【欧州】【海事】

Utilisation of LNG: New study investigates the potential of LNG to reduce GHG emissions and air pollution from ships and trucks

Andrea Antolini　Former Researcher JTTRI

【概要：Summary】

The reduction of pollutants like SOx or CO2 emissions will have an ever-increasing priority in order to achieve a sustainable maritime transport and shipping industry. However, shipping emissions are still expected to grow significantly in the next decades, based on the further increasing demand for the movement of goods. The problem is that the increasing demand for long distance goods transportation creates major difficulties for decarbonising the maritime transport sector.

In maritime transport, the European Commission still considers Liquefied Natural Gas (LNG) being one of the alternatives fuels. It has the advantage to reduce the sulphur emissions in maritime transport and it is in particular suited for long-distance transport. However, LNG requires large-scale investments and it still lacks of infrastructure facilities for bunkering LNG in major EU ports and it is costly to retrofitting vessels, among others. Furthermore, it is not entirely clear whether LNG is a solution for maritime transport regarding its potential to reduce GHG emissions. In the past years, several studies have presented mixed results on the question whether LNG is a suitable alternative fuel for maritime transport for the reduction of GGH emissions. One of the major advantages for LNG in maritime transport is the achievement of lower sulphur emissions to reach compliancy with SECA zone requirements. However, natural gas seems to be largely ineffective for achieving a reduction of GHG emissions due to the methane slip during production, bunkering and at the engine. Consequently, the problem of methane slip needs to be tackled otherwise the utilisation of LNG in maritime transport could even increase GHG emissions relative to conventional fuels.

【記事：Article】

The EU transport sector's share of total GHG emissions is still more than 20% and still increasing. Also maritime transport has to improve its sustainability. The European Commission has proposed electricity, hydrogen, biofuels, but also liquefied natural gas (LNG), and liquefied petroleum gas (LPG) as alternative fuels in its "Clean Power for Transport: A European alternative fuels strategy". Regarding maritime transport, the utilisation of LNG is seen as an alternative to fossil fuels. In particular, LNG is considered an alternative fuel for maritime transport because of its low sulphur and NOx emissions and it is in particular suited for long-distance transport and for compliance with the global sulphur limit in 2020. However, its deployment in the shipping industry is still difficult due to a lack of infrastructure for bunkering LNG, also in the EU. In fact, the most critical aspect of the deployment of LNG as shipping fuel is the financing of LNG infrastructure.

Furthermore, it is not entirely clear whether LNG is a solution for maritime transport as the environmental advantages seem to be fewer than

anticipated when considering the LNG's potential to reduce GHG emissions. In recent years, some studies have pointed out the very limited advantage of LNG as alternative fuel with respect to a reduction of GHG emissions. The Transport and Environment (T&E) environmental NGO but also the US Maritime Administration (MARAD) presented study results that questioned the benefits of the utilization of LNG in the transport sector and also in maritime transport regarding the reduction of GHG emissions. The T&E commissioned study of Ricardo Energy & Environment concluded that the only sector in which the increased use of natural gas could have air pollution advantages is the shipping sector. At the same time, this implies that it has not enough positive effects in other sectors, including road transport. LNG is less polluting regarding SOx, NOx and PMs than other fossil fuels and this is the reason why the utilisation of LNG as alternative fuel in maritime transport has benefits in emission control areas (ECAs). However, the LNG powered vessels'GHG emissions'benefits are highly dependent on controlling and eliminating the methane slip at the production, distribution and operational levels of LNG.

Also the study commissioned by the U.S. Department of Transportation Maritime Administration (MARAD) in November 2015 came to the result that the methane slip during LNG bunkering operations and from ships that use LNG as fuel can undermine -- and in some cases even negates -- the overall GHG emission benefit of LNG over conventional oil-based fuels.

