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Removing barriers to the use of natural gas as a transportation fuel

DRAFT

Removing Barriers to the Use of Natural Gas as a Transportation Fuel

Maritime Fuel

Discussion document prepared for UNECE by DNV GL

DNV·GL

UNECE GROUP OF EXPERTS ON GAS TASK FORCE D: "REMOVING BARRIERS TO THE USE OF NATURAL GAS AS A TRANSPORTATION FUEL"

Maritime Fuel

UN Economic Commission for Europe

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1 INTRODUCTION

The UNECE Group of Experts on Gas created four task forces to address critical issues for the natural gas industry:

A. Best practice guidance to reduce gas leaks in the gas value chain

B. Best policy practices on the role of natural gas in increasing the uptake of renewable energy in the ECE Region and helping achieve the objective of access to energy for all in the ECE Region

C. Best practice policy guidance for Liquefied Natural Gas (LNG)

D. Removing barriers to the use of natural gas as a transportation fuel

Task Force D has focussed on the use of natural gas as a transportation fuel to facilitate and accelerate the commercialisation of natural gas, including renewable methane, as a fuel for the road and marine sectors. NGVA Europe was asked to lead the task force with respect to on-road vehicles and has coordinated its activities with important NGV stakeholders and international partners. GASNAM has provided preliminary inputs regarding maritime use of natural gas. This document summarises the findings to date on the main barriers to inform the Group of Experts on Gas as the task force explores the appropriate approaches to removing the barriers based on the contribution of DNV GL.

This report is considering not only gas-fuelled ships, but the supply chain as well. The report is acknowledging that – other than the established bunker industry – LNG as fuel for ships is still an industry in its infancy and not commoditized yet: a spot market is non-existing, contract models are individually negotiated, quality standards are under development, the number of suppliers is small, and so forth.

All activities in this emerging industry can be located in the framework as shown in Figure 1.

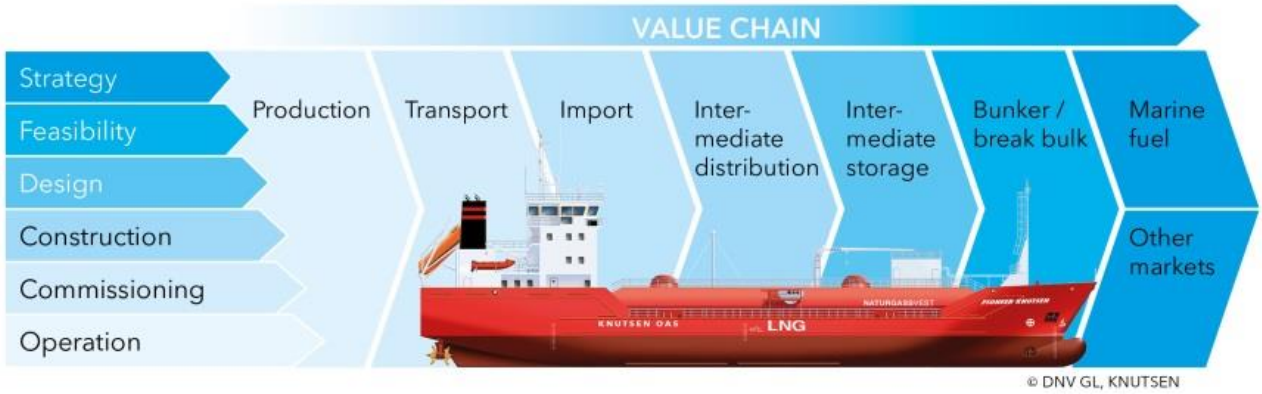

Figure 1 - LNG value chain and stages of development

2 LNG AS MARINE FUEL

LNG is in use as fuel for ships since decades: LNG transported by LNG tankers is continuously evaporating and creating boil-off gas. On many such ships the gas is sent to machinery on the ship such as boilers. auxiliary and main engines.

Since the year 2000 LNG is in use for ships that are not LNG tankers. A passenger ship was built in Norway in order to demonstrate the technical feasibility of using LNG as fuel for other ships than LNG tanker. At the time of writing of this report the number of ships using LNG as fuel that are not LNG tankers has been growing to 99 ships in operation plus 93 on order in addition. Ships in all ship segments are using LNG as fuel. The main geographical areas where LNG-fuelled ships are deployed are Europe including Norway and the US.

