Gas LNG Europe

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GLE Position Paper:
Overcoming barriers in the Small Scale LNG development

1. Who we are

Gas LNG Europe (GLE) currently comprises 15 European LNG terminal operators from 9 countries, representing around 90% of all the existing LNG regasification capacity in Europe. GLE is one of the columns of GIE, Gas Infrastructure Europe, the European association of the Transmission, Storage and LNG terminal Operators.

GLE is committed to promoting the development of a fully operational European internal market for LNG and the creation of a stable and predictable regulatory framework which is conducive to investments and which ensures transparency and non-discriminatory treatment.

2. Executive Summary

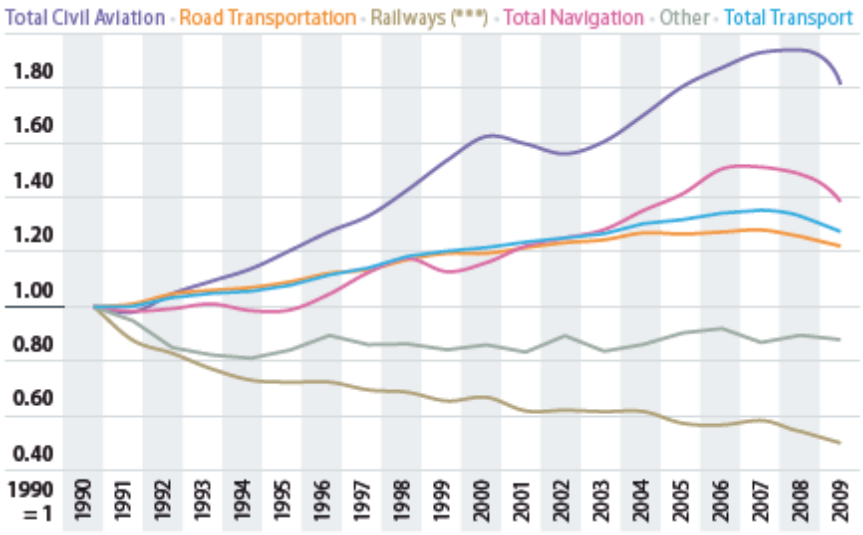
- The small scale LNG development is strongly driven by policies and targets to reduce emissions and increase the sustainability of the transport sector. New emissions control regulations are making LNG an increasingly attractive option for the (short sea) shipping sector as well as for heavy road transport.
- The technologies for handling large and small scale LNG are worldwide available.
- GLE members have a solid experience in management of small scale-LNG processes (i.e. truck loading or ship loading for vessels <40,000m^3)
- Main barriers to be overcome are the poor infrastructure and the missing consistent normative and regulatory framework which includes safety standards for the handling of small scale LNG.
- Outlook: There is an impressive amount of ongoing work to break through the barriers to implement LNG as a fuel.

3. Introduction

During the past few years we have witnessed a huge increase in interest for delivering LNG directly to the consumer. We see this development both for onshore transportation, such as trains and trucks, for land based power production, such as industrial generators and small scale power generation, and for use as a marine fuel. We expect this trend to continue, and even to be reinforced by stricter requirements and increasing taxation related to environmental emissions. It is obvious that switching to natural gas as a main energy source is a clear step towards a low carbon economy given the reduction of CO_2 emissions up to residual values. In addition, NO_x emissions are led to zero. For smog and air quality problems LNG offers an ultimate solution as local emissions are more or less eliminated.

The transport sector is currently responsible for around one quarter of the EU's Greenhouse (GHG) emissions, and is the second biggest emitter behind the energy sector. 17.2% of the EU's GHG emissions can be attributed to road transport, 3.3% to maritime and 2.6% to aviation, of which maritime and aviation are experiencing the fastest emissions growth. It has been estimated that without any policy intervention, transport GHG emissions could be 17% higher in 2050 than in 1990. Therefore, the transportation sector has been set a target of reducing GHG emission by 60% by 2050

relative to 1990 levels. **In order to achieve cost benefits and meet CO2 emission reductions, recognition should be given to the important role that natural gas can play in the transition to a low carbon economy.** This recognition is given now by the Clean Power for Transport Package announced by the European Commission on 24 January 2013.



