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Best Practice Policy Guidance for Liquefied Natural Gas (LNG)

Case Study: Small Scale LNG – Truck Loading

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The author of this study is Ms. Tania Meixus Fernandez of Enagás, a Spanish energy company that owns and operates the nation's gas grid and is the main transmission, LNG and storage operator in Spain. Enagás was asked by the ECE Group of Experts on Gas to lead the task force with respect to the use of LNG for truck loading services due to its experience and know-how, since it has been operating these services since the 1970s.

The Group of Experts on Gas is a subsidiary body of the intergovernmental ECE Committee on Sustainable Energy that provides a forum for multi-stakeholder dialogue on ways to promote the sustainable and clean production, distribution, and consumption of natural gas in the ECE region. Its principal areas of work are an exchange of experiences among ECE member States on the role of natural gas in the global energy mix and on the relation between natural gas and the environment.

Four task forces established under the Group of Experts on Gas are dedicated to developing several normative instruments, such as:

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

Task Force C has focussed on the use of natural gas in the form of LNG to facilitate and accelerate the commercialization of natural gas for different uses.

The United Nations Economic Commission for Europe (ECE), one of the five United Nations Regional Commissions, provides a forum through which 56 countries of North America and Western, Central, and Eastern Europe as well as Central Asia come together to forge the tools of their economic cooperation. The main areas of ECE's activity are economic cooperation and integration, environmental policy, forests, housing and land, population, statistics, sustainable energy, trade, and sustainable transport. ECE pursues its goals through policy analysis, the development of conventions, regulations and standards, and the provision of technical assistance. Energy related topics are discussed by the member States in the Committee on Sustainable Energy.

Acronyms and Abbreviations

| | |
|-----------------|--|
| CO ₂ | Carbon Dioxide |
| ECE | United Nations Economic Commission for Europe |
| GHG | Greenhouse Gas |
| GIIGNL | The International Group of Liquefied Natural Gas Importers |
| GEG | ECE Group of Experts on Gas |
| GWh | Gigawatt hour |
| LNG | Liquefied Natural Gas |
| LPG | Liquefied Petroleum Gas |
| NO _x | Nitrogen Oxides |
| SO _x | Sulphur Oxides |

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Introduction

This report provides a picture of the regasification terminals in the ECE region. It differentiates between those that are currently offering truck-loading services and those that do not, and explains the benefits of implementing this kind of service through a case study that examines the roll out of LNG trucking in Spain since 1970.

Key messages:

- Natural gas, including LNG, has clear environmental benefits with respect to carbon-intensive fossil fuels. Substituting other fossil fuels by natural gas can substantially reduce the emissions of CO₂ and other pollutants (particles, NO_x, SO_x) in the short term and contribute to the long-term decarbonisation policy objectives, bringing significant air quality benefits for citizens.
- Regasification terminals can play a key role in ensuring security of supply, diversification of supply, as well as enabling the integration of renewable energy.
- LNG truck loading is a cost-effective means for countries that need a solution to reaching remote areas.
- LNG truck loading can temporarily colonize areas where there is a lack of gas grid until the network is developed and reaches these places.

Due to the impossibility of developing the full transportation and distribution grid to reach remote areas, LNG truck loading is a small-scale service developed as a cost-effective solution for those customers who are willing to use natural gas as their main fuel, but their connection to the grid is not economically justified, or it will take some time until the grid is fully developed. Regulatory frameworks need to be adapted in order to enable new services such as truck loading.

LNG is transported in methane tankers at -160°C. It is offloaded at the regasification plants. The temperature of LNG is raised through a physical process, generally using salt water vaporisers, transforming it into gas. The natural gas is then injected into pipelines and transported throughout the network.

For traditional LNG regasification terminals, the possible addition of LNG trucking could be one of the first aspects to look at when considering developing additional services. Additional services can be developed under certain circumstances, some of which can be fostered by policymakers through incentive regulation and the removal of barriers.

