EU marine LNG infrastructure – Expensive Diversion

USD 22bn+ for at best 6%, possibly no - GHG savings from LNG

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Summary

Europe has spent half a billion USD on LNG fuelling/bunkering infrastructure for shipping, almost half being from taxpayers with no corresponding significant GHG reductions. In a scenario where LNG uptake is further incentivised, this would cost Europe an additional USD22+ billion up to 2050, with at best a 6% (likely lower bound) to 10% reduction of GHG compared to replaced diesel fuel and all this under an optimistic methane leakage scenario. This level of potential GHG savings will likely be cancelled out in absolute terms because of the growth of maritime trade. Should methane leakage rates be higher, a switch to LNG could actually increase GHG emissions compared to the diesel fuel it replaces before even considering the growth in maritime trade. Europe would be better off spending taxpayers' money on future proof technologies that would deliver real GHG savings, including port-side electrification and liquid hydrogen bunkering infrastructure in European ports. EU Directive 2014/94/EU mandating LNG bunkering infrastructure must be revised as a matter of urgency to help ensure this happens.

1. Context

The signatories of the Paris Agreement (PA), including the European Union, and its member states, have stated a long-term goal of keeping the increase in global temperatures well below 2°C compared to pre-industrial levels, whilst also aiming at limiting this increase to 1.5°C. If the commitments under the "Paris Agreement" are to be met, all sectors, including maritime and inland shipping should contribute their fair share to the overall global emission reduction efforts.

Global shipping emits around 1000 million tonnes of CO2 every year, accounting for 2-3% of total anthropogenic emissions in 2012. Without additional action, the sector could account for 6-14% of global emissions by 2050 (IMO, 2015).

In aiming to contribute shipping's fair share to the Paris Agreement, the International Maritime Organisation's (IMO) Initial GHG Reduction Strategy, adopted in April 2018, commits the sector to reduce total GHG emissions by "at least" 50% by 2050 from 2008 levels, whilst pursuing efforts to decarbonise in line with the Paris temperature goals. The European Union has stated in its 2011 White Paper the intention to cut maritime emissions by 40% (if feasible 50%) by 2050 compared to 2005 levels.

The debate around maritime decarbonisation has led some industry leaders and policy-makers to consider liquid natural gas (LNG) as a potential alternative to conventional heavy fuel oil (HFO) and marine gas oil (MGO). Within the maritime shipping industry, LNG has come to be considered as an alternative fuel option, partly due to its perceived environmental benefits. LNG can lead to a net decrease in SOx of up to 100% and of NOx emissions up to 90% compared to HFO.

A significant legislative contribution to the promotion of LNG as a marine fuel with both lower air pollution and perceived carbon reductions came with the adoption of the EU 'Alternative fuels directive' (Directive 2014/94/EU) in 2014. The EU has been aiming to increase its usage of alternative fuels in transport for almost a decade since Directive 2009/28/EC set the market share target for alternative fuels at 10%.

Directive 2014/94/EU obligates member states to make available bunkering infrastructure for LNG as a marine fuel in their territory and allows this to be funded principally through the CEF (Connecting Europe Facility) which replaced the TEN-T funding facility in 2014. Funding is also available through the Horizon 2020 programme, but with a higher emphasis on research and innovation rather than infrastructure construction; and through regional and national level funding programmes. Additional financing is available under the European Fund for Strategic Investments and the EIB (European Investment Bank) (Figure 1).

Through the mentioned funding sources, the EU has created a regulatory obligation for the development of an LNG bunkering infrastructure network along the TEN-T core shipping and inland waterway corridors. In addition, it could be argued that Directive 2014/94/EU opens the door for the funding of significant LNG marine bunkering infrastructure beyond the core TEN-T networks contingent on future LNG demand.

To better understand the impact of LNG as marine fuel on sectoral GHG emissions reductions, as well as shipping infrastructure costs in Europe, T&E commissioned a study from UMAS.

2. GHG impact of using LNG under different scenarios

The study analyses LNG related shipping GHG emissions and infrastructure costs under 4 different scenarios:

BAU - The BAU scenario assumes the continuation of existing environmental regulatory arrangements (i.e. MARPOL commitments: EEDI, SOx and NOx regulations), but no further GHG policy developments such as a global MBM for shipping, measures to deliver immediate emissions reductions or those pursuant to the recently agreed IMO commitment to reduce shipping CO2 by at least 50%.

High Gas – This scenario assumes that the world is limited to a 2ºC (but not well below 2ºC or a 1.5ºC) carbon budget, with a global MBM implemented from 2025. In terms of fuels, this scenario assumes low bioenergy availability, low LNG prices and no hydrogen availability.

