ALTERNATIVE FUELS: THE FUTURE OF ZERO EMISSIONS SHIPPING

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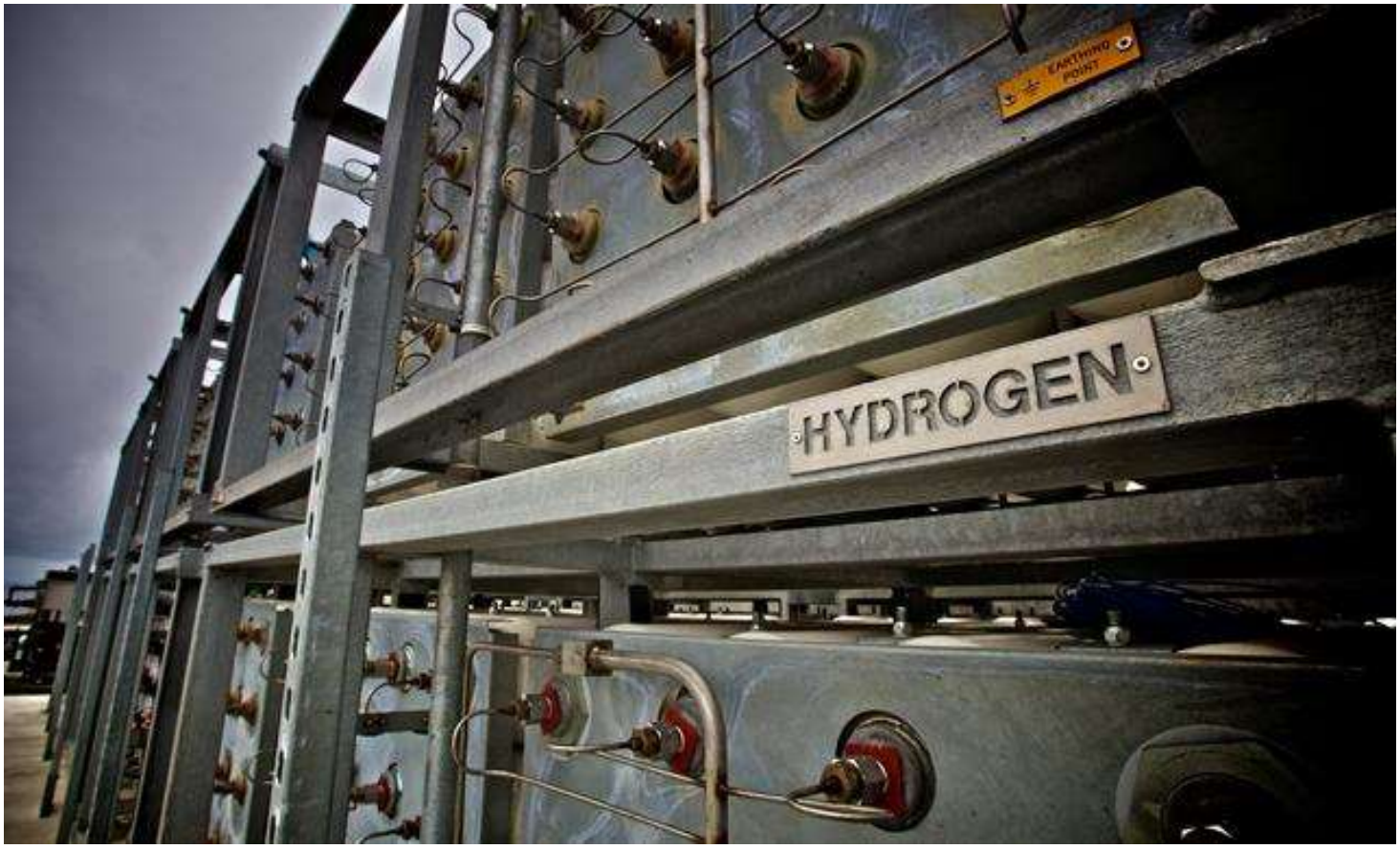

Credit: Colin Keldie, courtesy of EMEC (**www.emec.org.uk**).

