
Economic Commission for Europe
Committee on Sustainable Energy

Group of Experts on Gas

Third session

Geneva, 21-22 April 2016

Item 10 of the provisional agenda

Task Force D: Recommendations on removing barriers to the use of natural gas as a transportation fuel

UNECE Group of Experts on Gas TASK FORCE D: “Removing barriers to the use of natural gas as a transportation fuel”

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.

What are the barriers?

Although natural gas vehicles have a long history in Italy where a substantial industry has developed since the mid-1930s, the commercialization of NGVs on a global basis did not begin to take shape until the mid-to-late 1980s. The first ex-factory solutions entered the market in the late 90's and early 2000's. However, the market share of NGVs around the world remains at a low level, representing between 2-3 % overall. Europe even remains below 1%. There are a few factors that contribute to the slow development of the NGV market, in particular:

- Political and regulatory framework: Few, if any national NGV markets have developed without some type of support from government, be it in the form of incentives (financial and non-financial), mandates, the development of standards and regulations (on gas quality, refuelling stations, vehicles, components).

- Technology availability: Because of a general lack of factory produced vehicles (with the exception of Europe with a growing offer) in most markets, retrofit NGV systems remain popular. High quality factory-built vehicles (OEMs – original equipment manufacturer) have entered the global market and keep increasing (particularly in Europe), although their availability does not yet support robust demand enough to interest the vast majority of vehicle manufacturers to produce and market NGVs. Funding of NGV research is limited.
- Cost and Economics: Natural gas consistently has been 30-50% less expensive than gasoline and diesel fuel on an energy equivalent basis. But, like all alternative fuels, the cost of the vehicles generally is higher than traditional petroleum-fuelled vehicles. Fortunately the lower price of natural gas tends to make NGVs cost-effective over their full life cycle, particularly for higher fuel-consuming vehicles. However, low oil prices remain an imminent risk to further NGV uptake.
- Support from the natural gas industry and the development of a refuelling infrastructure: Natural gas companies are both fuel suppliers as well as potential NGV customers, using them as gas company fleet vehicles. But the expansion of a CNG and LNG refuelling infrastructure has progressed relatively slowly. Frequently there are not yet enough NGVs to make an economic case for individual refuelling stations when the critical mass of NGVs is lacking. Nor have many large petroleum suppliers embraced NGVs sufficiently to create a substantial fuel station network.
- The distribution and simultaneous use of LNG for inland navigation and trucks is not yet sufficiently coordinated. The development of LNG use for ships and bunkering facilities require time and substantial investments.
- CNG and LNG fuels have been given different names in various countries and regions (GNC, Fordongas, Metano, Fisikon, Erdgas, etc.), making it more difficult to be recognisable to customers.
- Lack of price transparency for different conventional and alternative fuels (litres, kg, kWh)

Specific to the maritime sector:

- Many market players still have the perception that the commercial risk of choosing LNG as ship fuel is still high. The relatively high capital cost of the system installation can be a barrier in some cases. LNG uptake is expected to grow fast in the next 5 to 10 years, first on relatively small ships operating in areas with developed gas bunkering infrastructure, where LNG prices are competitive to HFO prices.
- Owners will not start using new fuels if an infrastructure is not available, and energy providers will not finance expensive infrastructure without first securing customers.

Barriers identified by NGV stakeholders have been characterised by some as either ‘internal’ or ‘external’ to the industry. ‘Internal’ barriers are things such as industry communications (within the industry and external to customers) or a need for more gas industry enthusiasm for NGVs. ‘External’ barriers are more on the regulatory or political level. Thus, there is an issue of NGV perception versus reality. For example, NGVs tend to be viewed as less safe than petroleum-fuelled vehicles, although the opposite is true. Information dissemination and public education does not seem to be consistent and assertive enough to overcome this image, although natural gas is appreciated for its lower cost and environmental quality.

How to overcome these barriers?

Recommendations to overcome barriers must be distinguished and addressed mainly to the national and international government level (for creating the appropriate political and regulatory framework conditions) and industry, involving manufacturing of vehicles, components and stationary equipment, as well as production and distribution of gas (including natural gas and renewables).