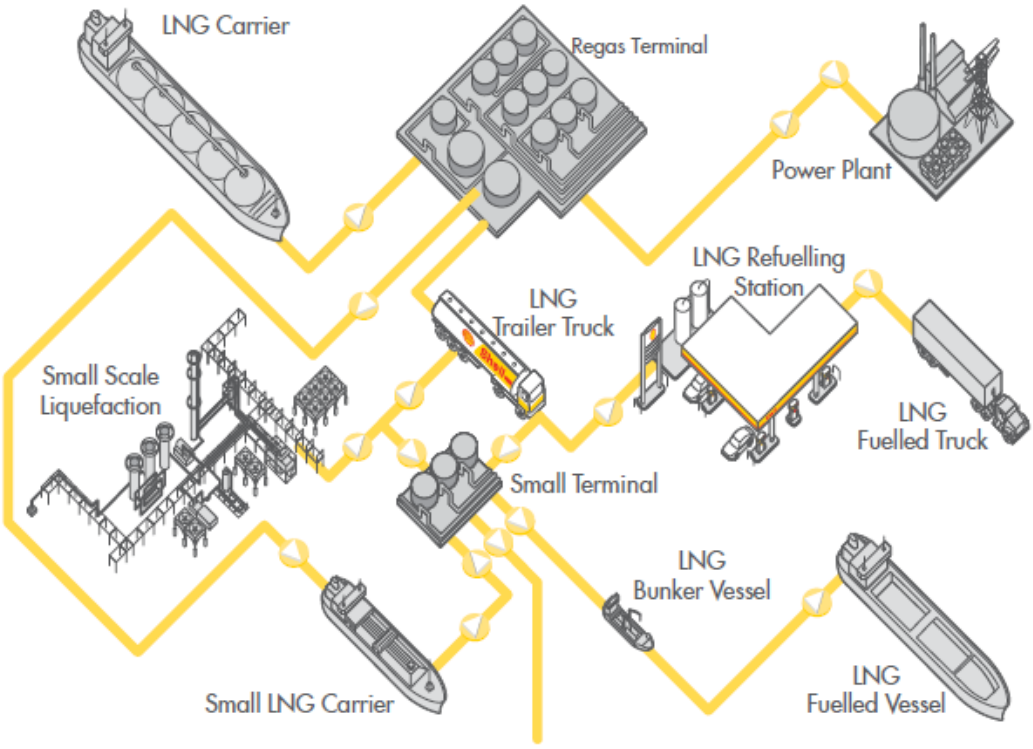
Development of EU-27 GHG emissions from transport by mode
Source: EU transport in figures, Statistical Pocketbook 2012

Potential barriers and challenges for Small Scale LNG need to be overcome. This could be achieved through implementing a range of policy measures, which are either aimed at stimulating natural gas in the transportation sector (but are currently implemented in few Member States), or that currently exist for alternative technologies but could be adapted towards natural gas. Such options include technology support measures; measures aimed at stimulating the use of alternative fuels more widely; the provision of appropriate gas-based infrastructure; the introduction of vehicle-specific performance targets or standards; fiscal measures; and measures aimed at improving air quality.

4. What is Small scale LNG?

On the one hand, the current value chain of LNG is built up to deliver full sized LNG carrier cargoes, about 150,000 m3, to receiving terminals for re-gasification and distribution through gas pipelines. On the other hand, it is built up for truck loading activities (50 m^3) in order to feed small LNG stations connected to distribution systems (e.g. about 45,000 truck loadings per year in Spain)

Although, more and more European LNG terminals have started to offer small scale services to supply ships, trucks, buses, and trains with the quantity they require and at the geographical locations they need to have a secure and efficient supply. Some of these activities have been already provided in some countries since15 years (i.e. at about 150 ship loading services provided from Enagás´ LNG plants, Spain, between 1997-2013 in small vessels < 40,000 m^3). Nevertheless, from a general point of view, there is not enough flexibility for small scale LNG and for breaking up LNG cargoes into smaller quantities.