Three potential markets where LNG truck loading can be used are:

1. Distribution market – remote areas not being connected to the gas grid for both industrial and domestic usage;
2. Transport sector – parties considering using LNG;
3. Power generation and Industrial customers – small power plants used for peak shaving where these are still supplied with fuel oil or industrial customers who may consider this a more feasible option.

As a first step, it needs to be considered that getting LNG to remote areas will depend on the establishment of LNG infrastructure, consisting of LNG trucks and LNG satellite terminals. In addition, LNG plants would obviously need to be adapted by adding LNG truck loading facilities.

In addition, truck loading with satellite plants presents a good opportunity to temporarily colonize areas where there is a lack of gas grid until the network reaches this place.

Natural gas, including LNG, has clear environmental benefits (the lowest GHG emissions of all the fossil fuels; local pollution; etc.) with respect to carbon-intensive fossil fuels, therefore being part of the green solution. Substituting other fossil fuels by natural gas can substantially reduce the emissions of carbon dioxide (CO₂) and other pollutants (particles, nitrogen oxides (NO_x), sulphur oxides (SO_x)) in the short-term, and contribute to long-term decarbonisation policy objectives, bringing significant air quality benefits for citizens. Furthermore, the European Union has approved a Directive, which includes natural gas, as an alternative fuel for many uses¹. It is a readily available solution in the power and transport sector, with already existing infrastructure.

On the other hand, as traditional fossil fuels have generally been more expensive than natural gas (except for coal), the strong push for LNG truck loading is supported for economic reasons, since LNG could be an interesting substitute for liquefied petroleum gas (LPG), diesel and fuel oil in terms of economic and environmental benefits. However, investments in natural gas need a long-term outlook.

Most of the times the main challenge is that the necessary infrastructure is not in place (LNG regasification plants, LNG satellite plants), which means that ECE member States are not fully aware of LNG trucking as a means to reaching remote areas and as an interim solution. There are barriers that need to be removed, although in parts of Europe, namely in Spain, this service has been provided for many years.

Such barriers cover several areas such as infrastructure development, regulatory framework, fiscal regime, technical standards, safety, training, etc.

Nevertheless, in order to know whether LNG trucking or the import of these services, could be an option in each country of the ECE region, a further business case analysis on a country by country level should be performed.

¹ Directive 2014/94/UE of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0094&from=EN>

Policy recommendations

In order to develop small-scale truck loading services, it is important to consider the following aspects:

- The development of the gas network, including LNG satellite plants in order to build a market for small-scale LNG.
- Harmonization, at least at regional level of the technical standards necessary for LNG truck loading.
- Governments and authorities should develop a regulatory framework and fiscal regime that would allow for the construction of the main LNG facilities that would guarantee a favourable environment for investments in truck loading services.
- Best practices on safety and design for truck loading projects should be shared in order to ensure that the safety and technical standards are as high as possible.
- Standards for training should be developed as well as fostering the adoption of certification accreditation mechanisms for the staff who work in truck loading.