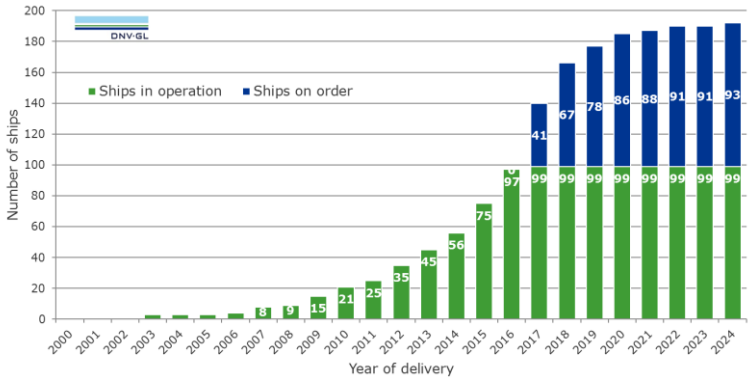

Figure 2 - status gas-fueled ships as per January 2017 (source: DNV GL)

Above figure is showing ships in service (green) and confirmed ships on order (blue) as per January 2017: 99 ships are in operation, 78 will be delivered before end of 2019, 91 ships will be delivered before end of 2021, including the ships delivered in the years before. It needs to be noted that the lead time for ship building is about two to three years. This means that more ships will be ordered with delivery in 2019 and onwards, increasing the number of ships on order and the blue bars significantly. In addition ships which are "LNG-ready" are on order. "LNG ready" means that all necessary preparations[1] are done to convert a ship easily to LNG as fuel – but the expensive equipment is not installed yet.

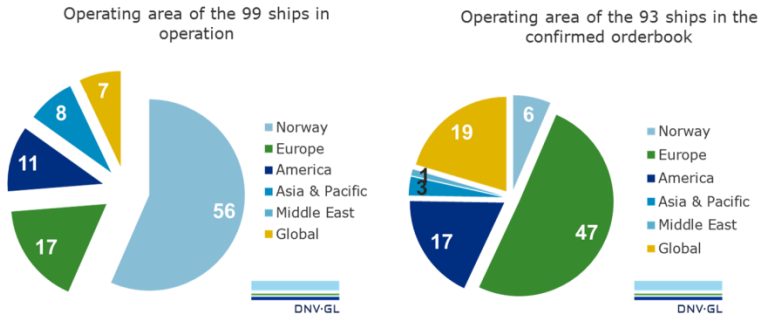

Figure 3 - operating area gas-fueled ships as per January 2017 (source: DNV GL)

[1] Aspects that are expensive to change: space and foundation for LNG tank, routings for pipes kept free, safety distances for ventilat on and safety valves are kept, engine chosen that can be easily converted, etc.

Gas-fueled shipping was perceived as being a Norwegian niche-market. Above picture shows clearly that this is not the case any longer – the majority of ships on order is for operation outside Norway. The international spread of gas-fueled ship operations is shown in Figure 4. Shown is a heatmap using a signal ships have to broadcast every few minutes. Red traces show high intensity, light blue lowest intensity in ship operations. The figure is giving evidence that whole Northern Europe is seeing gas-fueled ships, US is increasing the use of gas-fueled ships and single ships using gas as fuel operate in South America and the Far East.

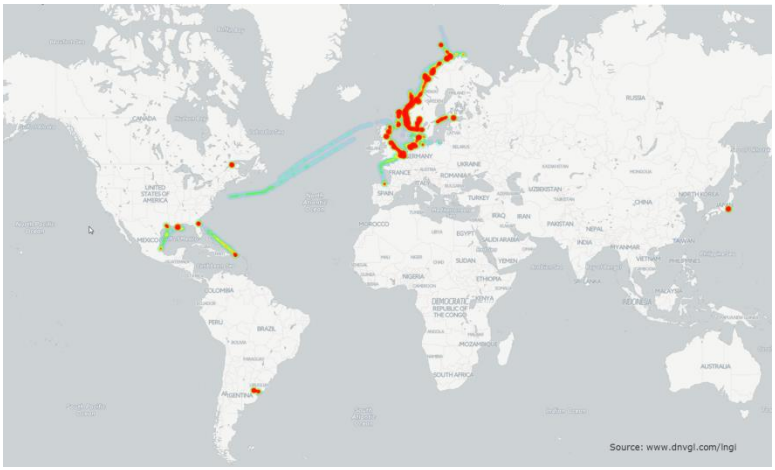

Figure 4 - global footprint of gas-fueled ships in operation (source: DNV GL)

It is worth to stress that technology for using LNG as fuel for ships is mature and available for most applications.

