



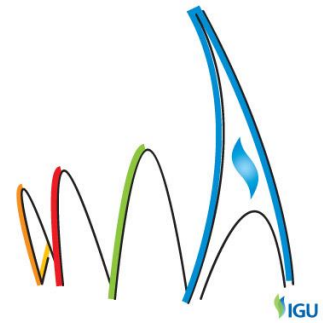
LNG re-exports

The base for the development of and Iberian Peninsula Small and Big Scale LNG Hub

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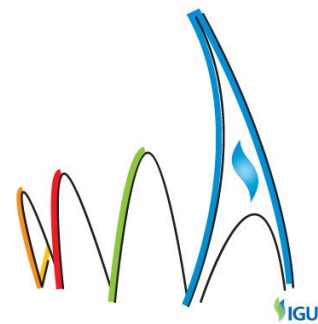
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Background

Spanish LNG regasification plants have been key infrastructures since 1969, both for the regasification and the small scale LNG (trucking and ship loading services). Nowadays, on the "golden age" of natural gas, they are key to improve efficiency, sustainability, and competitiveness on the natural gas value chain, as short to medium term market development depends on their use as LNG hub, taking profit of current long scale infrastructures to develop new small scale solutions: Low investment cost to supply new consumers and services, and LNG as a fuel. In this regard, the Spanish LNG Plants are key infrastructures to meet the aims of security of supply following the future European requirements.

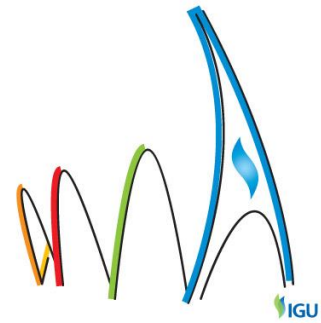
Since 2008 changing market conditions meant a decline in natural gas demand and a new demand for LNG logistic services. The difference of prices between Europe, Asia and America, and its independence from oil prices, forced Global shippers to adjust their LNG market approach by switching and optimizing their portfolios in the spot market, reducing their booked capacity, switching the LNG/NG supply balance, increasing LNG trading and requesting new LNG services. This new scenario has improved gas natural competitiveness and efficiency as a raw material, against not only coal and oil but also power. Despite this new scenario, long term contract continue since the Spanish player supply contracts remain in force.

In the new demand scenario, where competitiveness of new sources of alternative energies depends on as the life cycle efficiency of his components as the possibility to modify it by mean of logistic solutions that reach flexibility, the role of Midstream integrated operators as Enagas, turns out to be determinant. In case of Natural gas, and in the Midstream, the improvements has been applying gradually as new consumers has been joining to the system, however, for quantity, the impact from this it is not expected it is determinant. On the other hand, downstream improvements are more difficult due to the large number of small players. However, midstream players (44 TSOs registered in Europe, ENTSOG source) can implement technical modifications providing efficiency that would revert on a direct impact to final consumer prices. The fact that those operators are independent players on the market, as are subject to third party access, imply they have strong interest to gain efficiency to provide services to their users.

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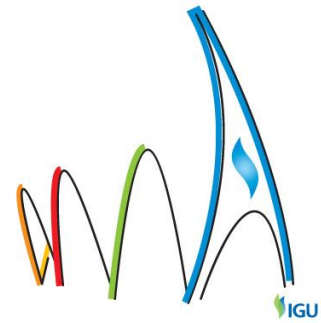
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Enagás, as Spain's leading natural gas transmission, regasification and storage company, and the technical manager of the gas system with more than 40 years of experience on the operation of integrated gas infrastructures, taking advantage of this experience Enagás has gradually adapted both our infrastructures and our services to the shippers and gas system requirements, improving flexibility and efficiency. This improvements joined to our experience have made possible to offer a new service portfolio that we can make available to the market with anticipation to the normative requirements what allow us to place us on the market.