Transition – Similar to the high gas scenario, the transition scenario derives the carbon budget from the 2°C temperature scenario; MBM start date is assumed to be 2030. Biofuels market penetration into shipping is low; LNG is more expensive than High Gas scenario; hydrogen is available as an alternative fuel.

Limited gas - The carbon budget in shipping is derived from the 2°C target; MBM start date is set for 2030; biofuels market penetration into shipping is mid-range. The LNG price is higher than in the High Gas Scenario, which still allows for a relatively high initial take-up of LNG as a marine fuel. However, unlike in the High Gas Scenario, hydrogen is available as an alternative.[1]

The study then calculates the total amount of LNG emissions in each scenario. The total GHG emissions for each LNG scenario can then be compared (using the emission factors for HFO, MDO, LSHFO) to currently available fuels to obtain a broad understanding of the potential total abatement achievable by switching to LNG as a marine fuel.

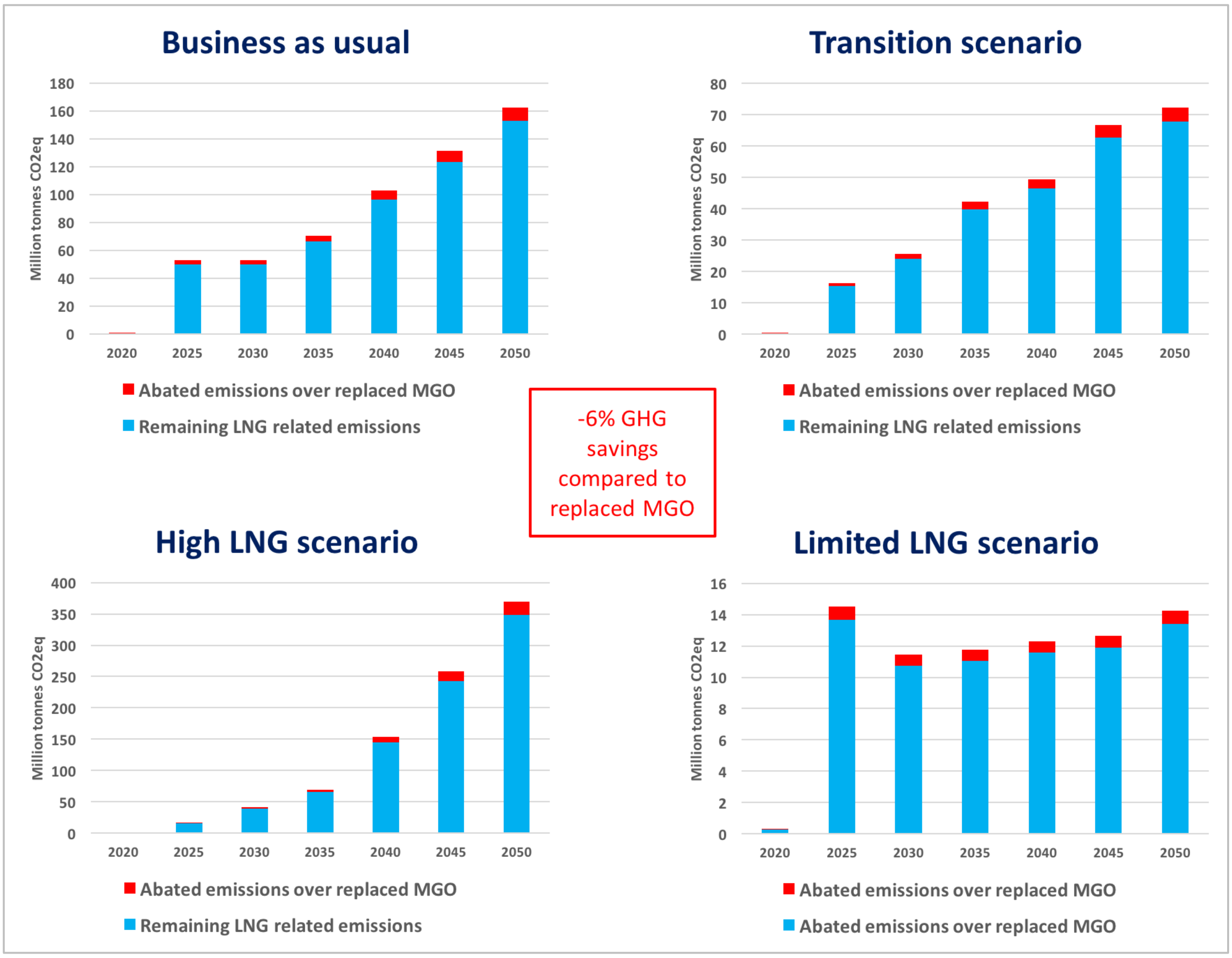
Figure 1, shows that under our base-case assumptions on emission factors for LNG and conventional maritime fuels (HFO, MDO, LSHFO), switching from diesel-based fuels to LNG under the four different scenarios could result in a relative GHG abatement ranging from 6 to 10%. The lower bound corresponds to LNG replacing MGO, while the upper bound corresponds to LNG replacing HFO/LSHFO (because MGO