2.1 Driver

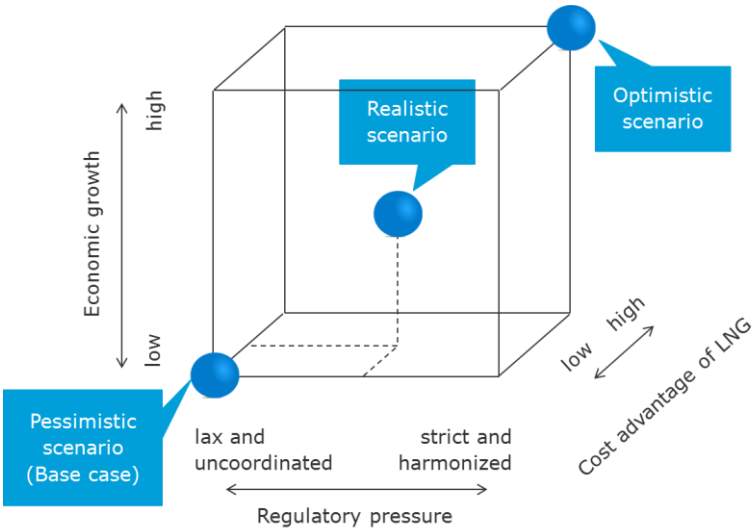

Figure 5 - main drivers for technology uptake (source: DNV GL)

Shipping is traditionally an industry which is operating compliance-based. Further, global shipping is closely linked to global economy. The motivation of shipping to adapt new technologies is driven by the factors "regulation" and "economic growth" – plus the cost competitiveness of that new technology. Figure 5 is demonstrating this for "LNG as fuel".

2.1.1 Regulation

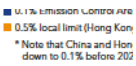

Figure 6 - sulfur regulation for global shipping (source: DNV GL)

Figure 6 is illustrating the regulatory pressure on shipping in the context of LNG. International regulation of emissions to air for shipping is the mandate of the 6th Annex to IMO MARPOL[2] convention. Since January 1st, 2015, all ships need to use fuel with a sulfur content of less than 0.1 % in the dark blue emission control areas[3] (ECA). Outside of these areas the sulfur content is limited to 3.5 %. From January 1st, 2020, ships need to use fuel of a sulfur content of maximum 0.5 % outside the dark blue areas. The orange areas are areas where the Peoples Republic of China is testing the impact of a 0.5 % limit already at the time of writing of this article.

In the dark blue area around North America, NOx emissions are limited to Tier III level[4] for ships build after January 1st, 2016.

Using gas-fueled engines is generally beneficial with regards to emitting SOx, NOx and PM[5]. Under discussion is the net advantage regarding CO2, but ideally up to some 25 % reduction may be realized.

2.1.2 Economic growth

Shipping and ship building are in a very bad state since several years. The current downturn has been characterized as one of the longest ever. Shipyards are running out of business mainly in the Far East. Shipping companies consolidate. Evidence shows that in cases ships are recycled at an age of seven years.

Thorough analysis, taking into account regional factors, however shows that a strong case for gas-fuelled ships does exist. Figure 7 is showing how clusters of year build, distribution of demand over areas, fleet

[2] International Maritime Organization, Maritime Pollution

[3] With a limit of 1 % up to December 31, 2014

[4] MARPOL Annex VI has three levels for NOx, with Tier III being by far the strictest

[5] 100 % reduction, 80 – 90 % reduction and 100 % reduct on, respectively

composition with concentration of energy demand and seasonality need to be worked out in order to assess a case for LNG as fuel.

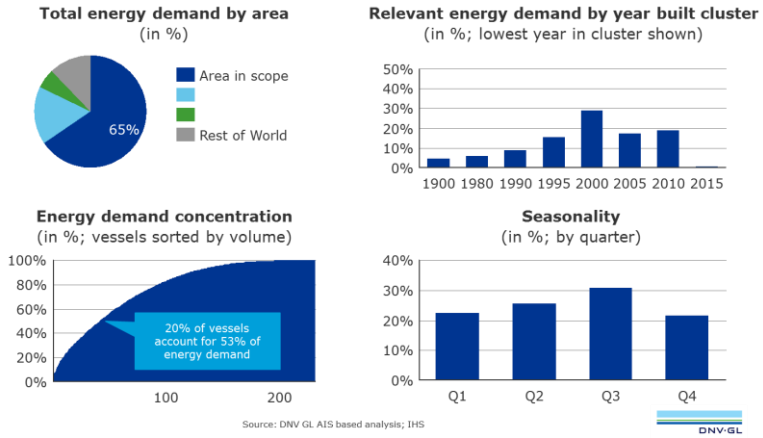

Figure 7 - examples for factors affecting fleet growth (source: DNV GL)

2.1.3 Cost advantage of LNG

Shipping is a capital intense industry using assets with a traditionally long life expectancy. Two cost types define the viability of an investment – capital cost (CAPEX) and operational cost (OPEX).