New fuels are needed in the shipping sector to comply with limits on sulphur emissions that will apply from 2020. This is causing quite a stir in the industry with some concerned that there will be insufficient supply to meet demand. A recent report, however, is the latest study to confirm that the required changes in the sector can be completed in time – the only question is at what cost.[1]

New fuels will also be needed to comply with the International Maritime Organization's recent agreement to reduce GHG emissions by at least half from 2008 levels by 2050.[2] With the industry depending predominately on highly polluting heavy fuel oil (HFO), meeting both air quality and climate change objectives will require a transition in the market that the industry has not seen for decades. This will shift will be challenging, but it will also create new market opportunities to compete for a share of the USD 98 billion maritime fuel sector.[3]

Already the sulphur content rules, to improve air quality, have led to the increased use of liquefied natural gas (LNG) due to its low sulphur content, cost and high availability.[4] Despite the near elimination of sulphur and high reduction of nitrogen oxide particles, the fuel's GHG emissions results are not negligible due to the high possibility of methane slip.[5] Virtually all analyses highlight the importance of taking into account not only the direct emissions from using the fuel, but also emissions related to the production and transport pathway of that fuel – i.e., its life-cycle emissions.[6]

Other alternative fuels that will be available in the future will be able to tackle both the GHG and air pollution emissions in the maritime sector are methanol, bio-fuel, ammonia and hydrogen. The table below outlines key characteristics of these alternative fuels:

Table: Key Characteristics of Alternative Fuels[7]

Alternative Fuel	*Source*	*Usability: Technology*	*Storage*
Methanol	Mainly natural gas or coal. However, also from renewable resources or synthesised from waste CO2	Internal combustion engine	Liquid form in tank
Bio-fuel	A variety of sources, edible crops, non-edible crops (waste, or crops harvested on marginal land) and algae,	Internal combustion engine.	Liquid or gas form in tank
Ammonia	Natural gas or Water produced using energy derived from fossil fuels or renewable energy[8]	Fuel cell, electric motor, internal combustion engine.	Liquid form at low pressure
Hydrogen	Natural gas or Water produced using energy derived from fossil fuels or renewable energy	Fuel cell, electric motor, internal combustion engine, batteries.	High-pressure gas, or in liquid form (at similar but even lower temperatures than LNG).

The lifecycle emissions from well to propeller of the above alternative fuels varies depending on a number of factors. As the table above indicates, one important factor is the energy source used to prepare the fuel for use. For example, hydrogen can be generated using fossil fuels, in which case its lifecycle emissions are very high but it can also be produced using renewable energy in which case its lifecycle emissions will be low.

The chart below highlights that there is a range of emissions generated throughout the lifecycle of any particular fuel depending on the energy source used to prepare the fuel for use. The lifecycle of biofuel has been calculated for second generation biofuels from waste only, due to first generation biofuels produced from food crops having significant potential land use change CO2 impacts (for example, deforestation of land to produce them or to produce the crops which were being grown on the lands converted to energy crop production). The chart illustrates that when production processes rely on fossil fuels for electricity and source material, ammonia and methanol produce more emissions than conventional HFO. However, the chart also indicates that

ammonia, hydrogen and methanol could be generated at almost zero emissions, if produced using zero emission electricity, sustainable sources (e.g. water), and high efficiency catalysts (e.g. palladium).