The small scale LNG value chain
Source: Royal Dutch Shell plc

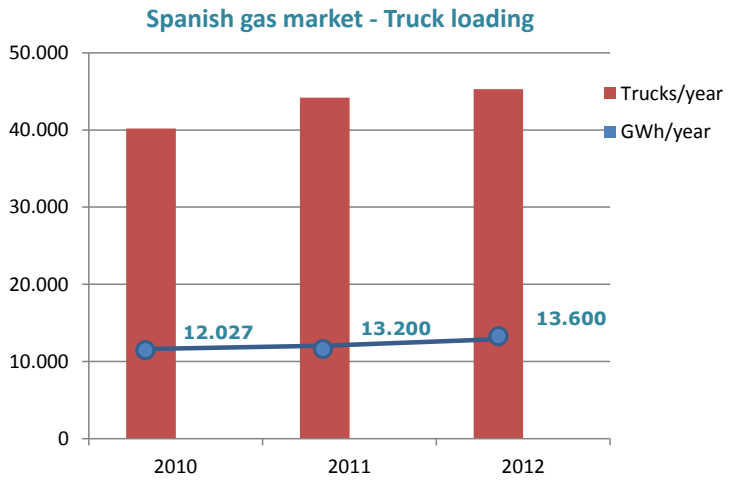
In fact, Small Scale LNG actually refers to *two* opportunities:

4.1. Breaking bulk

The first opportunity involves the distribution of LNG from the EU main import terminals to smaller regional and local regasification terminals throughout the EU: breaking up bulk cargoes and delivering to smaller markets. This is the process of loading LNG from a large LNG terminal into smaller vessels carrying around 5000 to 30000 m3, trucks carrying some 50 m3 and rail 500-1500 m3.

GLE notes that the redistribution of LNG to smaller terminals has great potential to improve security of supply and market functioning in the EU and will allow areas that are not easily connected to the main pipelines systems to benefit from the availability of natural gas.

The main land-based customers for small-scale and medium-scale terminals are first and foremost industrial applications such as for example steel manufacturers or paper mills, either in the vicinity of the terminal or served by LNG truckloads. Local district heating peak load services are another option. As an illustrative example, this sort of market has been a relevant driver on the development of truck loading activities in some countries like Spain, where levels of 45,000 trucks/year are reached (see graph).



4.2. LNG as a fuel for heavy transport

The second opportunity involves the application of small scale LNG as a fuel in the heavy transport sector (trucking, rail, shipping, buses). This is rapidly rising on the agenda of policy makers (e.g. Clean Power for Transport Package launched by the European Commission) and business (e.g., transporters, oil and gas suppliers, infrastructure operators, ship owners and ship engine makers). A key driver is the increasingly strict regulation concerning emissions (SOx, NOx, CO2), especially for shipping.

Source: NGVA Europe

GLE underlines the use of small scale LNG as a key solution to a cleaner transport sector, taking into account potential environmental and other benefits, safety, and the EU targets for the reduction of emissions. This is particularly important as traditional, oil derived transport fuels have been notoriously difficult to replace by cleaner fuels, especially in the heavy transport sector.

4.2.1. Road transport

LNG has much to recommend it: heavy trucks that run on it can work at night in city centres as they are so much quieter than diesel. But currently there are only about 40 LNG refuelling stations in Europe available.

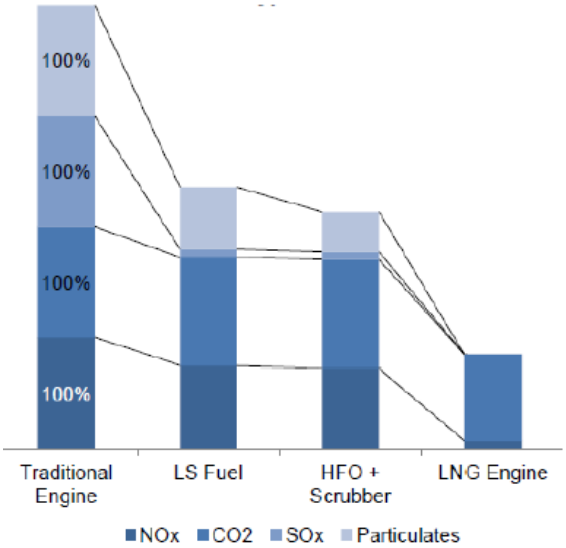
In addition, local service vehicles such as refuse collection and buses but also trains are an option for the use of LNG as fuel.