Using LNG as fuel is affecting both CAPEX and OPEX. Due to the cryogenic nature of LNG and respective technologies, CAPEX is higher than for a ship using traditional fuel that is compliant with the emission regulation. However, if compliance with emission regulation cannot be guaranteed by the choice of fuel alone and exhaust treatment technologies need to be installed, the disadvantage in CAPEX is shrinking for gas-fueled ships. On the other hand, the outlook is promising that LNG delivered free on board may be cheaper than low-sulfur traditional fuels. This is the main advantage regarding OPEX when using LNG as fuel.

Key OPEX driver are not the molecule costs but costs for infrastructure.

LNG will benefit most from January 1st, 2020, when the global sulphur cap is introduced. Already today ships that are considered to be built for sailing a significant proportion of time in ECAs are likely to be fuelled with LNG.

2.2 Discussion of key enablers

Figure 8 - six key enabler for LNG as marine fuel (source: DNV GL)

In order to allow the use of LNG as marine fuel to grow, six key enabler need to be in place as shown in Figure 8. All in all it can be said that – in Western Europe – no showstoppers do exist.

2.2.1 Access to LNG

Cost effective access to LNG is vital for establishing LNG as fuel for ships. "Access" relates to physical access as well as commercial access: where to get LNG from and how to purchase it for what terms. The LNG industry is used to long-term take-or-pay contracts, whereas shipping is used to a spot market for bunker fuels. In other words both industries are working on different timescales. This needs to – and increasingly is – bridged commercially by LNG bunker suppliers.

Physical access includes reload capability of LNG terminals to load not only large tankers of a capacity of 165,000 m3 or more but small LNG bunker supply vessel of 10,000 m3 capacity or less. Being aware of this need terminals are being extended with reloading jetties dedicated to small vessels, the GATE terminal in Rotterdam being the latest example. This is reducing the CAPEX for LNG bunker supply vessel as a second manifold for accessing large terminals are not needed anylonger.

Figure 9 is showing the global development of LNG bunker infrastructure in the stages in operation (green) , decision made (dark blue), under discussion (light blue).

Figure 9 - global LNG bunker infrastructure under development (source: DNV GL)

In summary it can be said that each ship that wants to take LNG as bunker will be able to get supply. The supply may not be secured as easy as it is the case for traditional fuels, and significant more lead time may need to be factored in for setting up the necessary logistics and for getting all necessary permits in place. Using LNG as ship fuel has been starting with ships on regular trades. An increasing number of ships on tramp trades are using LNG as fuel in Northern Europe, where access to LNG can be provided by LNG bunker suppliers.

2.2.2 Logistics

Logistics for LNG as marine fuel need to be safe and reliable. "safe" in an HSE sense, "reliable" in a ship owners sense as the owner is dependent on fuel supply in quantity and quality as needed at a location where needed to a time when needed. The logistics for supplying LNG as fuel needs to fit in the use of the

ship. In most cases the molecules need to come to the ship – most ships won't move to the molecules for bunkering.

Broadly speaking, shipping has two main operating patterns: on a fixed trade for a period of time, or on tramp. Ships on a fixed trade sail like buses or railcars on fixed schedules with fixed berths in the ports they are calling, at least the terminals are fixed. Their trading patterns are very predictable, and logistics mainly need to ensure that the delivery of LNG at the intended terminal or berth is possible.

Trade patterns for ships on tramp have a fundamentally different characteristic. They are called for one voyage to pick up goods at a point in the world and to deliver within an agreed period at another point in the world. It is inherent to the very nature of this pattern that it is very unpredictable. A ship may be mobilized to sail half around the world for picking up cargo, and then sail again half around the world for delivery.

A potential exemption for the rule of thumb that the molecules need to come to the ship are ships on a back-to-base pattern. For example port service vessel like tugs, pilot boats, port ferries and similar are stationary in one port. They have a fixed berth and scheduled downtimes. Often these vessels share bunker supply in a port. This common use of one supply point may be the case for LNG as well – depending on local interests.

2.2.3 Legal Certainty

Regarding environmental legislation legal certainty has been provided by the decision of IMO MEPC 70[6] in October 2016 to introduce a global cap of 0.5 % sulphur for marine fuels by January 2020, see Figure 6.

Regarding ship design and construction the introduction of the IGF Code[7] by IMO MSC[8] with effect of January 1st, 2017, has provided legal certainty for ship design.

