank ASA at +65 6212 6144 in respect of any matters arising from, or in connection with, the report. The report is intended for and is to be circulated only to persons who are classified as an accredited investor, an expert investor or an institutional investor. If you are not an accredited investor, an expert investor or an institutional investor, please contact the Singapore Branch of DNB Bank ASA at +65 6212 6144. We, the DNB group, our associates, officers and/or employees may have interests in any products referred to in the report by acting in various roles including as distributor, holder of principal positions, adviser or lender. We, the DNB group, our associates, officers and/or employees may receive fees, brokerage or commissions for acting in those capacities. In addition, we, the DNB group, our associates, officers and/or employees may buy or sell products as principal or agent and may effect transactions which are not consistent with the information set out in the report.

**In the United States**
Each research analyst named on the front page of this research report, or at the beginning of any subsection hereof, hereby certifies that (i) the views expressed in this report accurately reflect that research analyst's personal views about the company and the securities that are the subject of this report; and (ii) no part of the research analyst's compensation was, is, or will be, directly or indirectly, related to the specific recommendations or views expressed by that research analyst in this report.

The research analyst(s) named on this report are foreign research analysts as defined by FINRA Rule 1050. The only affiliate contributing to this research report is DNB Bank through its DNB Markets division ("DNB Markets/DNB Bank"); the foreign research analysts employed by DNB Markets/DNB Bank are named on the first page; the foreign research analysts are not registered/qualified as research analysts with FINRA; foreign research analysts are not associated persons of DNB Markets, Inc. and therefore are not subject to the restrictions set forth in FINRA Rules 2241 and 2242 regarding restrictions on communications with a subject company, public appearances and trading securities held by a research analyst account.

This is a Third Party Research Report as defined by FINRA Rules 2241 and 2242. Any material conflict of interest that can reasonably be expected to have influenced the choice of DNB Markets/DNB Bank as a research provider or the subject company of a DNB Markets/DNB Bank research report, including the disclosures required by FINRA Rules 2241 and 2242 can be found above.

This report is being furnished solely to Major U.S. Institutional Investors within the meaning of Rule 15a-6 under the U.S. Securities Exchange Act of 1934 and to such other U.S. Institutional Investors as DNB Markets, Inc. may determine. Distribution to non-Major U.S. Institutional Investors will be made only by DNB Markets, Inc., a separately incorporated subsidiary of DNB Bank that is a U.S. broker-dealer and a member of the Financial Industry Regulatory Authority ("FINRA") and the Securities Investor Protection Corporation ("SIPC").

Any U.S. recipient of this report seeking to obtain additional information or to effect any transaction in any security discussed herein or any related instrument or investment should contact DNB Markets, Inc., 30 Hudson Yards, 81st Floor, New York, NY 10001, telephone number +1 212-551-9800.

**In Canada**

The Information has been distributed in reliance on the International Dealer Exemption pursuant to NI 31-103 section 8.18. Please be advised that:
1) DNB Bank ASA (DNB Markets) and DNB Markets, Inc. are not registered as a dealer in the local jurisdiction to make the trade. We provide our services in Canada as an exempt international dealer. 2) The jurisdiction of DNB Bank ASA (DNB Markets) and DNB Markets, Inc.'s head office is Norway. 3) There may be difficulty enforcing legal rights against DNB Bank ASA (DNB Markets) and DNB Markets, Inc. because all or substantially all of their assets may be situated outside of Canada.
4) The name and address of the agent for service of process for DNB Bank ASA (DNB Markets) and DNB Markets, Inc. in the local jurisdiction is:
Alberta: Blake, Cassels & Graydon LLP, 855 - 2nd Street S.W., Suite 3500, Bankers Hall East Tower, Calgary, AB T2P 4J8. British Columbia: Blakes Vancouver Services Inc., 595 Burrard Street, P.O. Box 49314, Suite 2600, Three Bentall Centre, Vancouver, BC V7X 1L3. Manitoba: MLT Aikins, 30th Floor, Commodity Exchange Tower, 360 Main Street, Winnipeg, MB R3C 4G1. New Brunswick: Stewart McKelvey, Suite 1000, Brunswick House, 44 Chipman Hill, PO Box 7289, Station A, Saint John, NB E2L 2A9. Newfoundland and Labrador: Stewart McKelvey, Suite 1100, Cabot Place, 100 New Gower Street, P.O. Box 5038, St. John's, NL A1C 5V3. Nova Scotia: Stewart McKelvey, Purdy's Wharf Tower One, 1959 Upper Water Street, Suite 900, P.O. Box 997, Halifax, NS B3J 2X2.
Northwest Territories: Field LLP, 601, 4920 52nd Street, Yellowknife, NT X1A 3T1. Nunavut: Field LLP, P.O. Box 1734, House 2436, Iqaluit, NU X0A 0H0.
Ontario: Blakes Extra-Provincial Services Inc., Suite 4000, 199 Bay Street, Toronto, ON M5L 1A9. Prince Edward Island: Stewart McKelvey, 65 Grafton Street, Charlottetown, PE C1A 1K8. Québec: Services Blakes Québec Inc., 1 Place Ville Marie, Suite 3000, Montréal, QC H3B 4N8. Saskatchewan: MLT Aikins, 1500 Hill Centre I, 1874 Scarth Street, Regina, SK S4P 4E9. Yukon: Macdonald & Company, Suite 200, Financial Plaza, 204 Lambert Street, Whitehorse, YK Y1A 3T2.

**In Brazil**

The analyst or any close associates do not hold nor do they have any direct/indirect involvement in the acquisition, sale, or intermediation of the securities discussed herein. Any financial interests, not disclosed above, that the analyst or any close associates holds in the issuer discussed in the report is limited to investment funds that do not mainly invest in the issuer or industry discussed in the report and the management of which these persons cannot influence.