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Alternative fuels for Kraken feasibility study

Report

Apollo for Bumi Armada, EnQuest & NZTC

BUMIARMADA

EnQuest

Net Zero Technology Centre
Technology Driving Transition

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Executive Summary

The 'Alternative fuels for Kraken feasibility study' looks to explore the options available for a fuel change-out and the resultant implications, with the key focus being to reduce onboard emissions to align with net zero and energy transition targets. Phase 1 of this project centred around understanding the key differences between alternative fuels and traditional fuels. It included looking at OEM offerings around generator sets and boilers. The information and knowledge gained within Phase 1 acted as the foundation for the second phase of the study. Phase 2 of this project built on the findings from Phase 1 and further develop the options deemed feasible. A range of options were then developed for the adoption of alternative fuels on the Armada Kraken FPSO.

This study addresses the following five areas:

- Technical – brownfield modifications, energy storage and fuel delivery methods
- Regulatory – safety and environmental
- Technology – gap analysis and technology opportunities
- Economics – cost implications (positive and negative)
- Operations – construction and maintenance constraints

In recent years there has been a big evolution in the alternative fuel market with their potential to help decarbonise offshore power generation now being realised. This study grouped alternative fuels into two categories carbon neutral fuels and zero carbon fuels. The fuels considered in this study are shown in Figure 1.

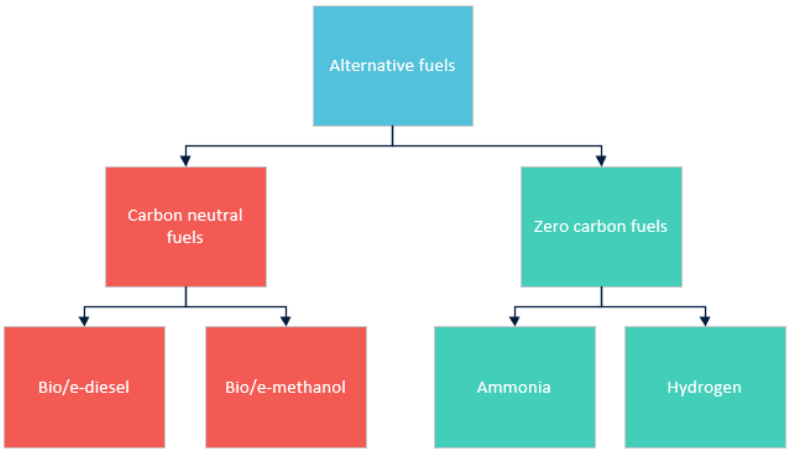

Figure 1 Carbon neutral and zero carbon fuels

Carbon neutral fuels

For these fuels to be classed as carbon neutral the feedstocks and energy used in the manufacturing process and transportation need to be from sustainable sources. Carbon can be captured from industry and utilised but this is simply giving the carbon a second use and not necessarily carbon neutral, so care needs to be used when considering the fuels origins.

Zero carbon fuels

Zero carbon fuels do not contain carbon in their molecule and therefore produce no CO_2 when burned. For this study ammonia and hydrogen are considered zero carbon fuels. For these fuels to be classed as zero carbon the feedstocks and energy used in the manufacturing process and transportation need to be from sustainable sources.

The following has been concluded from this study:

- Although every option considered in this study is technically feasible, it can be concluded that the only practical and economically feasible solution for the Kraken FPSO is bio/e-diesel.
- Using bio/e-diesel on Kraken is the simplest option to implement and requires no significant modifications or changes to operating procedures.
- For every option considered the cost of the alternative fuels will be greater than the fuel used at present. There is uncertainty surrounding the cost of the alternative fuels in the future, however the expectation is for the cost to decreases as uptake increases.
- Every alternative fuel option considered has a positive impact on ETS costs. For methanol this is dependent on it being "green methanol". A gas turbine solution reduces ETS costs compared to burning diesel.
- Every alternative fuel option has a level of uncertainty or risk attached to it. Changing to bio/e-diesel has the lowest level of uncertainty with every other option having greater levels of uncertainty or risk.
- Wartsila are not developing a conversion package for the 50DF engine onboard the Kraken FPSO. Therefore a brand new power generation modules would need to be installed if methanol, ammonia, or hydrogen are to be used as the primary fuel source.
- The only fuels that can be stored within the existing storage tanks are bio/e-diesel and methanol as these can be stored as liquids at atmospheric temperature and pressure. Storing methanol inside the existing fuel storage tanks is possible however these would need to be cleaned and coated to prevent corrosion.
- Hydrogen and ammonia are gasses at atmospheric pressure and temperature the only method of storing the volumes required for Kraken are to store them as liquids. The technical challenges and energy intensity involved with liquifying hydrogen and ammonia and storing them at pressure and/or cryogenic temperatures makes them an impractical option for Kraken.
- Review of existing installed pipework and assess for additional equipment needs, i.e. transfer pump installation. Requirements will be storage option dependent.

Table 1 shows the scenario rankings using the criteria in Table 2 for each alternative fuel including the use of fuel gas through a new gas turbine. Hydrogen was discount on cost grounds.

Table 1 Scenario Ranking

Fuel Option	Cost	Emissions	Technology
Bio/e-diesel			
E-methanol			
Ammonia			
Gas turbine			

Table 2 Scenario Ranking Criteria

Item	Cost (£10^6)	Emissions	Technology
Green	<5	Zero carbon emissions	Commercially available
Orange	5-10	Carbon neutral	Nearly commercially available (within 2 years)
Red	>10	Minor carbon emission reduction	Early development stages

Figure 2 shows the key gaps identified during this study impacting the implementation of alternative fuel solutions.