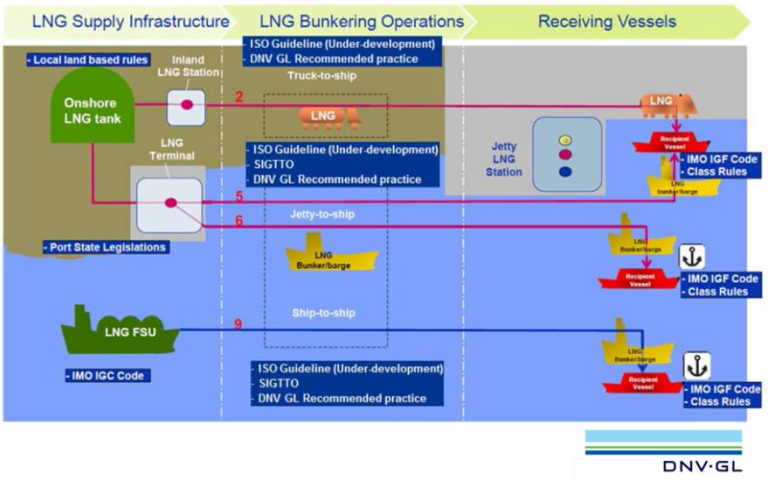

Figure 10 - safety regulation along LNG supply chain - overview (source: DNV GL)

[6] 70th meeting of IMOs Maritime Environmental Protection Committee

[7] International Code for Ships using Gases and other Low Flashpoint Fuels

[8] Maritime Safety Committee

Not fully clear is the picture where ship regulation and onshore regulation meet. DNV GL has performed a thorough study for DG Move[9]: *"Analysis and evaluation of identified gaps and of the remaining aspects for completing an EU-wide framework for marine LNG distribution, bunkering and use"*.

The analyzed gaps are located mainly towards the right end of the valuechain for LNG as fuel at the interface between maritime and onshore regulation, see Figure 1. A key element is that maritime regulation is harmonized globally, whereas onshore regulation can be in the responsibility of a manifold of local authorities. However, no showstoppers have been identified. A list of recommendations for treating gaps has been provided by the report.

Figure 10 is summarizing the legislation pertinent to LNG bunker supply chains.

2.2.4 Investment Climate

Ships

The investment climate is decisive for the uptake of LNG as fuel for ships as the CAPEX has to be balanced by the OPEX, and the total investment needs to be competitive with alternative options to comply. These are

1. Heavy fuel oil with a scrubber.
2. Compliant heavy fuel oil of 0.5 % sulphur content.
3. Compliant marine diesel oil or marine gas oil with a sulphur content of 0.1 %.

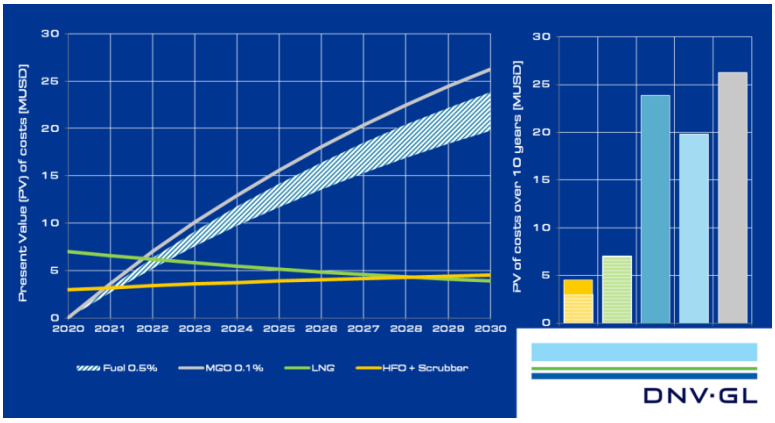

Figure 11 - example for accumulated cost compared to HFO baseline (source: DNV GL)

Figure 11 shows a present value calculation for the different compliance options for one particular scenario. The scenario is mainly characterized by prices for fuel, CAPEX, OPEX other than fuel costs, depreciation and rate of interest. Depending on these values the attractiveness of the options vary significantly.

Below options are in use for supporting the choice of cleaner fuels in order to stimulate investments. Examples are

1. Governmental tax on emissions

   For example tax on NOx in Norway.

[9] https://ec.europa.eu/transport/sites/transport/files/modes/maritime/studies/doc/2015-12-lng-lot1.pdf

2. Industry run funds as alternative to taxes

   For example NOx funds in Norway.

3. Governmental investment in pilot applications

   For example EC TEN-T and CEF schemes; German scheme to support the uptake of low emission fuels.

4. Governmental investment in development of new technologies

   For example German scheme for development of low-emission technologies for ship propulsion.

For suppliers of LNG as fuel it is of utmost importance to understand who would be in charge of what cost. Often ships are owned by company A, the owner, technically managed by company B, the shipmanager, and chartered out (leased out) to company C, the charterer. The owner is responsible for all CAPEX, where the charterer is responsible for the cost of fuel. If increased CAPEX will reduce cost for fuel and maybe other OPEX an agreement between owner and charterer needs to be found.