The vehicle and refuelling technology is already available.

4.2.2. Maritime transport

The International Maritime Organization (IMO) controls pollution from ships through the "International Convention on the Prevention of Pollution from Ships", known as MARPOL 73/78. The MARPOL Convention has been amended by Annex VI titled "Regulations for the Prevention of Air Pollution from Ships". This annex sets limits on NOx and SOx emissions from ship exhausts, and prohibits deliberate emissions of ozone depleting substances. The requirements are split in two categories: global requirements and more stringent requirements applicable to ships in Emission Control Areas (ECA). An Emission Control Area can be designated for SOx and particle pollution, or NOx, or all three types of emissions from ships. In 2015, the ECA limit of sulphur limited is to 0,1% by mass. In 2020, the global limit for sulphur will be lowered from 3,5% to 0,5% by mass. The areas affected are illustrated below.

In order to be able to meet the new requirements, ship-owners currently have three choices if they want to continue sailing in an ECA from 2015, and globally from 2020: They can switch to low sulphur fuel, install an exhaust scrubber, or switch to LNG fuel. According to data from engine manufacturer Rolls-Royce (see chart), relative emissions for these various compliance options can be compared as follows, clearly demonstrating the LNG propulsion option as the overall environmental winner.



Economic studies conducted by DNV (Det Norske Veritas) for the three solutions to meet the ECA requirements, LNG, distillate fuel and Heavy Fuel Oil (HFO) with scrubber indicate that LNG is the preferable option in a lifecycle perspective. This is due to the predicted lower cost of LNG over distillate fuel and HFO, more

than compensating for the higher investment costs of LNG fuelled ships. The added investment cost of choosing LNG fuel for new ships is expected to decrease in the future, which will further reinforce the advantage.

The strict emission regulations of ECA and IMO has together with a projected competitive gas price made DNV anticipate that a considerable share of new ships will have run on LNG, especially in short-sea shipping and coastal trades. DNVs case study, Shipping 2020, anticipates that between 10% and 15% of the new buildings delivered up to 2020 will run on LNG. This equates to about 1000 ships. In 2020, the number of ships using LNG will increase significantly with IMOs introduction of a global sulphur limit. This creates a large market for bunkering stations, and DNV expects that there will be a significant increase in the number of bunkering terminals by 2020, especially within the ECAs, but also to serve the big deep sea trades.

5. Barriers to be overcome

The two main barriers to be overcome to boost the development of Small Scale LNG are the availability of the infrastructure and the legal framework.

5.1. Infrastructure

The main barrier against widespread uptake of Small Scale LNG is the lack of supply infrastructure. The current value chain of LNG is built up to deliver full sized LNG carrier cargoes, about 150000 m3, to receiving terminals for re-gasification and distribution through gas pipelines. In general, the infrastructure for small scale LNG is not developed enough to supply ships, trucks, buses, and trains with the quantity they require and at the geographical locations they need to have a secure and efficient supply.

In this context, existing related infrastructures (i.e. LNG plants, gas pipelines) should be integrated, as much as possible, into the supply chain of alternative fuels (natural gas) in order to avoid unnecessary investments which would be reflected on the final price assumed by customers.

The LNG value chain needs innovation and investment in order to be able to increase small scale LNG volumes. GLE contributes to the change in the LNG value chain. An increasing number of European LNG terminals are offering and will offer small scale services in the near future. GLE is committed to contribute to help further develop the necessary conditions to enable investments in small scale LNG, in particular from the perspective of the LNG terminal operators.

5.2. Legislative framework

In general, LNG has not been handled in small quantities in populated areas and near the general public. Consequently, there has been no need to develop legislation that governs this type of operations. In most countries, this means that project specific risk analysis, operational procedures, etc. need to be developed. This is an extra burden on a project, and may often be time consuming, especially because most Authorities will have a quite a steep learning curve to climb before they can make reasonably sound judgements on the matter.