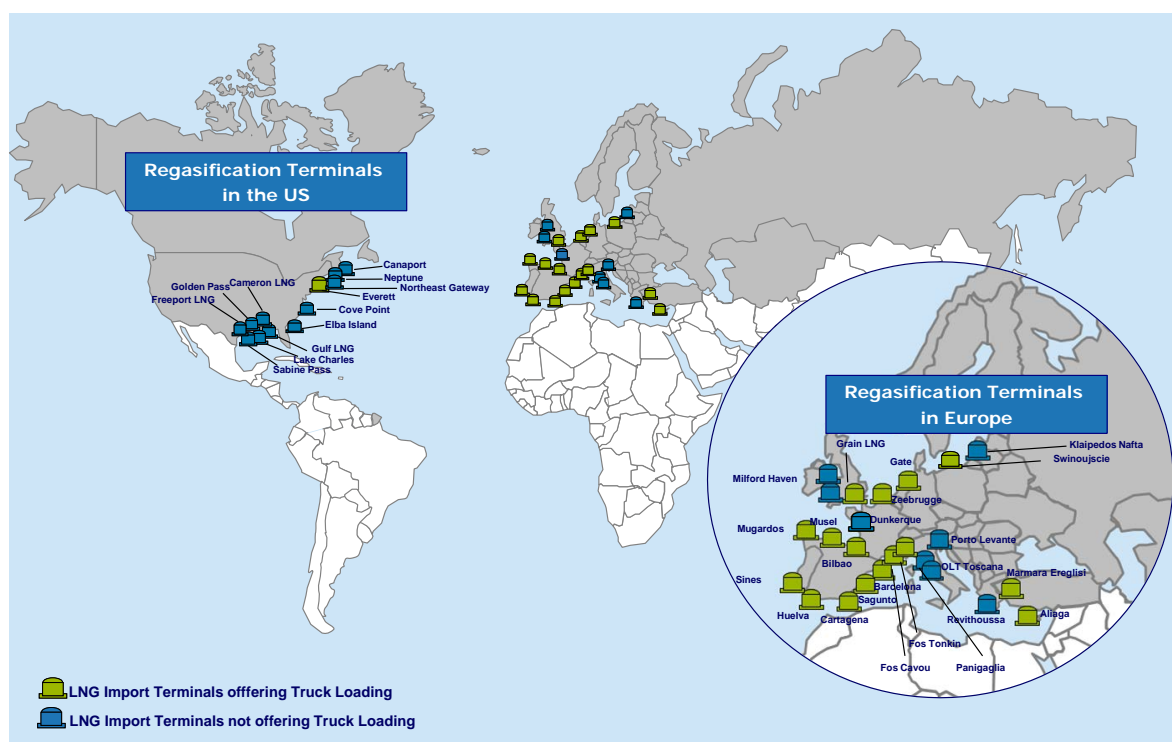
LNG Truck Loading

Situation in the ECE Region

The first issue that has been analysed is the situation with respect to locations offering truck loading services in the ECE region.

Figure 1 shows the location of regasification terminals in the ECE region, differentiating between those that offer LNG truck loading services and those that are currently not offering them.

Figure 1
LNG terminals in the ECE region with/without truck loading services



Source: GIIGNL Annual Report, 2016 Edition²

To date, LNG truck loading is offered at regasification terminals and through ISO containers which are loaded next to shale gas production fields and then distributed through trucks, trains and even ships. Floating Storage Regasification Units (FSRU) have been included in the map, however they are not within the scope of the document since there is no certainty as to the way this kind of terminal will be able to accommodate truck loading facilities.

Based on the International Group of Liquefied Natural Gas Importers (GIIGNL) Annual Report, 2016 Edition, in the United States the only regasification terminal currently providing truck loading services is Everett, near Boston. The LNG terminal delivers between 6,000 and 12,000 trucks of LNG per year to different customers.³ In general

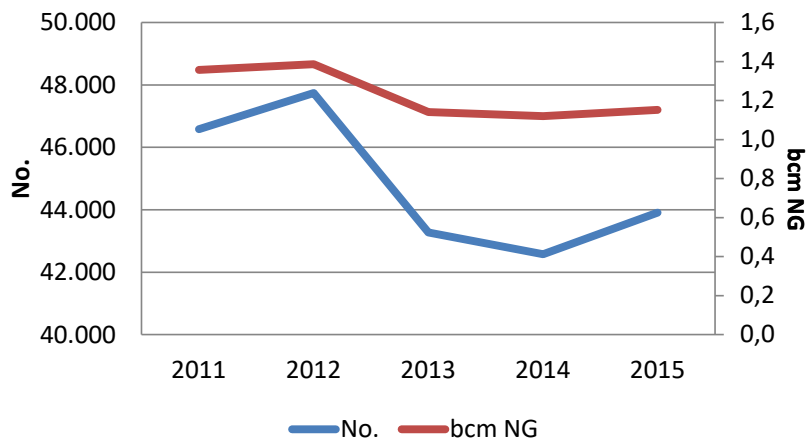
² The LNG Industry, GIIGNL Annual Report, 2016 Edition:
http://www.giignl.org/sites/default/files/PUBLIC_AREA/Publications/giignl_2016_annual_report.pdf

³ Press release: Everett LNG terminal in the US, 2 July 2014:
<http://www.engie.com/en/news/everett-lng-terminal-united-states/>

terms, the LNG truck loading services are not sufficiently developed. The European market however, is very different to that of the United States. In the context of this publication, Europe is considered to be the geographical region within the wider ECE region. Most of the regasification terminals with truck loading services are based within the European Union (EU). Additionally, both LNG terminals in Turkey also offer this service.

