Case study: Identify and de-risk low emission fuel pathways for offshore support vessels.

Well to wake emissions and costs analysis | Techno-economic analysis | Supply chain assessment
Hazard assessment | Strategic recommendations

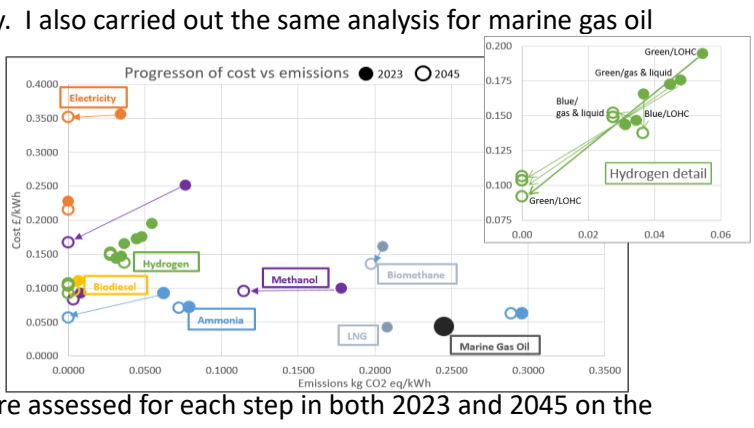
Client: Offshore Renewable Energy Catapult. **Funder**: BP.

Delivery: Conceptualisation, research, analysis, reporting: Dr John M. Low.
Review: Dr W. Sun, University of Edinburgh.

Challenge: With the ongoing development of their offshore wind farms in the northern and central North Sea, BP faced a challenge: their existing support fleet relied on fossil fuels, threatening the overall net zero benefit of the programme. The need was to identify a renewable fuel solution which was safe, affordable, and available in sufficient quantities for a 2029 vessel launch.

This project is to identify the optimum fuel to power the new support vessels. It will have to optimise investment risk and operating cost, minimise emissions, comply with regulatory requirements, reduce infrastructure and availability uncertainties, and fulfil operational needs – both now and through the service lifetime of the vessel.

Investment requirements, costs and emissions: I considered seven alternative fuelling solutions with potentially zero or reduced emissions: biodiesel, biomethane, methanol, ammonia, hydrogen, liquid natural gas (LNG), and battery stored electricity. I also carried out the same analysis for marine gas oil (MGO – marine diesel) to provide a baseline.



Each fuel was assessed across six steps or processes: production, storage (onshore and onboard), transportation, refuelling, and use. Factors included source of raw materials and energy, storage method, transportation method, fuel transfer method, and onboard power generation method.

Investment, operating costs, and emissions were assessed for each step in both 2023 and 2045 on the basis of cost or emissions per kWh, and summed from end to end to give the totals per kWh of useful energy delivered. The emissions reduction and financial profile for each fuel, relative to MGO, was then assessed, along with developing understanding of how they are expected to change over the period of assessment, 2023- 2045.

Hazards and supply chain: I evaluated operational and safety risk associated with each fuel, alongside likely UK and, where necessary, international supply chain availability.

Insights

My analysis showed that a full electric solution would require a battery capacity of almost 600 MWH- this would weigh around 1400 tonnes, and cost approximately $60 million. This renders the design of such a vessel effectively impossible. Even a hybrid system, requiring a battery around 10 to 20% of the size, would be impractical and prohibitively expensive. Early identification of this saved the client from pursuing a non viable solution, redirecting the focus to chemical fuel systems.

Biomethane was also ruled out as unviable, as the demand from the proposed initial two vessels would consume around 10% of the entire UK's supply available for transport., creating an unsustainable restriction.

LNG could provide reduced, but still substantial, emissions compared to MGO, at a similar cost.

Ammonia, methanol, biodiesel and some hydrogen pathways are likely to be viable and are competitive in cost. Of these, ammonia appears to offer the optimum balance of emissions, cost, availability, and ease of handling. While it is more toxic than most of the other options, there is over 100 years of worldwide experience in handling it in large quantities due to its widespread use in fertiliser – and indeed the client has considerable expertise in handling and transporting hazardous fluids – which should allow the risk to be mitigated. It is available in various locations, including a new green ammonia plant under construction in Orkney.

Impact

This analysis provided BP with the confidence to proceed with the vessel ordering timeline, de-risking a £multi-million investment by validating viable net zero fuel pathways.

Key advisory input value: Integration of lifecycle emissions, economics, infrastructure, operational constraints, regulatory requirements, hazards, and future supply viability - reducing uncertainty and optimising investment planning.

Consultant profile, Dr John Low

I am an independent energy transition advisor, specialising in energy transition and decarbonisation strategy and targeted research in sustainable fuel systems. I am a chartered engineer, with a background spanning management, strategy and engineering positions in the utilities and petroleum industries, and a PhD in infrastructure issues around renewable fuels and the wider energy transition.

If you are facing similar challenges in decarbonising your systems, let's discuss how we can apply this approach to meet your goals.

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