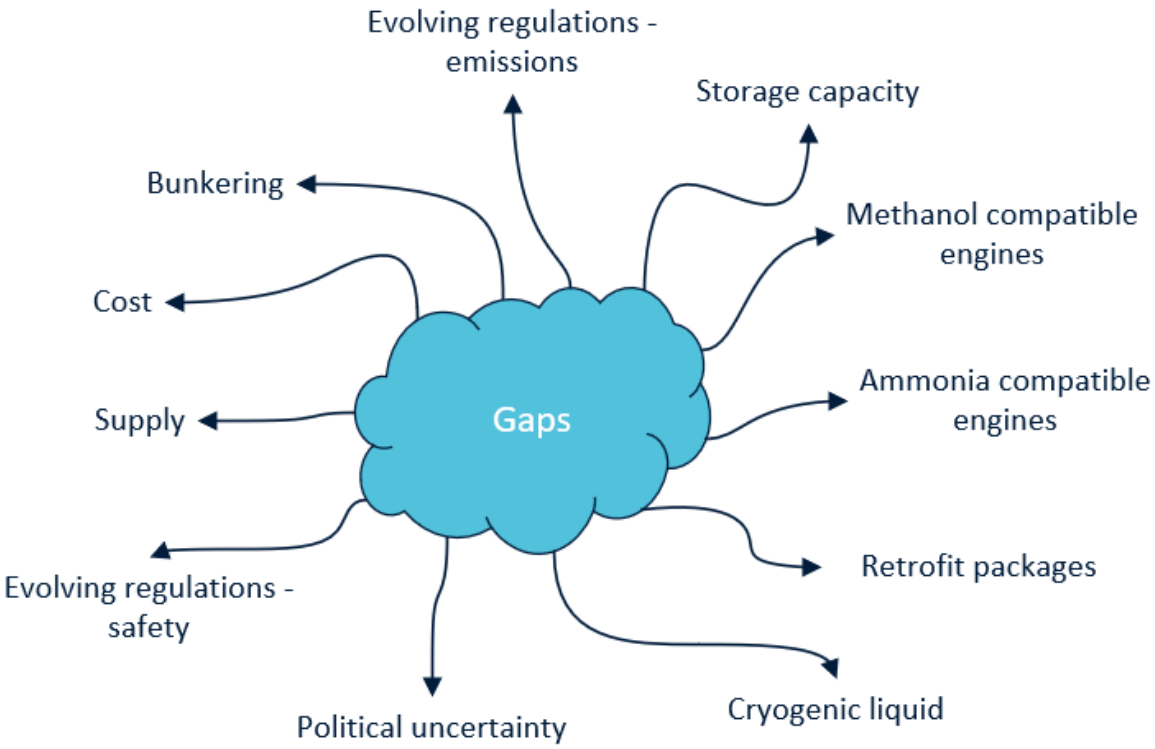

Figure 2 Gaps identified

Recommendations

The following recommendations can be made from this study:

- This study has only considered the four main power generation engines and boilers on Kraken. Several other smaller diesel fuelled engines are used on kraken and it is recommended that the ability to use an alternative fuel within these is investigated. It is possible that conversion packages will be available for them to be changed over to operate on methanol.
- It is recommended that the gas produced on Kraken be utilised as a fuel source either in the engines or boilers as the only other way of dealing with it is to send to flare.
- The use of a flare gas recovery system may also be employed to increase the available fuel gas and make best and efficient use of what the asset has available.
- Operational costs for each fuel option have not been taken into account as a part of the scope for this study and would need further in-depth study. Key considerations would include:
  - Supplier costs
  - Supply locations, logistics and contracts
- Keep watching brief on Wartsila engine development.

Figure 3 shows the recommended pathway for adopting an alternative fuel on the Kraken FPSO following the completion of this study.

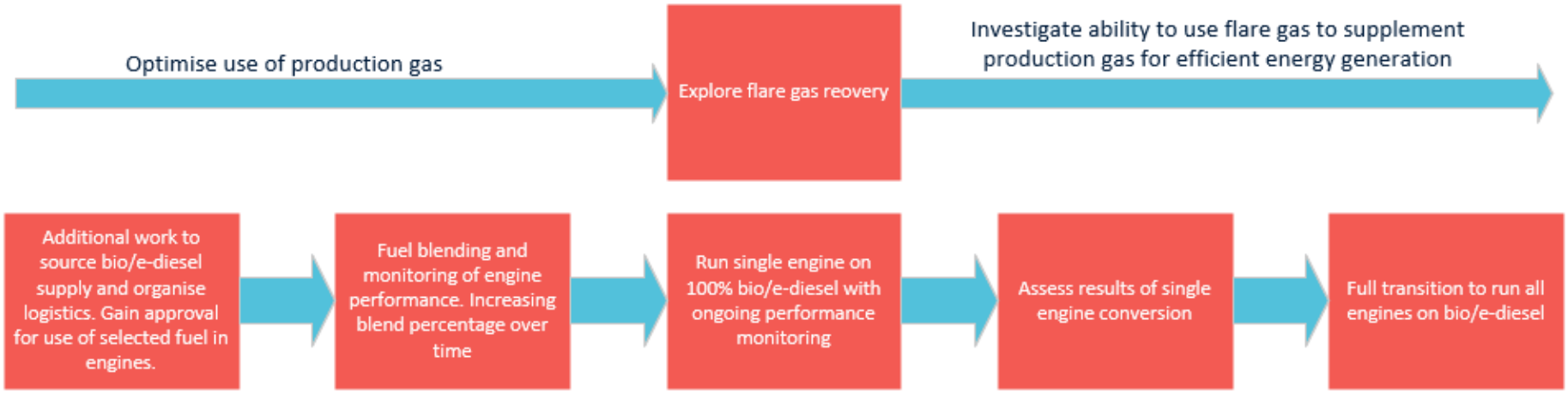

Figure 3 Recommended alternative fuel pathway

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