The number of loaded trucks and volumes of LNG (in bcms) in the EU in recent years is summarized in Figure 2.

Figure 2
Truckloading in the European Union

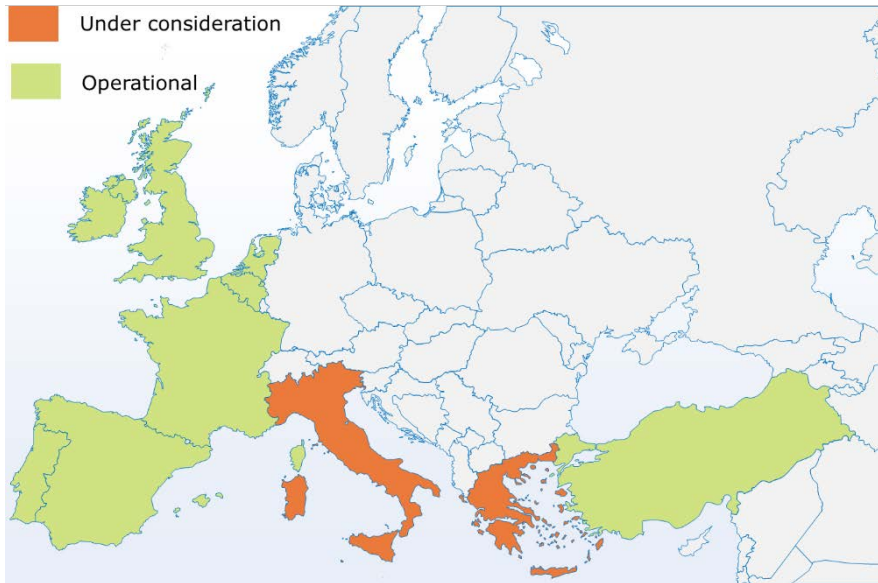


Source: GLE New LNG Services Inventory⁴

The countries offering LNG truck loading services in Europe are: Belgium, France, the Netherlands, Spain, Portugal, the United Kingdom and Turkey. There are additional LNG terminals in other countries such as Greece or Italy that are currently considering offering these services in Europe and thus, are currently undertaking feasibility studies.

⁴ GLE New LNG Services Inventory, March 2016:
<http://www.gle.eu/index.php/maps-data/gle-lng-services-inventory>

Figure 3
Operational/Under Consideration LNG truck loading services in Europe



The capacities offered per LNG regasification terminal with regard to truck loading services is shown in Figure 4.

Figure 4
Truck loading development in the EU

| Country | Belgium | France | France | France | France | Greece | Italy | Italy | Italy | Lithuania | Netherlands | Poland | Portugal |
|-----------------------------------|-----------|---------------------|---------------------|---------------------|--------------------|-------------|---------------|--|--------------------------|---|--------------------------------------|-------------|----------------|
| Company | Fluxys | Dunkerque LNG | Elengy | Elengy | Fosmax LNG | DESFA | ADRIATIC LNG | GNL Italia | OLT Offshore LNG Toscana | Klaipedos Nafta | Gasunie | GAZ-SYSTEM | REN Atlantico |
| Facility | Zeebrugge | Dunkerque LNG | Montoir de Bretagne | Fos Tonkin | Fos Cavaou | Revithoussa | Porto Levante | Panigaglia | | Independence | Gate terminal | Swinoujscie | Sines |
| Truck loading | yes | no | yes | yes | yes | no | no | no | no | no | yes | yes | yes |
| Capacity: (LNG) m ³ /h | 75 | but under study | 1 x 100 | 1 x 100 | - | 1 x 100 | | Feasibility study in progress; FID expected by | | but available from 2017, EPC contract is signed | 1 x 100 | 2 (+1) x 90 | 2 x 50, 1 x 75 |
| comment | | 3 x 100 under study | 3 x 100 under study | 3 x 100 under study | through Fos Tonkin | by end 2017 | | | | | second under construction for 1Q2017 | | |