Infrastructure for LNG bunkering

LNG infrastructure comprises only very few main elements:

- Production.
- Transportation.
- Storage.

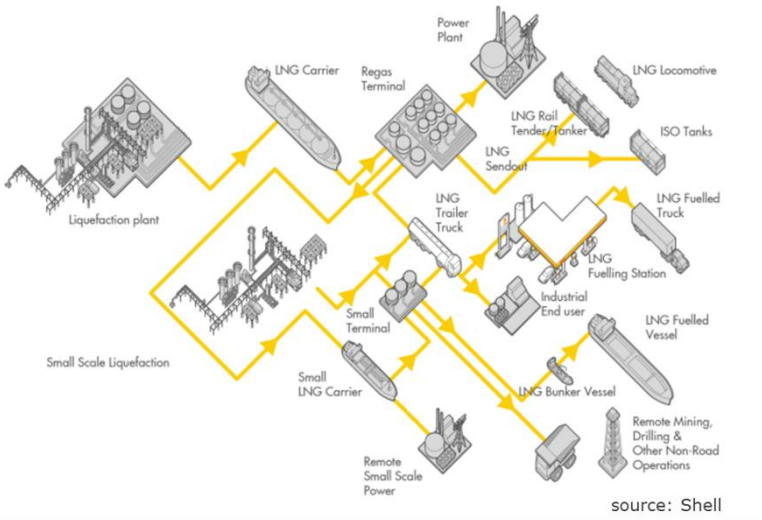

Figure 12 - modalities in LNG infrastructure (source: Shell)

However, as any of these main elements is realized on different scales and on different modes – production from few tons a day to millions of tons a year, storage in atmospheric tanks or in pressurized tanks, storage

of less than 30 cubic meters up to storage of several hundreds of thousand cubic meters, transport on sea, rail or road – the picture is pretty complex. Figure 12 is giving an overview.

The key challenge for investing into a downstream LNG infrastructure is to get the utilization of the infrastructure up to levels where payback times are acceptable for investors or investing companies.

LNG bunkering infrastructure is unlikely to be developed by established ship bunker companies in general. The reason is that the existing bunker business is characterized by a spot market with high transaction volumes but low margins, and that high investments are needed for building an LNG bunker supply chain.

Active in developing LNG bunker supply chains are O&G majors (for example Shell's LNG bunker supply vessel under construction), downstream companies (for example Engie's LNG bunker supply vessel delivered in QI 2017), newly established companies (for example BominLinde LNG's LNG bunker supply vessel on order) and joint ventures (for example Shells' and Keppel's joint venture in Singapore).

A common pattern is that LNG bunker investments are linked with investments into other LNG supply like feedstock for industry in order to get the investment costs per unit down.

2.2.5 Competences

Competences, knowledge and skills are relevant on three levels:

1. Policy makers and C-Level decision makers need to have the competence to give the right directions for safe and cost-effective introduction of LNG as ship fuel and the development of a safe and cost-effective LNG bunker supply chain.
2. On the organisational levels in charge for developing regulation and businesses need to have the right knowledge for developing a safe and cost-effective LNG bunker infrastructure.
3. On operational level skilled workforce is needed for building and operating installations.

These three levels are addressed differently. Main instrument for reaching policy makers and C-Level decision makers are for examples industry-run instruments. An example on national level in Germany is the "Maritime LNG Plattform"[10] and on international level "Sea\LNG"[11].

The second level is addressed in addition by instruments provided by the European Commission like ESSF[12], industry organizations like shipowner associations, shipbuilder association etc.

On board of seagoing ships, skills are identified by available standards[13], and provided by international regulation[14] and by model courses recommended by IMO. On the shore side no particular competence standard or model courses for training of personnel directly involved in LNG operations or indirectly related to LNG operations do exist. Existing are technical specifications of ISO for LNG facilities on land[15] or LNG

[10] http://www.lng-info.de/en/
[11] http://sea-lng.org/
[12] European Sustainable Shipping Forum
[13] DNVGL-ST-0026:2014-04 "Competence related to the on board use of LNG as fuel"
[14] The international Convention on Standards of Training, Certif cation and Watchkeeping (STCW)
[15] ISO TS 16901 "Guidance on performing risk assessment in the design of onshore LNG installations including the ship/shore interface"

bunkering[16], and recommended practices for LNG bunkering, of which the first one was published by DNV GL[17] in early 2014.

An instrument used by the European Commission have been and are funded projects under the TEN-T framework. These initial projects had the purpose of building sufficient competence as a basis for decision making. Examples are the COSTA-project in Portugal or Archipelago LNG in Greece, to name a few.