In 2018, the *University Maritime Advisory Services UMAS* published a report entitled"LNG as a marine fuel in the EU. Market, bunkering infrastructure investments and risks in the context of GHG reductions" on the impacts of utilisation of LNG as marine fuel in the EU. UMAS found that if the methane slip is well controlled there are clear advantages of LNG compared to conventional fuel. However, in the case of spark ignited LNG systems, methane slip is more significant, and can actually negate the advantages of the LNG system. The second important finding is that routine bunkering leakages can have a disproportionate impact on overall GHG emissions due to the high volume of natural gas throughput. The UMAS report also concludes that while LNG has benefits for reducing the local and regional air pollution, it has little to no benefits on climate change regarding the levels of GHG emissions. Consequently, the UMAS report stated that Europe should back future-proof technologies that would deliver the much greater emissions reductions, including portside charging or liquid hydrogen infrastructure rather than heavily investing into LNG-refuelling capacity for maritime and inland shipping. The utilisation of LNG in shipping would only yield GHG emission reductions ranging from 6% to 10%. Therefore, also the UMAS report comes to the conclusion that LNG is not a bridge fuel, but an expensive deviation that will make it harder for the EU to achieve its shipping climate goals.

On 28 January 2019, the Sustainable Gas Institute (SGI) at Imperial College London released a whitepaper entitled "Can natural gas reduce emissions from transport? Heavy Goods and Shipping". However, also in this study, the conclusion remains that a switch to LNG might not be sufficient to meet a 50% GHG emissions reduction target for the shipping industry by 2050. Therefore, also the SGI study, as other studies before, sees the danger of limited potential to reduce GHG emissions by utilisation of LNG.

Nevertheless, the SGI study, in contrast to the other studies, concludes that while the value of natural gas as a transport fuel is dependent on maximising the GHG and air pollution benefits, it is essential to understand to which extent natural gas can usefully contribute to GHG emissions reduction.

The SGI study concludes that natural gas as a transport fuel has the potential to reduce GHG emissions in trucks and ships by around 16% and around 10%, respectively, relative to heavy fuel oil in ships comparing lowest estimates of lifecycle emissions. GHG emissions from trucks or ships vary given differences in engine efficiency, methane slip through the exhaust, engine and fuel system methane emissions and supply chain emissions. Air pollution

emissions can be reduced significantly in shipping by switching to natural gas and air pollution benefits in trucks are reduced given improvements in modern diesel engines. NOx emissions from spark ignited natural gas engines may be reduced by up to 80%, though emissions from dual fuel engines may be higher than diesel vehicles. Lowest NOx emissions are typically achieved on motorway driving cycles, with urban driving cycles leading to higher emissions for natural gas vehicles.

In ships the utilization of LNG can reduce NOx emissions by about 90%, SOx emissions by about 90% and particulates by up to 98% against the average heavy fuel oil ships. However, global GHG emissions reductions from natural gas trucks and ships may not be sufficient to meet global emissions goals alone.

The value of natural gas as a transport fuel in the future is therefore dependent on maximising the GHG and air pollution benefits it provides. Also this SGI study concludes that supply chain emissions, relatively lower efficiency in gas engines, and methane emissions can all reduce the GHG emissions reduction potential of natural gas. The constrained level of emissions reduction available in natural gas engines also indicates the need for a wider range emissions reduction measures in order to meet longer-term emissions reduction goals.

In shipping, natural gas engines, in combination with ambitious energy efficiency improvements, might achieve the required GHG reduction, potentially reducing these by 35% relative to 2008 fleet emissions. However, even assuming very challenging rates of efficiency improvement it appears difficult to meet a 50% GHG emissions reduction target by 2050 using natural gas engines and ship efficiency improvements alone.

The challenge will therefore be to understand the extent to which natural gas can contribute to emissions reduction and at what point in the future lower emissions fuels should be used to achieve higher GHG emissions reductions. Considering the limited benefits of the utilisation of LNG, global goals for GHG emissions reduction will likely require trucks and ships to adopt a combination of options, including efficiency measures, after-treatment technologies and fuel switching to low carbon fuels such as biofuels or hydrogen fuel cells.

References:

https://www.manifoldtimes.com/news/d/study-challenging-for-lng-to-meet-2050-emissions-reduction-target, 30 January, 2019

https://www.sustainablegasinstitute.org/wp-content/uploads/2019/01/SGI-can-natural-gas-reduce-emissions-from-transport-WP4-1.pdf?noredirect=1, 28 January 2019

https://www.manifoldtimes.com/news/d/study-challenging-for-lng-to-meet-2050-emissions-reduction-target