| Country | Spain | Spain | Spain | Spain | Spain | Spain | Spain | UK | UK | UK | Turkey | Turkey |
|-----------------------------------|--------|-----------|-----------|--------|----------|----------|---------|---------------|---------------|---------------|-------------------------------|---------------------------|
| Company | BBG | Enagas | Enagas | Enagas | Enagas | Reganosa | Saggas | Dragon LNG | Grain LNG | South Hook | Marmara Ereğlisi LNG Terminal | Aliaga Izmir LNG Terminal |
| Facility | Bilbao | Barcelona | Cartagena | Huelva | EL Musel | Mugardos | Sagunto | Milford Haven | Isle of Grain | Milford Haven | Marmara Ereğlisi | Aliaga |
| Truck loading | yes | yes | yes | yes | yes | yes | yes | no | yes | no | yes | yes |
| Capacity: (LNG) m ³ /h | 2x27 | 3 x 91 | 3 x 91 | 3 x 91 | 3 x 91 | 2 x 75 | 2 x 70 | | 2 x 80 | | 3 x 75 | Not found |
| comment | | | | | | | | | | | | |

Source: GLE New LNG Services Inventory⁵

⁵ GLE New LNG Services Inventory, March 2016:
<http://www.gle.eu/index.php/maps-data/gle-lng-services-inventory>

Spanish Case Study

Small-scale LNG services have been developed in Spain for several decades. In recent years, the demand for LNG truck loading services has represented around 4-5 per cent of the conventional demand in the Spanish gas system.

The development of LNG satellite plants started in 1970 with its first facility in Figueras (Gerona). LNG was supplied from the Barcelona regasification terminal, which started operating in 1969. The main objective was to supply the area where there was a lack of transmission infrastructure and to do so in a simple and economically feasible way.

Once Cartagena and Huelva were put into operation at the end of the 1980s, new satellite plants were then deployed along the Spanish coastline.

Figure 5

Number of trucks that can be loaded by Spanish LNG terminals per day

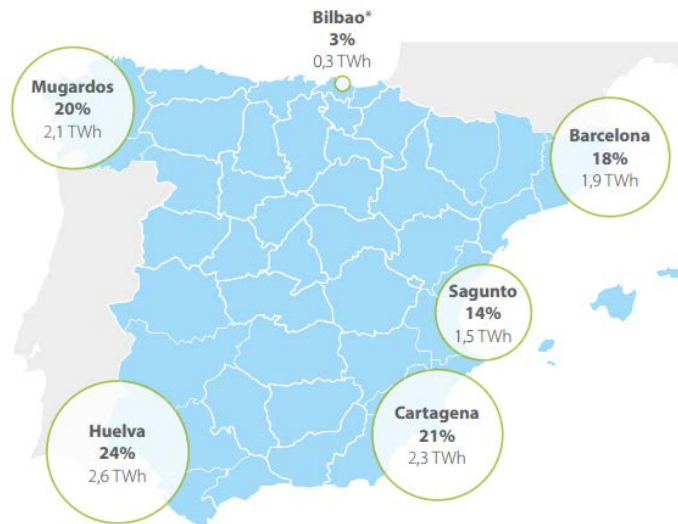
| Barcelona | Cartagena | Huelva | Sagunto | Bilbao | Mugardos |
|-----------|-----------|--------|---------|--------|----------|
| 50 | 50 | 50 | 40 | 15 | 30 |

Spain accounts for almost 60 per cent of the truck loading capacity in Europe⁶.

LNG through truck loading services is supplied to industrial customers via satellite plants. During 2015, a total of 10,719 GWh/year was supplied via 34,400 LNG trucks.

