Natural gas in ships

Costs/benefits of LNG versus conventional fossil fuels

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Summary

The Commission's 2011 Transport White Paper includes a high-level target to reduce EU CO_2 emissions from maritime bunker fuels by 40% by 2050 (50% if feasible). The 2015 Monitoring Reporting and Verification (MRV) regulation imposes a CO2 reporting requirement on all ships calling at EU ports from 2018. Emission Control Areas (ECAs) to reduce SO_x emissions from shipping have been established in the Baltic and North Seas and the English Channel. But there are no engine emission standards for particles (PM) and very lenient ones on engine NO_x.

In this situation of dirty fuels and inadequate engine emissions controls, using Liquefied Natural Gas (LNG) offers clear air pollution benefits. However, any greenhouse gas (GHG) emissions advantages are highly dependent on 'methane slip' – unburnt gas released into the atmosphere during LNG production and distribution and vessel operation. Measures to control methane slip should therefore be taken.

The consultants did not specifically investigate the use of LNG in polar waters notably the Arctic, but a mandated shift away from oil products towards gas would go a long way in addressing the most pressing environmental concerns of Arctic shipping – oil spills and black carbon emission deposited on the ice.

T&E is of the view that the use of public funds should be limited as much as possible; after all, this would constitute another subsidy for the use of (predominantly) fossil fuels. Standards and mandates respect the polluter pays principle much better.

1. Impacts on greenhouse gas emissions

To understand what role natural gas could have in reducing ship emissions in Europe, Transport & Environment commissioned a study from Ricardo Energy & Environment to examine the cost impacts and environmental effectiveness of the large-scale use of natural gas in shipping. The study found that there is some potential for reducing GHG emissions from shipping through the use of natural gas, but reductions achieved can be counteracted by methane slip in the production, distribution and on board combustion phases. The Global Warming Potential (GWP) of methane is 30 times that of CO_2 and there are large variations and uncertainties in emissions.

The study looked at the environmental impacts of using LNG in shipping compared to conventional fossil fuels using combined "well to tank" (WTT) and "tank to wheel" (TTW) analysis i.e. well-to-wake (WTW) GHG emissions. Well-to-wake greenhouse gas emissions are highly dependent on methane slip. If 1.8% of the gas is assumed to slip, well-to-wake GHG emissions of LNG ships 1-10% lower than ships running on Heavy Fuel Oil (HFO) or Marine Gas Oil (MGO). However, under a 3.5% methane slip assumption, total well-to-wake emissions of LNG ships are 0.3-9% higher than those of MGO and HFO ships.

These findings indicate that LNG in shipping may currently not reduce GHG emission at all, or only marginally under positive assumptions on methane slip. But technically more is possible; if the sector would use best available technology to control methane slip, overall well-to-wake GHG emissions of LNG could be 12%-27% below that of HFO and MFO. Wider research has shown that the overall long-term impacts of a

fleet-wide shift to LNG could be significant in terms of the length of time it might take for LNG vessels to achieve climate neutrality compared to conventional vessels powered by HFO and MGO. This research found that using LNG as a fuel for the shipping sector could achieve climate neutrality within 30 years for ships powered by compression ignition, dual-fuel LNG engines, but that for mono-fuel spark ignition LNG ships, it could take up to 190 years to achieve climate parity with conventional marine fuels. This is using the concept of Technology Warming Potential (TWP).

2. Infrastructure and capital costs

Widespread uptake of LNG fuelled ships would require the development of infrastructure, including terminals, and LNG storage facilities (with/without liquefaction capabilities). Currently, most production plants and LNG import terminals are designed to service full sized LNG carriers and are not equipped to serve smaller vessels, or to frequently receive ships. Existing LNG terminals would therefore require modification to refuel ships. LNG can also be supplied by trucks, provided the volumes required are relatively small. The costs of LNG terminals for ship refuelling can be high. Taking into account different scenarios, the study cites average infrastructure costs of €170 per tonne of LNG in the cost analysis compared to 10 €/tonne for existing HFO and MGO infrastructure. This is a very significant difference; if it is funded from the public purse it constitutes another fossil fuel subsidy.

3. Air pollution impacts

LNG burns significantly cleaner than MGO or HFO, producing negligible sulphur or particle emissions and drastically lower NOx emissions per unit of fuel. As such it is one of the options to comply with ECA requirements. Shifting to LNG-powered vessels from either HFO or MGO fuel types can reduce NOx over 80%, SOx by over 90%, and PM by over 95%. These large differences mean that even at today's low oil prices, an LNG ship sailing in the North Sea (i.e. close to densely-populated shores) offers net benefits to society of €0.7-2.6m per year compared with ships using MGO. However, LNG vessels operating in the North East Atlantic do not offer benefits in terms of social costs at today's fuel prices.

The study found that whilst LNG-fuelled ships have higher capital costs than HFO-fuelled ships equipped with scrubbers and MGO-fuelled ships, there can be economic benefits to operators but these benefits are very sensitive to shifts in fuel prices. In particular, at current fuel prices, for most vessel types there would not be any economic benefits to operators in shifting to LNG because the annual fuel costs for LNG ships would be higher than for HFO and MGO-fuelled vessels.

4. Arctic

The study does not quantify the use of LNG in the Arctic, but clearly a requirement to use LNG in the Arctic would go a long way in addressing two of the greatest environmental concerns related to using oil predicts in this region: spills and black carbon deposition on ice.

Further information

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