

Evaluating the Investment Value of Alternative Fuel Vessels: A Scenario-Based Approach

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ABSTRACT:

This study aims to provide a model for the quantitative assessment of the investment value of ordering alternative fuel vessels by addressing two main challenges: the difficulty of obtaining numerical details of the parameters in the model, and the uncertainty as to whether shipowners' perceptions are consistent with these parameters.

This study uses two approaches to overcome these issues: firstly, to use shipowners' perceptions of future alternative fuel adoption scenarios, and secondly, to refine the model to exclude dependence on parameters other than shipowners' perceptions.

This study provides a preliminary assessment of the validity of the model using preliminary probabilities derived from small-scale interviews with industry experts on dry bulk carrier and a containership. The results, which show a negative value for the ordering of alternative fuel ships for a dry bulk carrier and a positive value for a containership, are consistent with the trends in ordering of alternative fuel ships in 2023.

KEYWORDS:

Decarbonization; Vessel Investment; Dry bulk; Alternative Fuel

EXTENDED ABSTRACT:

Motivation and objectives:

The shipping industry is currently facing a critical challenge in the transition to alternative fuels, following the International Maritime Organization's (IMO) MPEC 80 resolution in 2023 to

achieve net-zero greenhouse gas emissions by 2050 (IMO, 2023). Among the zero emission fuels, biodiesel is compatible with existing diesel fuel. However, the future supply of biodiesel is expected to be insufficient to meet total shipping consumption (IEA, 2023). This means that the introduction of alternative fuels such as methanol, ammonia and LNG will be necessary to meet the target. However, the pace of newbuilding orders for alternative fuel carriers varies by ship type, with dry bulk carriers, which account for 40% of the world merchant fleet, having the lowest percentage of alternative fuel orders in 2023 at just over 10% (Clarkson, 2024). Therefore, accelerating the adoption of alternative fuels in the dry bulk sector is very important.

The reluctance to order alternative fuel vessels is attributed to the perceived low return on investment. Technical risk is another possible reason, but this should be largely mitigated, as evidenced by the fact that all orders for large containerships (over 13,000 TEU) in 2023 are for alternative fuels (including 'ready' options).

The aim of this study is to present a methodology to assess the quantitative value of ordering an alternative fuel ship compared to a diesel fuel ship. This assessment is critical not only for shipowners to make appropriate ordering decisions, but also for the development of policies to mitigate business risks and encourage the ordering of alternative fuel vessels by understanding the cost-benefit of such policies..

Methodology and data:

In developing a method to evaluate the value of investment in alternative fuel vessels, this study identifies two main challenges.

The first challenge is the difficulty in obtaining a numerical outlook on which to base the calculations. In order to evaluate the value of an investment decision with technical uncertainties, such as alternative fuel vessels, the real options approach is widely used and there have been previous studies in the shipping industry on investment in LNG-fuelled ships (Chen et al. 2018, Acciaro 2014). However, the real options approach requires numerical details of parameters, such as averages and variances, in advance. Unlike LNG prices, historical track records do not exist for alternative fuels and other information is extremely limited.

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The second challenge is that even if an accurate outlook could be obtained for these numerical details of parameters, it would not necessarily be consistent with the shipowners' perceptions. As noted above, there is limited information available at present on the outlook for alternative fuel vessels. In such a situation, there is no guarantee that the prospects that shipowners take into account when placing an order are accurate.

To address these challenges, this study employs two strategies: firstly, to conduct surveys with shipowners to directly capture their perceptions, and secondly, to create a model that does not depend on other parameters other than shipowners' perceptions by devising a revenue scenario and alternative fuel vessels' specifications.

Instead of directly asking about expected ship prices in the survey, this study presented scenarios detailing the differences in prices between alternative fuel and diesel fuel vessels and asked for the probability of each scenario. This approach allows for a clear understanding of the reasons behind price differences and how changes in circumstances could affect these differences. This is useful for industry specialists to predict the future and for policy makers to know the value of interventions in scenarios.

The specific model employed in this study is as follows.

- The difference in expected investment value between alternative fuel vessels and diesel fuel vessels is determined in the form of the present value of the option to order an alternative fuel vessel instead of a diesel fuel vessel. The present value is calculated using the Discounted Cash Flow (DCF) method.
- The alternative fuel vessel is assumed to be a diesel/methanol dual fuel vessel, and the increase in operational costs due to methanol compatibility is offset by energy-saving equipment and design. As a result, although the initial cost of the alternative fuel vessel is higher than that of the diesel fuel vessel, the operational cash flow will be the same when operating on diesel.
- For the business case, it is assumed that the ship is ordered in 2023 and completed within two years, then operated with diesel fuel for five years before being sold as a second-hand vessel. With this setup, there is no difference in cash flow during operation on diesel fuel, as mentioned above. Moreover, the vessel is sold in 2030, when IMO's interim target for

alternative fuel adoption is in place. This means the shipowners has some expectations regarding the second-hand vessel price.

- The difference in the second-hand price between diesel fuel vessels and dual-fuel vessels is considered under the following four scenarios:
 - Full Adoption: Decarbonization in the shipping industry fully progresses, and the value of diesel fuel vessels aligns almost with their scrap value. The second-hand premium for dual-fuel vessels is 90%.
 - Moderate Adoption: Decarbonization in the maritime industry progresses to a certain extent, leading to a discount in the charter rates for diesel fuel vessels. The second-hand premium for dual-fuel vessels is 50%.
 - Status Quo: There is no significant progress in the decarbonization of the shipping industry, and the premium for second-hand vessels remains the same as the premium for newbuilding vessels, namely 20%.
 - Obsolete: It becomes clear that alternative fuels other than methanol will become mainstream, resulting in the disappearance of the premium for being able to use methanol. In other words, the premium is 0%.