⁶ GLE New LNG Services Inventory, March 2016:
<http://www.gle.eu/index.php/maps-data/gle-lng-services-inventory>

Figure 6
Truck Loading in Spain in 2015



Source: Spanish Gas System Report 2015⁷

During the period 2011-2015, almost 200,000 LNG trucks were loaded in Spain.

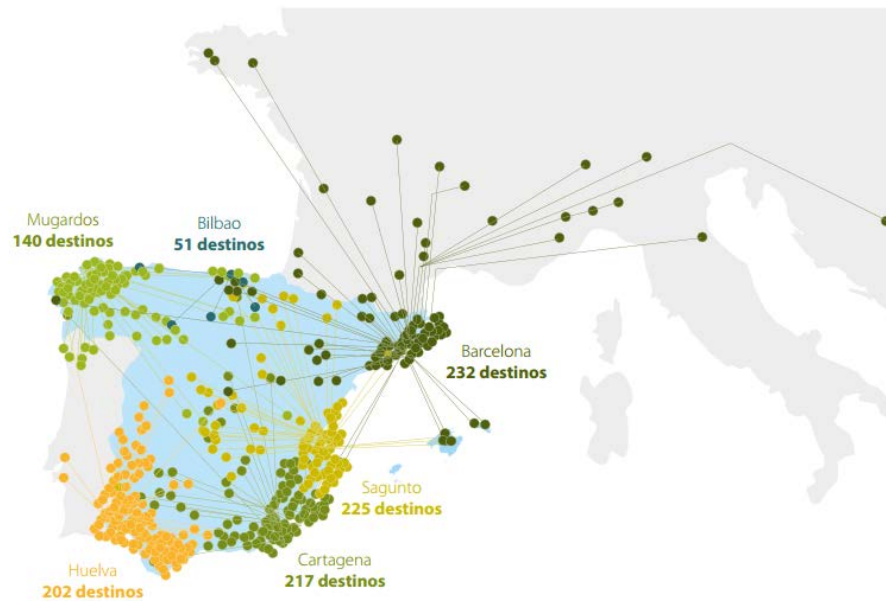
The destinations for these trucks were largely satellite plants, most of them connected to industrial customers. These industrial customers then regasified the LNG and supplied it to local distribution networks, industrial clients and small and medium enterprises (SMEs). Even relatively large cities such as Albacete or Almeria were supplied by LNG trucks without any significant incidents. The use of LNG truck loading is particularly useful in countries where the pipeline network infrastructure has not yet reached all potential users or where the investment cost for connecting those gas users to the grid is uneconomic. Enagás, in its role as technical manager of the Spanish gas system, performs the monitoring of all the steps.

In 2015, the number of final destination points was 869, which represented an increase of 10 per cent over the previous year. The Barcelona LNG terminal supplied the greatest number of final destinations amounting to a total of 232 active destinations, followed by Sagunto, Cartagena and Huelva, all of them with over 200 active destinations, Mugardos supplied 140 destinations and Bilbao 51 active destinations.

Apart from the local supplies performed in 2015, namely to satellite plants, LNG trucks leaving from Spanish regasification terminals, also supplied other countries such as France, Italy, Portugal, , Switzerland and The former Yugoslav Republic of Macedonia. The latter was a new destination in 2014. The number of LNG trucks with final destination outside Spain was 59 in 2015 and 35 in 2014.

⁷ Spanish Gas System Report 2015:
http://www.enagas.es/stfs/ENAGAS/GestI%C3%B3n%20T%C3%A9cnica%20del%20Sistema/Documentos/Seguimiento%20del%20Sistema%20Gasista/Sistema_Gasista_2015_optimizado.pdf

Figure 7
Total Number of Destinations by LNG Terminal in 2015



Source: Spanish Gas System Report 2015⁸

⁸ Spanish Gas System Report 2015:
http://www.enagas.es/stfls/ENAGAS/GestI%C3%B3n%20T%C3%A9cnica%20del%20Sistema/Documentos/Seguimiento%20del%20Sistema%20Gasista/Sistema_Gasista_2015_optimizado.pdf