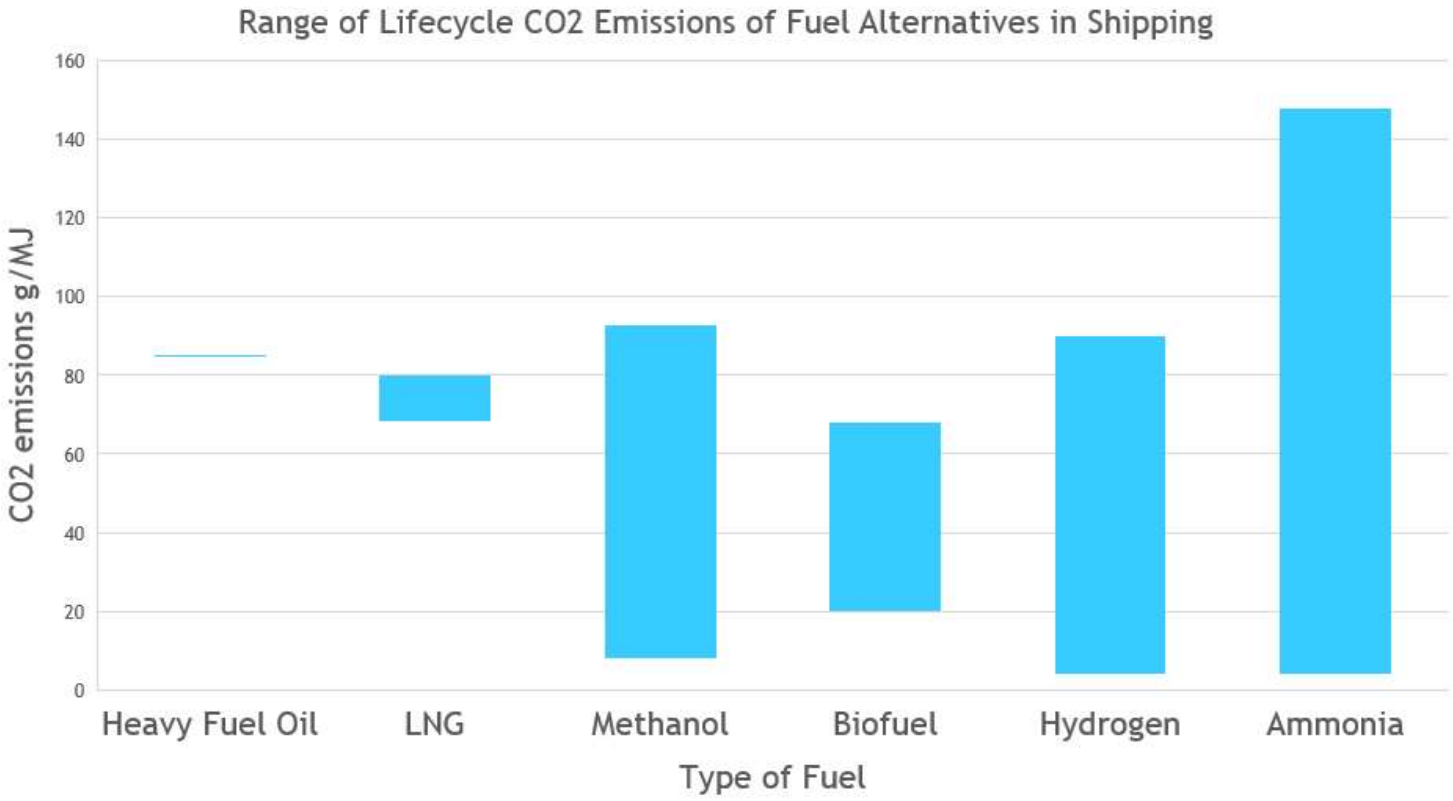

Chart produced internally by EDF using: UMAS, Lloyd's Register, DNV GL. The chart depicts the range of emissions intensity from the different potential fuel types for shipping

The lifecycle emissions of alternative fuels will be subject to change over time, specifically as new fuel development processes emerge that require less energy input. This has already been seen in the production of ammonia, where research has identified an alternative process (palladium catalysis[9]) to synthesise the fuel with drastically less energy input compared to traditional processes.[10]

To address climate change, delivering emissions reductions in the shipping sector, these fuels are likely to be needed in significant quantities. To bring costs down and ensure low impact, high quality supply chains and production processes are used, policies will need to be implemented. In aviation, alternative fuels need to meet a sustainability requirement criteria, and have a default value for life-cycle emissions reduction for each production pathway.[11] The shipping sector should develop similar sustainability criteria ensuring the integrity of the carbon benefits and that social and environmental impacts are taken into account. This sustainability criteria combined with a centralised certification process could establish a minimum threshold (aviation's threshold is 10% greater carbon benefits), reducing the possibility of error bars when calculating real emission reduction benefits. Furthermore, a centralised alternative fuels database hosted by IMO would reduce the possibility of double counting and claiming which has occurred in other fora.[12]

Ship owners adjusting to compliance requirements of the incoming low sulphur rules would be well advised to think carefully about what the next steps for their business are going to be as the need to address climate impacts comes into sharp focus. Planning to over-comply, with a shift to solutions that are both low sulphur and low carbon could pay dividends over time by positioning a shipper as a market leader and by giving it a dominant position in alternative fuels.

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8. Only when produced using renewable energy will this fuel have low life-cycle emissions.

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