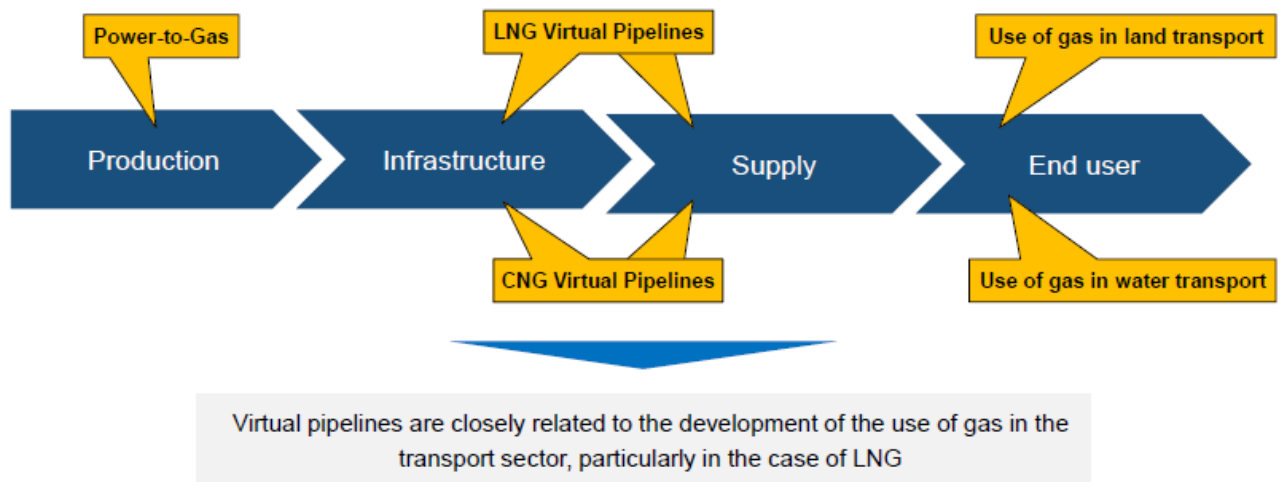
As an order of magnitude Enagas can present the followings historical figures till 2014:

- Close to 10.000 vessels unloaded..
- More than 250 vessels loaded included gassing-up and cooling down services.
- More than 500.000 truck loaded, with a daily peak loading of 80 trucks.

In this regard, is a key issue to considerer the role of Enagas as a midstream operator in LNG and NG systems considering the transportation management for next future with the new concepts of virtual pipelines, that is, the alternatives of gas transportation. Virtual pipelines is defined as the supply chain transporting natural gas to final consumers in the form of CNG or LNG, using road and sea means of transportation, such as trucks, vessels, and rail. Typically, a virtual pipeline supply chain consists of the CNG or LNG production/supply and loading terminal, the transportation method and the unloading at the final consumer(s).



The new uses for gas have different roles across the gas supply chain



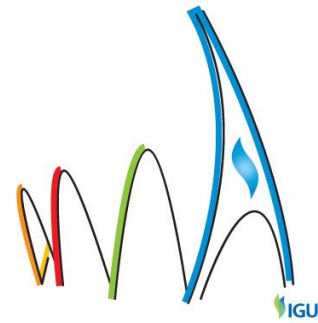
Enagas as midstream operator will help to improve some issues of value chain of gas transportation, at least in two main areas:

- Implementing new managing models
- Maximizing the efficiency of existing assets:
- Adding Efficiency to the classical value chain integrating new logistics: virtual pipelines
- Ensuring the accumulated excellent availability and safety KPI's along complementary developments of the LNG/NG value chain.

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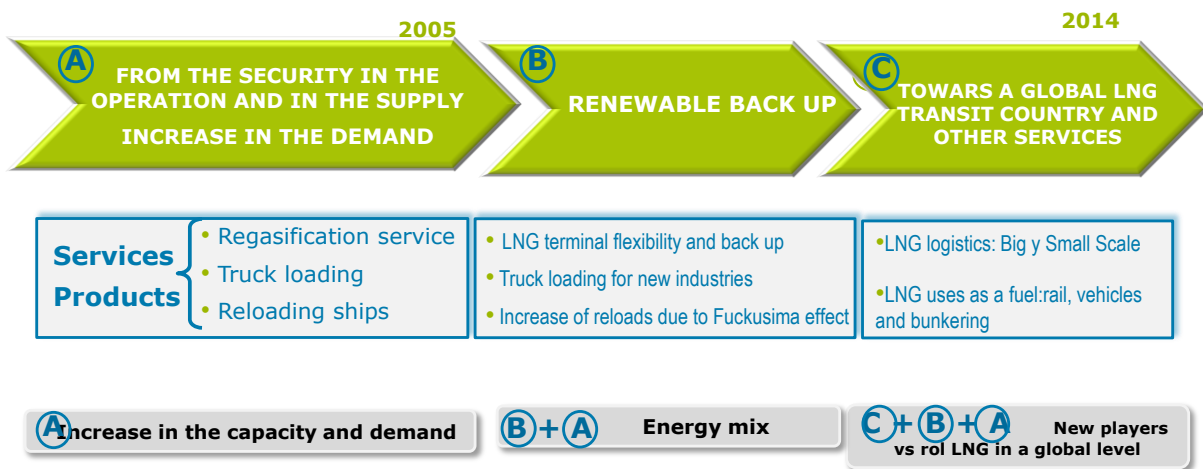


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- Providing a regulatory development compatible with existing services and commercial interest.