Considering the above definitions, the premium for ordering a dual-fuel vessel over a diesel-fuelled vessel can be calculated as follows.

$$\frac{\text{Weighted average of the difference in second-hand price}}{WACC^7} - [\text{Difference in newbuilding price}]$$

At the moment, the survey with shipowners is not conducted. The reason for this is that a survey is a burdensome task, and it was deemed preferable to first validate the utility of this model with provisional information as a preliminary step, and then, based on the results, to consider conducting a survey and further research. The provisional information used for the validation of this model was obtained through interviews with industrial experts in contact with the author, and the figures were assessed as being "within a plausible range". Furthermore, to determine the usefulness of the model, two ship types were taken into account: neo-panamax from containerships, which have the highest percentage of alternative fuel adoption ordered in 2023, and kamsamax from dry bulk carriers, which is main subject of this study.

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For the other parameters, newbuilding and five-year secondhand prices are based on the average of the last five years from Clarkson's Shipping Intelligence Network database (Clarksons, 2024). For the difference in newbuilding price between dual fuel and diesel fuel vessels, 20 per cent was set based on interviews with industry experts. The Weighted Average Cost of Capital (WACC) was set at 9% based on industry reports and other references.

Main results:

The probability of occurrence of each scenario used in the above model, and the results of the evaluation, are as presented in Table 1.

	Kamsamax Bulker	Neo-Panamax Containership
Newbuilding Price of diesel fuel	\$31.5m	\$124.5m
Premium for dual fuel	\$6.3m	\$24.9m
Probability: Full Adoption	10%	30%
Probability: Moderate Adoption	30%	30%
Probability: Status Quo	30%	30%
Probability: Obsolete	30%	10%
Secondhand Price of diesel fuel	\$28.5m	\$107.8m
Present value for ordering dual fuel	\$-1.62m	\$3.41m
Ratio to newbuilding price	-5.2%	2.7%

Table 1. Probability of Occurrence and Results of Evaluation

The differences in the probability of occurrence for each scenario reflect the following situations:

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- For the Full Adoption scenario, there could be self-regulation among the major container shipping companies for the use of alternative fuels more strictly than the whole shipping industry. For dry bulk carriers, on the other hand, the scope for such self-regulation is limited.
- With regard to the Obsolete Scenario, the major container shipping companies have committed themselves to procuring alternative fuels and are unlikely to be affected in their procurement, even if other alternative fuels become mainstream. In contrast, for dry bulk carriers, there are few such commitments, making it more likely that it will be more difficult to purchase methanol fuel at required locations if other fuels become the mainstream.

The present value of ordering a dual fuel vessel was evaluated a negative 5.2% of the newbuilding value for Kamsamax bulkers, whereas for Neo-panamax containerships it was a positive 2.7% of the newbuilding value. This result is broadly consistent with the ratio of alternative fuel vessels to the whole newbuilding orders in 2023, as discussed at the beginning of this study.

The results seem to confirm that this model may serve as an effective method for evaluating the premium of ordering dual fuel vessels over diesel fuel vessels.

Key findings and implications:

In the scope of this study, we have presented a model that evaluates the present value of the option to order an alternative fuel vessel instead of a diesel fuel vessel using shipowners perceptions obtainable through a simple survey. Additionally, we confirmed that the model produces results that align with the actual ordering of alternative fuel vessels at a likelihood consistent with the industry's common understanding.

These findings are of significant value to industry professionals in the shipping and shipbuilding sectors. This is because knowing the specific value of ordering alternative fuel vessels is directly linked to making the right ordering decisions, and knowing the probabilities of the proposed scenarios is a useful clue as to how the value of ordering alternative fuel vessels will change in the future.

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Furthermore, the results are also beneficial for policy makers. As mentioned earlier, the current rate of adoption of alternative fuel vessels, specifically dry bulk carriers, is not enough and aiming to decarbonise the shipping industry through measures to support their adoption could be a policy-relevant goal. To determine the cost-effectiveness of such support measures, the specific value of ordering alternative fuel vessels and the probability of the scenarios assumed could be a very useful clue.

Lastly, for researchers, the value of ordering alternative fuel vessels, the ordering probabilities of the scenarios underlying this value, and the variance obtained from the survey data are valuable. They provide a basis for conducting new analyses, such as calculations using the real options approach, thus offering significant benefits.

The next step in this study is to conduct the survey presented in our model with shipowners to calculate the formal results.

One of a limitation of this study lies in the assumption that alternative fuel vessels, which match diesel fuel ships in operating costs, can be constructed merely by increasing the building price. Specifically, the fact that alternative fuel vessels have a significantly shorter range than diesel fuel counterparts could cause a reduction in the value of alternative fuel vessels. This is due to the significantly lower unit heating value of any alternative fuel compared to diesel (IEA 2023), which is difficult to solve through technological advances in future.

The impact of a reduced range on the value of alternative fuel vessels will be examined based on, for example, whether the results of the survey deviate significantly from information used in this provisional evaluation. If the results indicate that the value should be lowered, we would like to calculate the specific amount of the reduction through interviews with experts in shipping and shipbuilding and reflect this in the model.

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