[1] Further details of the scenarios can be found in the study.

has a lower carbon intensity per unit of fuel consumed than HFO). Given that MGO is expected to be a more expensive fossil liquid fuel, it is likely that LNG would replace MGO instead of HFO/LSHFO. Consequently, LNG related GHG abatement will more likely correspond to the lower bound (i.e. 6%) of the above-mentioned range.

In absolute terms, a cumulative range of 23-458 MT CO2eq could be abated in the period 2015-2050 under the four above-mentioned scenarios by switching from diesel fuels to LNG.[2] This abatement is relatively small, and does not constitute a significant "fair share" contribution by shipping to global climate goals without carbon market linkage with other sectors.

Fig. 1: Abated and remaining EU maritime GHG if a share MGO is replaced with LNG (excl. GHG from remaining MGO/LSHFO)



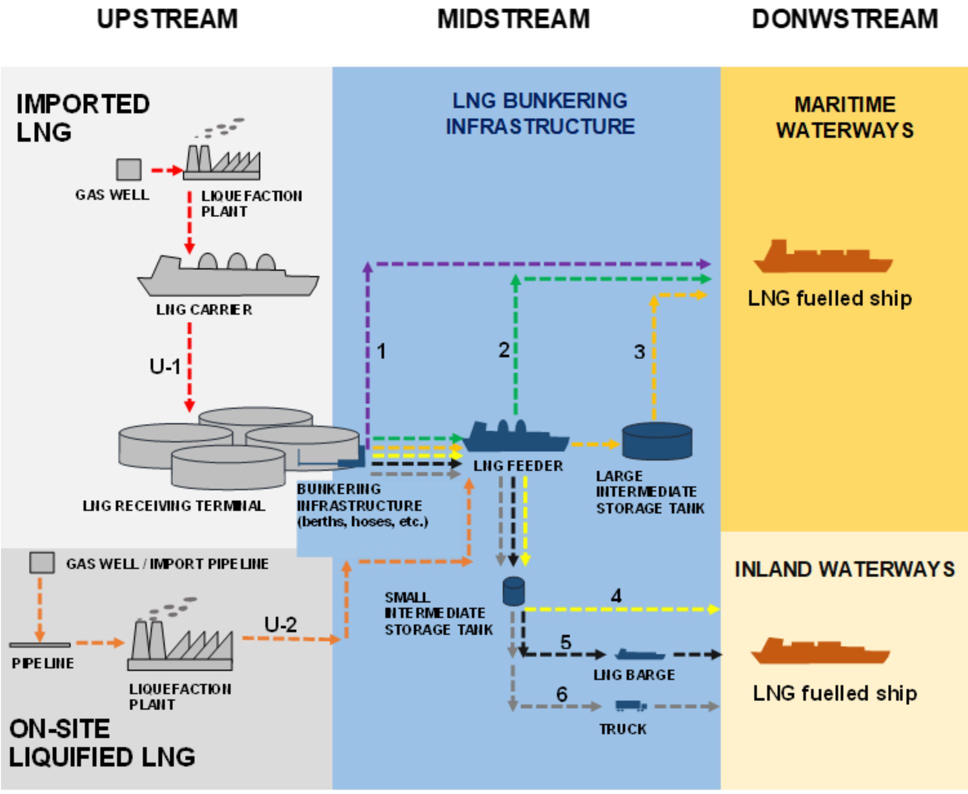
In addition, this analysis also shows clearly that a switch to LNG alone would mean Europe falling well short of its stated intention of decreasing emissions by 40% by 2050 compared to 2005 levels. To achieve this goal, the widespread uptake of another alternative fuel (e.g. hydrogen) would be necessary. In addition, a significant amount of uncertainty remains surrounding the level of methane slip from LNG, and a slightly higher level than estimated in the study could adversely affect the abatement numbers in Fig. 1.

[2] This range includes potential GHG reductions relative to both MGO and HFO/LSHFO.

3. Maritime LNG bunkering Infrastructure costs

Figure 2 illustrates that this analysis of LNG bunkering infrastructure is centred on the costs of the 'midstream' LNG bunkering infrastructure. These are costs associated with delivering LNG from import hubs (i.e. large LNG import terminals or domestic liquefaction plants) to the end-consumer (LNG fuelled vessels). The costs include all the associated capital and operating expenditures relating to this process.

