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Global potential of small-scale LNG distribution

A quick scan study

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Background

The Netherlands Organisation for applied Scientific Research, TNO performed a study in order to have a first impression on the potential volumes of LNG that are associated with the development of a Small Scale LNG LNG supply chain on a global scale in the future (2025).

During the last ten years, the application of natural gas as a transport fuel has become increasingly popular. Direct use of LNG, instead of compressed CNG, helps to extend the driving range of vehicles. This makes LNG an attractive fuel for shipping and (large) heavy-duty trucks, and a clean alternative for diesel. The essential supply chain for alternative applications of liquefied natural gas is commonly referred to as 'small-scale LNG' distribution (SSLNG), this way distinguishing it from the traditional large-scale intercontinental LNG transport. The International Gas Union (IGU) defines small-scale liquefaction and retail as facilities with a capacity of under 1 million ton of LNG per annum. Currently, small-scale LNG distribution infrastructure is under development in many countries for different transport segments. Its growth potential is still uncertain. The study concentrates on SSLNG off-take (retail) volumes for the pre-identified segments heavy-duty vehicles, the maritime sector and a specific part of the (stationary) electric power generation segment. The SSLNG liquefaction market is not addressed in this study.

The Netherlands has available large reserves of natural gas. The Netherlands Enterprise Agency RVO, aiming to improve opportunities for entrepreneurs, therefore has taken an interest in the potential of LNG and asked TNO to perform a quick scan study on the global potential of small-scale LNG.

Aim of the study

The goal of this quick scan study is to determine the potential global market volumes for small-scale LNG in the period 2015-2025. The study concentrates on SSLNG off-take (retail) volumes for the pre-identified segments heavy-duty vehicles, the maritime sector and a part of (stationary) electric power generation segments. The latter segments are chosen as relevant markets for substitution of conventional fuels (Fuel-oil) for LNG, typically supplied in smaller quantities than traditionally has been done.

In other words, the study identifies which retail LNG business cases (segment per region) are potentially attractive in terms of volumes and growth rate. Because of the limited scope of this project, recommendations will point out where additional market surveys are needed and opportunities can be expected. Also, it signals hurdles that are likely to be encountered.

The International Gas Union (IGU) defines small-scale liquefaction and retail as facilities with a capacity of under 1 million ton of LNG per annum (1 MTPA)[1]. 1 MTPA is the typical yearly consumption of 25,000 long-haulage trucks or one 200 MW electric power plant. This study addresses only the retail of LNG.

[1] 1 Million Tons of Oil Equivalent (MTOE) per annum = 0.854 MTPA-LNG based on ratios of Lower Combustion Values.

Research approach

The approach was based on the following steps. Firstly, the current conventional fuel volumes for the relevant substitution segments for SSLNG was determined. Secondly, describe the main drivers influencing the LNG uptake was described after which, thirdly, the LNG market shares in the future were estimated and the potential SSLNG volumes were calculated. This approach considers technical and economical independent variables, such as technical feasibility of applications, lifetime of vehicles and ships and fleet expansion rates. It does not consider future fuel price estimations. This approach is taken since fuel prices are quite dependent on other factors besides the potential volumes and availability.

Relevant markets for small-scale LNG substitution are selected by evaluating conventional fuel consumption projections per segment from key studies. It shows that the truck market is the largest relevant substitution market for small-scale LNG, reaching a fuel volume of about 62% of the total identified small-scale LNG substitution market volume in 2025. Global maritime fuel consumption, amounting to a share of 17% of fuel volume, is a sizeable market. It will become especially interesting after 2020 or 2025, when global fuel sulphur requirements will be lowered to 0.5%. Shipping in ECA (Emission Control Areas) is a small but important segment, because of the stringent environmental requirements. The oil-fuelled electric power generation market is with 17% of the identified LNG volume relatively large as well.

Results

For road transportation, fuel cost is the main driver which is strongly dependent on excise taxation. Stringent pollutant emissions requirements such as Euro VI and US 2010 can relatively easily be met with natural gas depending on the engine technology, but also for diesel fuel the emission control technologies are well developed. One of the main drivers for LNG as a ship bunker fuel is emission regulation in combination with expected competitive fuel pricing. This applies to both shipping in ECA as well as for global shipping. SOx requirements will always be met with LNG with its very low sulphur content. In addition, NOx requirements are often met depending on the requirement and the engine technology.

For new LNG-fuelled heavy-duty (HD) vehicles a maximum potential market share for truck sales of 26% for Europe in 2015 has been determined based on energy share and estimated market share per vehicle segment. Subsequently, the determined European market share is projected on Asia-Pacific, North America and Middle-East. For Latin America and for 'rest of the world' lower percentages are estimated (respectively 10% and 5%). Consequently, the potential volume of LNG off-take was calculated for the total HD vehicle segment per region in 2025, by using a fleet expansion rate of 5% per year, and a replacement rate of 12% per year. For ECA ships, it is assumed that a maximum of 50% of newly-built ships is potentially suitable for fuelling by LNG. This means that in 2025, the percentage of LNG-fuelled ships is potentially 27% to 33% depending on the economic growth or fleet expansion rate (2.5 or 5%). To estimate the potential LNG market share in the deep sea or global maritime segment, a distribution of energy consumption over size categories is made. For each size category a potential LNG share for newly-built ships is estimated. For 'oil-powered' electric power generation a direct share is estimated per region in the world, not taking into account life time or expansion of these power stations.

Conclusions

With a maximum volume of 192 MTOE and 16% of the total energy consumption for HD vehicles in 2025, trucking is the largest global potential market for small scale LNG substitution. Since the share of excise duties in road fuel prices can be large (e.g. EU), the tipping point of natural gas versus diesel strongly depends on local tax regimes. There is additional potential for SSLNG when supplied as CNG at fuel stations. In the shipping segment, the second largest market, a maximum substitution of 17% of the conventional maritime fuel by LNG can be achieved, representing a volume of 55 MTOE per annum in 2025. Specifically shipping in ECAs is a small but important segment with 12 MTOE per annum in 2025, driven by the future stringent environmental regulations. Substitution of fuel-oil at electric power generations with SSLNG can be sizeable market, with an estimated volume of 33 MTOE in 2025.

Recommendations

In order to create better understanding of how the potential for SSLNG can be utilized, it is recommended to assess the local geographical aspects of dense logistical corridors for HD vehicles. Additionally, the potential for LNG-fuelled stationary electric power generation needs to be detailed, taking into account the production sizes, political influences and environmental advantages. For an optimal utilization of the SSLNG infrastructure, it is recommended to assess business cases of multi-segment supply per region e.g. combined LNG supply for bunkering, stationary power and trucking. The latter can even be enhanced when combined LNG-CNG (LCNG) fuelling stations, and potential replacement of LPG fuelled vehicles and domestic use (heating, cooking) is considered. Therefore, detailed investigation of multi-segment SSLNG supply chain is recommended.

References

TNO Report "Global Potential of Small Scale LNG distribution"; Ruud Verbeek, Nina Nesterova, Bas van den Beemt, Cyril Widdershoven, Jordy Spreen; Delft 2014