It is recommended that further research is undertaken into potential policy measures and how they should be implemented in the EU to achieve the desired results. Measures to be considered with the greatest potential are:

- Measures aimed at incentivising the investment in small scale services at LNG terminals and provision of natural gas refuelling infrastructure should be considered. This could include allocating specific funding and subsidies loans/grants for the development of small scale services and public and private natural gas refuelling infrastructure.
- Through the introduction of vehicle purchase/substitution subsidies, and subsidised loans for the purchase of natural gas trucks and ships (or their conversion), economic barriers to the purchase of natural gas vehicles could be removed.
- Taxation-based measures, such as reduced taxation schemes for natural gas fuels, tax benefit schemes for vehicles and company car reduced income tax schemes could contribute to ensuring running costs associated with natural gas vehicles remain attractive.
  There is a risk of taxing LNG at parity with liquid fuels, since LNG is a liquid. Chemically LNG is the same as compressed natural gas, but CNG, another vehicle fuel, is not taxed at the same high rate as diesel. Conversion to LNG therefore could benefit the environment but hurt the treasury.

5.2.1. LNG as fuel for road transport

- The EU is likely to create a strategy for heavy goods vehicles, as there is currently no EU legislation aimed at GHG emissions from these vehicles. The EC commissioned a study in 2011 to consider a range of policy instruments for tackling GHG emissions that could be implemented in this sector at the European level.
- A lack of standardisation constrains the development of LNG as fuel for road transport. The following standardisation is requested:
  - Create an **harmonized regulation** for natural gas refuelling station using a liquefied storages.
  - Define a standard LNG **temperature and pressure** requirement for the vehicles.
  - Define a standard vehicle **tank execution** whether it is single or dual nozzle.
  - Define standard **fuel quality** requirements for LNG vehicles.
  - Standardize and harmonize the **refuelling nozzles** at least within European Union.

5.2.2. LNG as fuel for the maritime sector

- In order to promote the use of natural gas ships, the most successful policy measures are likely to include those aimed at increasing the number and emission limits of Emission Control Areas (ECAs).
  Unfortunately, the International Maritime Organisation (IMO) has decided to postpone the entry into force of nitrogen oxide (NOx) emissions limits for ship engines from 2016 to 2021. Therefore, due to IMO's sudden and abrupt change of direction, Europe should act by itself and set clean engine standards at EU level.
- Despite several ongoing initiatives, there is currently no comprehensive (international) legislation available for the bunkering of LNG as a fuel. In order to allow safe bunkering operations, there is a need for (standardized) technical requirements for the equipment and for operational procedures (e.g. with regard to safeguards and safety distances).
- Furthermore, in order to be time-efficient, the possible concurrency of LNG bunkering with cargo handling and passenger embarking or debarking is a point of interest.
  - The regulatory framework for seagoing vessels that is covered by the International Maritime Organization does not include the transfer of materials from one vessel to another. Advice and support of the transfer operations are captured in standards and best practices of societies like 'The society of international gas tanker & terminal operators' (SIGTTO) and 'The oil companies international marine forum' (OCIMF).

- The use of LNG as fuel will create new hazards compared to conventional fuels. Perform a training needs analysis for people who board LNG fuelled vessels and trucks in their line of duty, e.g. ship pilots, truck drivers, surveyors, government inspectors, customs officials, firemen, rescue services,... and on how to potentially enforce this by law.

- To create a possible market for LNG propulsion of inland vessels, European regulations need to be adapted to allow shipping fuels with flashpoints lower than 55°C. Before this can be accomplished the European legislations must be extended with additional safety rules for the application of LNG propulsion systems.

6. Ongoing development

In short, there is an impressive amount of ongoing work to break through the barriers to implement LNG as a fuel described above. Just a few of them are mentioned here:

6.1. Small Scale services offered by GLE members

GLE members are interested in supporting the small scale LNG development in Europe. The European LNG terminal operators are increasing their efforts to provide small scale services. Some operators already offer small scale services; some are in the planning phase. These services include

- Reloading and trans-shipment,
- loading of bunkering ships,
- truck loading or
- rail loading, whereas rail loading isn't offered in Europe yet.

