IMO Pushing Shipping Industry Innovation and Potential LNG Adoption

The shipping industry has a big impact on global air pollution. In fact, in coastal regions like Hong Kong, marine shipping is responsible for 48% of SO2 emissions, 32% of NOx emissions, and 36% of particulate matter.[i] It's no surprise, then, that new regulations are looking to squeeze as much of this pollution from the shipping industry as possible, with significant implications for ship owners and fleet managers. While many approaches have been suggested for meeting these new regulations, many are pointing to liquid natural gas (LNG) as the new fuel of choice in the shipping industry. Whether or not this fuel can take the place of heavy oil and other fuels depends on many important factors that we'll discuss here.

Overview of the IMO Marpol Annex VI Tier III Regulations

The International Convention for the Prevention of Pollution from Ships (MARPOL) has undergone several amendments, the most recent of which is the Annex VI, which covers the regulations for the prevention of air pollution from ships. MARPOL, which comes under the auspices of the International Maritime Organization (IMO), the UN shipping agency, was ratified by 53 countries including the United States – a group that represents 81.88% of the world's tonnage.

The purpose of Annex VI amendments, which were adopted in October 2008, is to introduce new fuel quality requirements, Tier II and III NOx emission standards for new engines, and Tier I NOx emissions standards for existing pre-2000 engines. The revised version of Annex VI entered into force on July 1, 2010 and is applied in one of two ways. First, there are global emissions standards, and second, there are more stringent emissions standards for areas called Emission Control Areas (ECAs).

Each ECA can be designated for SOx, NOx, PM, or all three types of emissions reductions. To date, four ECAs have been designated around the world. The first is in the Baltic Sea where SOx emissions have been regulated since 2005. The second is in the North Sea where SOx emissions have been regulated since 2005/2006. The third exists in North America and includes most of the coastlines of both the US and Canada, with regulations for both NOx and SOx emissions, which were implemented in 2010/2012. Finally, there's an ECA in the US Caribbean (Puerto Rico and the US Virgin Islands included) where NOx and SOx emissions are also regulated (2011 and 2014).

The MARPOL Annex VI also introduced greenhouse gas emissions reduction measures. Additionally, the US, Canada, and many European countries have introduced emission control areas in their territorial waters, which will have a significant impact on shipping over the next 10 years.

Under Annex VI, Tier III NOx emissions limits for ECAs will come into effect in 2016 for all diesel engines, are measured in g/kWh, and depend on the engine's maximum operating speed (n, rpm). So, with an operating speed less than 130, the limit is 3.4 g/kWh; for speeds between 130 and 2,000, the limit is $9 \cdot n^{-0.2}$; and for speeds greater than 2,000, the limit is 1.96.

Technologies appropriate for managing NOx emissions include exhaust gas recirculation, selective catalytic reduction, and liquefied natural gas. It is important to note that Tier II standards are in effect for all areas outsides of ECAs.

SOx emissions are regulated somewhat differently in that reductions are achieved by setting caps on sulfur content of fuel oil. This has the knock-on benefit of also reducing PM emissions (there are no emissions limits for particular matter as such at this time). So, under Annex VI, fuel sulfur limits in ECAs is currently limited to 1% and must be reduced to 0.1% by 2020. Globally in non-ECA areas, fuel sulfur currently cannot exceed 3.5%, and it must be reduced to 0.5% by 2020.

There are several approaches to reducing sulfur content of fuel oil, with scrubbers being the most popular. That said, heavy oil is still permitted provided it meets the sulfur limit standards.[ii]

The Pros and Cons of Introducing LNG as a Shipping Fuel

The industry is already in the process of adjusting to the changes that Annex IV standards will require within the shipping industry. Many are exploring the possibility of switching to LNG as a way to go beyond the Annex VI Tier III requirements, but detractors have rightly recognized that many hurdles will have to be overcome before LNG becomes the fuel of choice within the industry.

LNG provides advantages over many other types of fuels to address these requirements. For instance, LNG as a ship fuel would come close to meeting NOx emissions compliance levels, offering an 85% to 90% reduction. For SOx, there would be between 90% and 95% fewer emissions with LNG. Not only that, but

liquid natural gas reduces carbon dioxide emissions by 20% to 25% for further savings.[iii]

Other technologies do not offer such substantial results. For instance, Exhaust Gas Recirculation (EGR) produces only 40% to 50% reductions in NOx and a 70% reduction in particulate matter.[iv]

There are also financial benefits associated with a switch to LNG for seagoing vessels. For instance, though at this point marine gas oil (MGO) will be required within Emission Control Areas (ECAs), if no other technical improvements are made for reducing SOx emissions, liquid natural gas should be less costly than MGO while solving the SOx problems. In fact, LNG prices in the US and many European countries is so low based on energy content at this point that it may even reach heavy fuel oil (HFO) prices. This may be possible even after small scale distribution costs associated with LNG are taken into consideration.

In a recent study comparing the use of LNG to the installation of scrubbers, liquid natural gas fared far better both in terms of emissions reductions and costs. This is due to three factors: the investment costs for a new LNG tank system, the price difference between LNG and HFO, and the ability to share the operation inside an ECA.[v]

There are other technologies offering various benefits for meeting the coming regulatory requirements, but none with such holistic advantages. For instance, SCR technology has the downside of potentially increasing carbon dioxide emissions and is sensitive to SOx. Scrubbers, on the other hand, emit extra CO2 emissions, cool down exhaust gases (where wet technology is used), and are still in the development stages with several technical issues yet to be resolved. As such, LNG offers a cost-effective solution for the short and medium term until some of these other technologies can be brought to maturity.

There are still yet other challenges to be overcome in the transition to LNG in seagoing vessels. The shipping industry is an old one with established infrastructure and systems that have stood the test of time. Shifting the industry to a new fuel will take effort and perseverance for many reasons.

To begin, bunker fuels have dominated the market in the shipping industry for some time, which will create tension if the industry attempts to make a widespread shift.

Logistical matters must be considered. For starters, most ports do not possess the infrastructure to allow ships to take LNG as a fuel. Capital investments are required at these sea transportation hubs in order to ensure sufficient fitting ports can enable such a transition. The high capital cost of investing in LNG fuelling facilities has not garnered a lot of attention from investors in the oil and gas industry, which is one of the reasons the demand for LNG for shipping has been slow to rise.

Additionally, investments will need to be made into a fleet of support LNG-powered ships. This notion is not being met with much enthusiasm in today's market due in large part to the fact that there is currently an over-supply of non-LNG vessels in the industry. The slow economic environment no doubt also plays a role.

Not surprisingly, in regions where ECAs are already planned or in place LNG has already been introduced. This is true in Australia where LNG-fueled support boats and port tugs have been introduced; as well as regions as diverse as Sweden, Belgium, the Netherlands, and Singapore where LNG bunkering infrastructure is already being developed.[vi] But for the rest of the world, LNG remains a question.

Conclusion

Many large companies – ExxonMobil, Chevron, and BP, for instance – have made commitments to increase their use of LNG as a transport fuel, but few have made any significant moves on that front. According to Lloyd's Register, the use of LNG as a shipping fuel will only start to really ramp up until 2019 and beyond, liquid natural gas accounting for only 3% to 8% by 2025 of bunker fuel demand.[vii] From there, it is uncertain as to LNG's future in shipping. Will it take its place in marine shipping as a fuel leader or are there too many hurdles to overcome? Time will tell.

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