At government level:

- Maintain level playing field for alternatives fuels, avoid unilateral decisions and hopes in a single fuel as the “silver bullet” solution. National and long-term planning for natural gas as a transportation fuel (2030-2050) is needed to create confidence for both consumers and investors.
- Create minimum level of ambition to develop CNG and LNG refuelling network: The EU has introduced the Clean Power for Transport (CPT) package in 2014, including Directive 2014/94/EU on deployment of alternative fuels infrastructure. Member States of the EU will have to develop so-called National Policy Frameworks by November 2016, including roll-out plans and supporting measures for CNG and LNG fuel infrastructures. Other regions should follow this example and create an internal market for natural gas as a vehicle fuel.
- Incentives to NGV buyers and users in terms of some financial support to cover upfront costs and encourage more customers to switch to CNG and LNG. Vehicle fleets will trigger further investments in refuelling infrastructure.
- Sustained tax regime (= maintain price differential of 30-50% for natural gas vs petroleum fuels) as prerequisite for further NGV growth.
- Soft adoption measures supporting NGVs: road toll reductions, free parking, preferential access to low pollution or low noise areas and city centres, public procurement giving priority to new CNG/LNG vehicles, etc.
- Biomethane and synthetic methane (power to gas) can meet an important share of the current fuel demand, provided biomethane would be made available for the transport sector and not be subsidised to produce electricity.
- Vehicle homologation and emission legislation must consider life-cycle emissions of CO₂ when using blends of natural gas and renewable methane.
- Introduction of a new and transparent pricing policy based on litre equivalence or energy content.
- Provide stronger R&D support to deploy full NGV potential, including for vehicles, engines and components, such as gas storage in on-board vehicles tanks and stationary equipment.

At industry level:

- Develop full potential of NGV engines (efficiency, horse power).
- Improve NGV product portfolio (OEMs), additional manufacturers needed. Manufacturers of NGV light and heavy duty vehicles should increase their efforts to market their NGVs as legitimate alternatives to petrol and diesel. This extends to the vehicle dealerships where customers typically are encouraged to buy diesel or gasoline vehicles much more so than NGVs.
- Development of technical standards are critical to the development, promotion, commercialisation and on-going use of safe and reliable technologies and equipment (i.e.: UNECE R.110 must be consistent and to the best extent possible harmonised with the ISO NGV standards or the recently developed a world first draft standard “Bunkering LNG”, with

coordination with SGMF (Society for Gas as Marine Fuel), Klaipėdos Nafta, NGVRUS (NGV Russia) and ANGVA (Asia-Pacific NGV Association).

- Natural gas as a propulsion fuel for the maritime sector has only recently begun and now is expanding steadily due to strict emissions control regulations mandated by the United Nations International Maritime Organization (IMO). As with land vehicles, new challenges are being identified and overcome in order to supply fuel (LNG mostly but also CNG), such as the need to develop new engines, fuel storage systems, and fuel dispensing technologies and techniques. There are many barriers to be overcome, not the least of which is to create an integrated knowledge base that can help the maritime industry deal effectively with the advent and growth of natural gas as a marine fuel.
- Work with the same terminology and similar branding to convey familiarity to new and existing customers.
- Use professional training opportunities for users and operators of NGVs and equipment. For example, the Spanish association of gas for mobility, GASNAM, is preparing a wide catalogue of training courses at different levels for the people to be involved in LNG bunkering operations, all in accordance with the IGF Code.
- Leverage supply of LNG to ships as there are LNG road stations nearby. The supply could be supported by the use of LNG on satellite plants all around water ways and ports.

Special tasks addressed to the natural gas industry level:

- Ensure commercial viability through strong commitment of the natural gas industry across the full 'value chain' from production, transportation, distribution and retailing.
- Gas industry stakeholders need to build more refuelling stations and, in conjunction, advertising more about NGV and refuelling availability. This would support the more rapid development of a second hand market for NGVs, which further consolidates the economic position of customers (private and commercial) to purchase NGVs.
- Provide an acceptable and broadly used gas quality standard compliant with vehicle technologies (i.e.: limit odourisation).
- Provide more reliable figures and explaining the source of the fuel better, i.e. studies on well-to-tank emissions of natural gas.