Additionally, the GIE General Assembly approved the budget for a GLE study in 2013 on small-scale LNG development. The GLE members agreed to use this budget to develop a map showing the small scale LNG infrastructure and projects but also missing links in the European network. In addition to the transport sector, the study shall support the development of the use of LNG in off pipeline locations. It is expected to be ready at the end of 2013.

6.2. Port initiatives

The large North European Ports Rotterdam, Zeebrugge, Hamburg, Antwerp and several others communicated plans for LNG availability within the next few years. They have collaborated with States, gas and LNG terminal companies, and companies from the maritime cluster on a feasibility study for an LNG filling station infrastructure and test of recommendations named "North European LNG Infrastructure Project". The project has resulted in recommendations for regulations, guidelines and industry standards for small scale bunkering. The report expects a range of small-scale terminals to be established in Norway, Denmark, Sweden, Finland, Germany, Belgium and Netherlands within 2020. Most of the key ports in the area have followed up with areas projects to move ahead towards implementation.

6.3. Legislative framework

On 24 January 2013 the European Commission announced within the Clean Power for Transport Package a Communication on a European alternative fuels strategy, a Directive focusing on infrastructure and standards and an accompanying document describing an action plan for the development of LNG in shipping.

- LNG is used for waterborne transport both at sea and on inland waterways. LNG infrastructure for fuelling vessels is at a very early stage, with only Sweden having a small scale LNG bunkering facility for sea going vessels, with plans in several other Member States. The Commission is proposing that LNG refuelling stations be installed in all 139 maritime and inland ports on the Trans European Core Network by 2020 and respectively 2025.

- LNG is also used for trucks, but there are only 38 filling stations in the EU. The Commission is proposing that by 2020, refuelling stations are installed every 400 km along the roads of the Trans European Core Network.

The feedback of the GLE members regarding this initiative is included in the 'GIE position paper regarding the Clean Power for Transport Package announced by the European Commission on 24 January 2013', published on the GIE website in July 2013.

6.4. Standardisation

On 6 June 2013, the long awaited ISO Technical Specification of LNG bunkering was published on the International Association of Oil & Gas producers' (OGP) website for review. The document has been developed by an international committee of experts with representatives from classifications societies, LNG suppliers, flag states, equipment suppliers, shipping companies etc.

The technical specification provides guidance for the planning and design of

- the bunkering facility
- the ship/bunkering facility interface
- procedures for connection and disconnection
- the emergency shutdown interface, and
- the LNG bunkering process control

and thereby ensuring that an LNG fuelled ship can refuel with a high level of safety, integrity and reliability regardless of the type of bunkering facility.

Recognising the industry cannot wait and that the characteristics of LNG fuel differ significantly from other marine fuels, the document has been issued for pre-standardisation purposes with the intent to develop it over time into an ISO International Standard.

An ISO standard can be referenced by local Authorities, and can form a main basis for their approach for governing LNG bunkering. Countries will implement this in different ways, but hopefully the ISO standard can serve as a common denominator.

7. Conclusion

There is a growing interest in LNG fuel as a result of stricter emission requirements and a competitive LNG price. There are trucks, buses, generators and ships already running on LNG and the number of LNG fuelled engines are increasing. Development of the LNG value chain has given better access to LNG as a fuel for consumers only in certain areas.

There is still a long way before there is a wide and trustworthy supply chain and proper legal framework for small scale LNG. GLE is excited about the opportunities offered by Small Scale LNG and will play its part in removing the barriers and promoting its further development in a safe way.

8. Sources

- GLE Position paper: GLE's views on Small Scale LNG, 14 December 2011
- North European LNG Infrastructure Project: A feasibility study for an LNG filling station infrastructure and test of recommendations, Danish Maritime Authority, May 2012
- REPORT: Modalities for the provisioning of LNG as shipping fuel in Flemish ports: PART II: Legal & Regulatory; DNV, FLEMISH DEPARTMENT OF MOBILITY AND PUBLIC WORKS, 10 July 2012
- The LNG Value Chain Needs Innovation, A Paper for Gastech 2012, London, By Graham Bennett, Vice President DNV, Business Development Director Maritime Oil & Gas Europe
- Presentations from experts provided at several conferences
- Other public sources, articles etc.