2.2.6 Acceptance

Public acceptance of LNG as fuel for ships is linked to two factors: fear on the basis of being wrongly informed or not informed, and by the view on emissions pertinent to LNG fuelled ships.

The first factor, fear, has an element of "not in my backyard"[18]. Sometimes LNG is confused with other substances and wrongly perceived as being more dangerous than well-known fuels.

The second factor can be split into two items: the undisputed benefits in reducing local emissions for NO_X, SO_X and PM[19], and in a discussion about the net impact on greenhousegas (GHG) emissions. Pertinent to the discussion about GHG are two main subjects: the net reduction of direct CO2 emissions from gas-fuelled engines, and the slip of methane along the value chain and in the engines. The subject is pretty complex as important factors are engine technology– two-stroke engines in Diesel-cycle have for example virtually no methane slip - and engine generation, old converted Diesel engines generally have a higher methane slip than new designed gas engines.

Both NIMBY and GHG need to be addressed very transparent and pro-actively. In the best case local population support the introduction of gas as fuel including the necessary local storage. An example is the German city Brunsbüttel, where the Kiel Canal enters the North Sea. Pollution by ships is a serious issue and reduction of emissions are more than welcome. In addition, through well planned and executed communication, possible future local storage of LNG is not disputed by the population.

2.3 Discussion of gaps and barriers

Figure 8 is identifying the key enablers for using LNG as marine fuel. No showstoppers do exist that prevent the enablers from being put in place. However, in some areas gaps and / or barriers do exist which are discussed in this part of the report.

2.3.1 Easy access to LNG

No particular gaps and barriers have been identified. More and more LNG terminals are building re-export capabilities for truck filling or loading small ships like LNG bunker supply vessel. LNG import terminals do exist at all European coastlines or are under development in the Baltic and in Russia.

2.3.2 Reliable and safe logistics

The key gap for logistics is of regulatory nature on the ship/shore interface, where marine regulation and onshore regulation meet. This is in cases preventing from developing cost effective solutions in short time.

[16] ISO TS 18683 "Guidelines for systems and instrallations for supply of LNG as fuel to ships"
[17] DNVGL-RP-G105 "Development and operation of liquefied natural gas bunkering facilities"
[18] NIMBY
[19] Nitric ox des, sulfur oxides, particulate matter

The reason is that the two regulatory regimes – marine and onshore – are of different nature: marine regulation is by its nature global, whereas onshore regulation is national, regional or very local in its nature.

2.3.3 Legal certainty

Harmonization of legislation for LNG distribution and LNG bunkering has been addressed by a report produced by DNV GL for DG Move, "Analysis and evaluation of identified gaps and of the remaining aspects for completing an EU-wide framework for marine LNG distribution, bunkering and use". Parts of the executive summary of that study are quoted:

"*The assessment of the existing rules, standards and guidelines shows that from a legal point of view, there are no remaining major showstoppers for the use of LNG as fuel - both for seagoing vessels and inland waterway vessels – nor for the deployment of LNG bunker facilities.*

Recently, legislation and rules previously prohibiting the use of LNG as fuel for seagoing vessels and inland waterway vessels have been adapted or are being adapted to allow the use of LNG as fuel. The bulk of the proposed recommendations mainly address issues where further harmonisation is possible. An important harmonisation opportunity is the bunkering activity itself, which is today not harmonised in EU ports. Furthermore, EU-wide standards for LNG bunkering installations and requirements for LNG bunkering equipment are missing. Some suggested standards are not strictly required from a legal point of view but are perceived as strong enablers, disseminating codes of good practice.

One of the specific aims of this study was to identify harmonisation opportunities with respect to following focus areas: permitting, quantitative risk assessment and incident reporting. Most important findings are summarised below.

The design of the permit process and the related practices vary between the Member States. In some Member States permitting procedures are considerably more complex than in others. Several factors are leading to slow and inefficient permit processes. There are on-going initiatives to speed up the overall permit process via e.g. all-in-one permits with only one authority coordinating, and via specific LNG guidance documents. In some Member States specific regulation is in force to smoothen the permit process for selected critical projects.

Although the permit processes are well enforced by law in the EU Member States, the overall process is not fully transparent to all involved parties, this includes information on milestones and deliverables, authorities responsible, documents to be produced, …. In addition various Member States have no clear time targets for the different steps in the permitting procedure and/or no enforcement/consequences if the delays are not respected.

The responsible authorities are not always familiar with LNG and its benefits. This in combination with lack of LNG skilled people (specific knowledge on LNG and LNG installations) at authorities and clear standards might lead to an overkill of environmental studies to be executed for LNG developments. Some Member States have already created platforms to share best practices and information between all LNG stakeholders.