Joint tasks for governments and industry together:

- Education of the public and potential users via communication campaigning, including media and workshops. Better public information about clean, economical NGVs is needed generally and in particular in specific regions where commercial and light duty NGVs are available. This information must be generated by the fuel suppliers (i.e. natural gas companies), vehicle manufacturers, NGV industry suppliers and governments.
- Better information about the existing CNG and LNG refuelling network and accessibility is required so that customers know where and how they can refuel NGVs.
- The distribution and simultaneous use of LNG for inland navigation and trucks must be addressed by aligning LNG deployment plans.

Back ground: Why natural gas in transport?

The use of natural gas in transport is cleaner and competitive with petrol and diesel in all modes of transport. CNG and LNG technologies are very mature, which makes them promising solutions from environmental and operational points of view. The increased use of natural gas in the transport sector offers reductions of carbon dioxide as well as other pollutants. Customers retain all of the

comforts to which they are accustomed, since gas-based transport provides the same options as oil-based transport. State-of-the-art natural gas vehicles meet the European targets for 2020 on CO₂ emission reduction already today (95gCO₂/km for cars and 147 gCO₂/Km for vans). Natural gas is the only commercial fuel alternative to diesel achieving lower CO₂ emissions. Natural gas contains less carbon than traditional hydrocarbon fuels and therefore emits much less CO₂ as a vehicle fuel: 25% on average, moving toward carbon neutral mobility when blended increasingly with renewable-sourced methane. Natural gas is the only suitable fuel for the marine and inland navigation sector and helps to eliminate sulphur dioxide (SO_x) emissions entirely, which complies with new legislation reducing sulphur content in shipping fuels to 0,1% in coastal areas in the Northern and Baltic Sea and North America.

In the maritime sector, Sulphur Emission Control Areas (SECAs) or Emission Control Areas (ECAs) are sea areas in which stricter controls were established to minimize airborne emissions (SO_x, NO_x, ODS, VOC) from ships as defined by Annex VI of the 1997 MARPOL 1 Protocol which came into effect in May 2005.

Annex VI contains provisions for two sets of emission and fuel quality requirements regarding SO_x and PM, or NO_x, and a global requirement and more stringent controls in special Emission Control Areas (ECA). These regulations stemmed from concerns about the contribution of the shipping industry to "local and global air pollution and environmental problems." By July 2010 a revised, more stringent Annex VI was enforced with significantly tightened emissions limits.

As of 2011 there are four existing ECAs: the Baltic Sea, the North Sea and the North American ECA, including most of US and Canadian coast and the US Caribbean ECA. As it can be understood, it is possible that in the following years the United Nations International Maritime Organization (IMO) will suggest the expansion of the ECAs to other zones of the world like Mediterranean Sea, Japan Sea or Norway Sea.

Besides the ECAs, there is going to be a reduction in the emissions from ships in the whole world, not only in the ECAs. Everything indicates that vessels currently use heavy fuel oil (HFO) need to change their fuel. As another alternative to keep HFO fuel is the construction of scrubbers, filters that reduce SO_x emissions but its major drawback is to do with the waste it produces.

The number of ships using LNG as fuel is increasing rapidly and more infrastructure projects are planned or proposed along the main shipping lanes. More than 50 LNG-fuelled ships (excluding LNG carriers) already operate worldwide, while another 100 new buildings are confirmed. DNV GL expects LNG to grow even more rapidly over the next five to ten years in the shipping sector and some estimates suggest the number of 1,000 non-LNG carrier vessels running on LNG in 2020 or shortly thereafter.

The benefits of natural gas use in the transport sector can be summarised as follows:

- Natural gas is the most cost-efficient CO₂-mitigation option (€/t CO₂) in the on-road transport sector compared with other alternative solutions. In cars, the break-even-mileage (km/year) for natural gas is already reached at 13,000 km versus 47,000 km for plug-in hybrids or more than 100,000 km for electric vehicles (University of Cologne, EWI, 2014).
- Dedicated compressed natural gas (CNG) and liquefied natural gas (LNG) vehicle technology is very mature and simple (using a 3-way-catalyst) and does not require costly additional

¹ MARPOL is the International Convention for the Prevention of Pollution from Ships is one of the most important international marine environmental conventions

chemical treatment (with the use of heavy systems), to meet the European and international emission limits.