Fig. 2: Likeliest LNG bunkering pathways for maritime and inland waterways



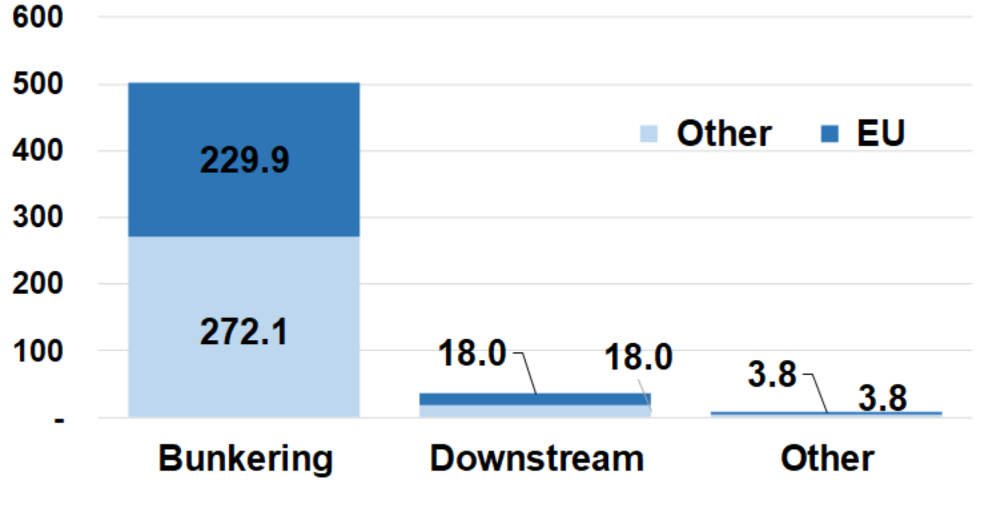
Based on the total projected amortized CAPEX to be spent on marine bunkering infrastructure, the EU member state funding share has been estimated. Many uncertainties are associated with such an estimation. Firstly, there are several different funding schemes that can constitute EU member state funding under Directive 2014/94/EU. These include CEF, regional and national funds in the form of grants, all of which could potentially fund a different share of the overall cost of various bunkering projects. This study estimates the proportion of EU bunkering infrastructure capital costs to be funded publicly by EU and member states at 45%. This figure is based on a literature review of all historical and existing TEN-T and CEF projects that mainly fund activities surrounding the development of LNG as a marine fuel. The figure was calculated based on the average EU funding share for the listed projects.

Table 1: Estimated share of future EU and member state investments into LNG bunkering infrastructure (million $)

Funding:	"BAU"	"High Gas"	"Transition"	"Limited Gas"
Private funding:	4,296	11,055	2,002	957
EU-2050:	4,763	9,992	2,486	1,028
EU-2025/30:	1,525	1,158	1,036	952
Total:	10,584	22,205	5,524	2,937

To date, it is estimated that a total of around $500 million has been invested in the EU through TEN-T and CEF funding for marine LNG bunkering infrastructure projects. It is estimated that around $220m is from EU public funding sources and the remainder from other sources (including private sources).

Fig. 3: Historical TEN-T and CEF funding for marine LNG projects (mln $)



4. Conclusions

By considering LNG as achieving abatement of CO2eq relative to diesel based fuels through their substitution, the total cumulative abatement in the decarbonisation scenarios varies between 23 and 460 million tonnes, over the period 2015-2050, depending on the scenario and assumptions on the baseline fuel. The abatement cost associated with LNG infrastructure, is estimated at between 51 and 85 $/t of CO2eq abated, depending on the scenario. The highest abatement cost is associated with the "limited gas" scenario.

If investments in LNG infrastructure are made expecting the development of a large LNG market, but in fact the market follows the "transition" or "limited gas" scenarios which assume a high level of penetration of non-fossil fuels in shipping – as compliance with the Paris agreement will require - then significant numbers of infrastructure assets (feeders, barges and storage tankers) will become redundant prematurely. Financiers would be likely to incur significant negative cashflows in the period out to 2050.

If we consider the higher levels of ambition, including 100% decarbonisation by 2050, which the future revision of the IMO GHG Strategy will consider, establishing a significant market for LNG becomes even more challenging. These higher levels of ambition in combination with any significant growth of LNG investment in the short-term, will increase the stranded asset risks as set out in this study. The EU Directive 2014/94/EU, which mandates LNG bunkering infrastructure in European ports and allows public financing of these infrastructure, must therefore be urgently revised in order to remove investment in LNG bunkering infrastructure as a regulatory obligation.

Given that the study does not include investment (new build, retrofit) in LNG-powered ships themselves, the level of stranded assets from any large scale switch to LNG would likely be larger for the maritime sector as a whole.

Further information

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