The current risk assessment (e.g. QRA) practices and risk acceptance criteria are identified to provide recommendations for harmonization and improvements to LNG bunkering risk assessment practices across EU Member States and ports. EU countries apply different methodological approaches and criteria to determine and assess external risk for LNG establishments that are subjected to the Seveso directive. It is found that harmonization of the latter is difficult to achieve due to the fact that each Member State has

transposed their own interpretation and implementation of the directive in their legislation. For non-Seveso LNG establishments and activities, EU-wide harmonization of the risk assessment approach seems feasible.

Several other more specific knowledge gaps have been identified that should be considered as potential improvements in the overall risk analysis process of small scale LNG infrastructure and activities.

The current incident reporting structure needs to be adapted to be able to efficiently capture data from LNG bunkering incidents and the lessons learned. The aim of such an updated reporting structure is to capture LNG specific incident data in a European database and to make these data accessible for all relevant stakeholders. The proposed database will combine data from existing databases (e.g. eMARS, EMCIP, ADR, port databases, …). This necessitates that the mentioned existing databases are populated and thus implies that detailed incident reporting routines are in place and followed.

The incident database should be implemented at EU level and should cover all incidents, accidents and near–misses with (potential) implications on safety and operations related to the small scale LNG value chain.

The preceding part has resulted in a long list of potential interventions (via recommendations) that could help achieve the overall study objective, namely the reduction of emissions by shipping and to stimulate harmonisation across EU and further serves as input to the analysis of the social, economic and environmental impact. The impact assessment is meant as a key tool to ensure that Commission initiatives and EU legislation are prepared on the basis of transparent, comprehensive and balanced evidence. The analysis was ultimately aimed at achieving insight into the (policy) ways of stimulating the use of LNG as clean shipping fuel."

2.3.4 Favorable investment climate

Resulting from the crisis in global shipping and ship building, and from the international financial crisis, banks are very thorough in their due diligence when assessing new projects. Access to capital is not as easy as it was in the pre-Lehmann times.

European governments including the Commission are making funds available to

- Develop technologies
- Build technology demonstrators
- Back the investments of first movers.

The key barrier for the uptake of LNG as fuel for ships at the time of writing of this report is the too low price difference of LNG compared to low sulfur Marine Gas Oil or compared to Heavy Fuel Oil combined with exhaust treatment.

2.3.5 Competences, knowledge & skills

Closely linked to Chapter 2.3.3, competence and knowledge on side of authorities has in cases proven to be a barrier. Cases where product specific aspects have not been understood by authorities, such as flammability, dispersion etc, have led to lengthy approval processes. Similar experience has been made with authorities who did not accept ships as safe, that are certified according to IMO/SOLAS and Class Rules.

2.3.6 Public acceptance

Public acceptance is varying very much. In general a “not in my backyard” attitude not specifically linked to LNG may slow down the development of LNG bunkering in some areas.

3 CONCLUSION

Downstream LNG and LNG bunkering is an industry in its infancy. LNG fueled shipping and consequently LNG bunkering is for historic reason characterized by strong development in one country, namely Norway. At the time of writing of this report, the development outside Norway has a higher momentum than inside Norway. LNG bunker is not yet a commodity business, as is for example established bunkering of heavy fuel oil or distillates. For securing future supply for a ship under construction, today it is necessary to, while the ship is being designed, secure and fix the LNG bunker supply for the time the ship will enter service.

Other than few years ago, ship owners are not any longer confronted with 20 year take-or-pay contracts when they want to buy LNG as bunker. Other than few years back, port authorities now have heard about LNG bunkering and are more and more prepared to give permits for LNG bunkering – if they do not have already a full updated port regulation in place, taking bunkering of LNG into account.

With the IGF Code, IMO has provided a technical regulation to ensure safe design and operation of gas-fuelled ships. IMO has put a regulation in place, which is preventing the use of high sulfur fuels globally from 2020.

Taking into account the high investments needed to further develop technology and infrastructure, regions like the European Union and countries like Germany have put innovation and funding schemes in place which are co-financing prototype projects and development of new technologies.

Main open items are related to the shipping industry, which is a) very conservative, b) under high commercial pressure, c) possibly facing the beginning of a major shift in how container shipping is organized globally and d) by its nature an international and global business. To accelerate the introduction of LNG as a marine fuel, it is recommended to take these factors into account and to consider actions that are reflecting the global nature of shipping.

It can be said that in general no showstoppers for the introduction of LNG as ship fuel are present. Depending on a specific port, country or region where LNG supply is under development, issues mainly related to local regulation needs to be addressed carefully and in advance of deployment of ships into that area.

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