- Natural gas engines can run on blends of natural gas with biomethane or synthetic methane (power to gas), with even larger GHG savings as a result. No blend limitations exist, unlike for the integration of liquid biofuels in petrol and diesel fuels. Extensive blending of natural gas and biomethane is already put into practice in countries like Sweden and the Netherlands, where renewables already account for half of the natural gas fuel demand (50%), followed by Germany and Switzerland (20%) and France (15%).
- Combustion of natural gas reduces emissions of particulate matter (PM) by up to 95% and nitrogen oxides (NOx) by up to 70% compared to the very strict emission standards for new heavy duty (Euro VI) and light duty vehicles (Euro 6), therefore making it an ideal fuel for extensive use in urban areas and improving air quality in cities. Furthermore, natural gas engines emit much lower levels of other harmful and carcinogenic pollutants like non-methane hydrocarbons (NMHC), including aromatics as benzene.
- Natural gas engines are almost 50% quieter than those powered by diesel fuel.
- Natural gas vehicles (NGVs) meet the highest international safety standards, CNG and LNG systems are tight and robust.
- Natural gas is lighter than air, making it possible for CNG or LNG vehicles to access ventilated car parks.
- Fuelling natural gas is as easy and quick as filling up with petrol or diesel.

The full potential of natural gas engines has yet to be deployed. Optimised natural gas engines (using direct injection and higher compression ratios) will become as energy efficient as diesel engines, meaning additional CO₂ and other harmful emission savings will be achieved. Further development may also include hybridisation of natural gas engines. All of the above make natural gas one of the most promising solutions in the transportation sector.

Specific to the maritime sector, the following benefits can be summarise:

- The replacement of conventional oil-based fuels (heavy fuel oil, marine gas oil, or distillate fuels) by LNG provides a significant reduction in local air pollution - ranging from emissions of SO_x (nearly 100%) and NO_x (up to 85%) to carbon dioxide, particulates (PM) and black carbon (nearly 100%). This is especially important for shipping in coastal and sensitive ecosystems. In addition, LNG also reduces CO₂ emissions by at least 20%.²

Conclusion:

The amortisation period for investments in infrastructure, technology and engine development, as well as the purchase of a vehicle, is based on long-term business cases. To justify a multimillion investment, a foreseeable and fair risk profile needs to be created. Risks must be predictable and calculable. Investors and operators of CNG and L-CNG refuelling infrastructure generally lack confidence in the policy environment to make needed long-term investments. Decided leadership from legislators and a clear commitment to NGVs at government level is therefore crucially important for investment decisions, while natural gas industry stakeholders must clearly identify the

² International ship traffic constitutes a major problem for impacts on human health in Europe with economic cost estimated at 58 bn Euros/year in the year 2000, forecasting an increase to 64 bn Euros/year for 2020, due to a general increase in the ship traffic worldwide. Hence, health and economic impacts are major drivers for timely and effective regulation of emissions to the atmosphere from shipping and other sources. Source: LNG as Fuels, IGU 2015

national, regional and or global benefit to a determined shift to natural gas in the transport sector. The main argument holding back customer acceptance is insecurity in the fuel price development (excise duty) and a limited refuelling infrastructure, where mobility will always follow a regional logic where cross-border continuity must be ensured. Collaboration between all stakeholders will be the most important factor to determine further market growth.

Contributing organisations:

On-road content and overall structure of the report:



About NGVA Europe

NGVA Europe has more than 140 members from 40 countries and promotes the use of natural gas and renewable methane as a transportation fuel. It serves as a platform for the industry involved in the production and distribution of vehicles and gas. It defends their interests to European decision makers, to create accurate standards, fair regulations and equal market conditions. NGVA Europe creates networks with interested stakeholders to reach consensus on positions and actions. It also collects, records and communicates reliable facts and significant developments in the gas vehicle market. For more information, please visit www.ngva.eu.

Maritime content:



About GASNAM

The objective of GASNAM is to act as the single Iberian platform for the promotion of natural gas as a vehicle fuel for road, railway and maritime transportation. To involve all the peninsula's relevant industry segments with the aim of using the advantages provided by natural gas as a fuel: reduced operational costs, environmental benefits, compliance with the latest emission standards, modernisation of infrastructure. Secondly, to establish harmonised legislation foremost related to security aspects, but also regarding the development of financial aids and incentives for the deployment of natural gas as a vehicle fuel. Lastly, to influence the formation of opinion among authorities, potential user companies and citizens in order to generate support for natural gas as a fuel that provides both economical and environmental advantages.