Enagás, aware of the importance of providing efficiency to the value chain, switched its terminals from the traditional LNG terminal model (unloading, storage and regasification and LNG trucking) into LNG multimodal terminals (Big scale: transshipment (unloading, storage and reloading to export); Bulk breaking & Parking Gas; and Small Scaling: maritime small scale, LNG trucking, LNG on the train and Bunkering as LNG as fuel) and introduced modifications to increase technical ratios.

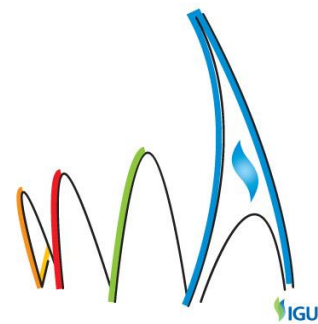
The evolution of the terminals, as we can see in the following chart, has been a constant at Enagás from the early beginning as already in 1971 introduced the LNG Truck service at its Barcelona LNG Terminal. This company spirit has been intensified on the past years due to market evolution.



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Finally, gas market demands the development of an Iberian commercial and physical LNG Hub in which big and small scale activities coexists at the LNG terminals and create enough liquidity to guarantee an LNG market that creates a coherent LNG price and continue its contribution to the Security of Supply (SoS).

Gas operator's role is key on this market as a risk manager, as on Big Scale business there are few well regulated agents, but on the Small Scale business there are lots of non-experienced shippers being a risk to the market that only experienced operators can minimize by sharing know-how and expertise.

Aim

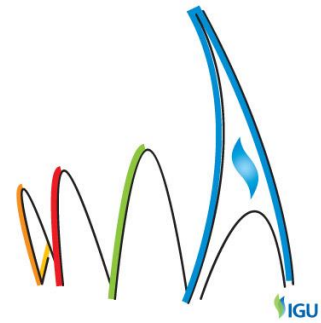
Due to market evolution, Enagás needed to adapt its traditional LNG terminals to provide the services required by terminal users and to improve the efficiency of their processes. On this process, our infrastructures were developed being able to accommodate big scale with small scale LNG activities, to gain efficiency on the process and to go beyond market expectations by creating a multimodal LNG terminal at the midstream ground.

Hence, the main aim has been developing infrastructures, based on the know-how and expertise granted during 40 years, to offer new services, through the proposal of enhanced procedures and technical implementations. These technical, human and logistic developments have been carried out maintaining availability, operative security and efficiency on the processes.

However, a secondary aim is going to be the development of an LNG Hub at Iberian Peninsula creating a comprehensive LNG price.

Nevertheless, the process has been carried out maintaining current role of regasification terminals as a contributor to the Security of Supply (SoS) to the Spanish and European Gas Systems. This objective is not the main aim of this process but represents always the core objective of any midstream operator.

During this process, one key point was the improvement of technical ratios related to these new services to increase efficiency: reloading rate, boil-off gas losses rate, logistic efficiency and measurement process, minimum send-out, optimization flow on the transmission system and optimization of the underground storage operations. Those issues have a direct impact on our client's profits and prize optimization.



Methods

As a key and experienced midstream integrated operator, and based on the results of the analysis performed and worldwide LNG developments, Enagás selected and developed some key modifications in our terminals due to a change in the role of the LNG terminals as this infrastructures were originally designed for a kind of service, that was mainly for regasification purposes, but nowadays in situation of setback, however at the same time is needed to keep similar quality of service as availability, time of response, but penalized in a daily basis by inefficiencies that add a handicap to our development of new activities.

However, Enagas has kept its availability in spite of this great growing (0 incidents after more than 10 years of continuous capacity upgrading on under operation Regasification Assets), and at the same time it has been adapted the most, and all of this have been done facing itself with technical aspects where innovative solutions were applied.

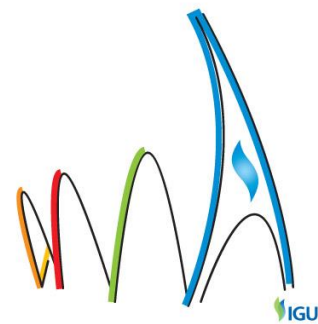
Particularly, the innovative solutions were

1.- Model of Management:

- a) Operation and Maintenance process optimization: Asset management based on failure risk (Industrial safety, environment, Service quality, availability, Opex management) b) O&M Procedure Certification according to ISO 9001.
- c) Implementation of a new Knowledge Management model and ongoing improvement model: Transversal management, professional certification in critic areas, Lean methodology.

2.- Maximizing the efficiency of existing assets:

- a) Increasing energy efficiency at the terminals by reducing fuel gas and self-producing electricity. New process management implies different fuel gas consumption, a cost that is shared between the users and terminal operator. Efficiency on the process and the development of power self-production has helped to reduce operational costs, hence increasing revenues for all.



b) Boil-Off Gas (BOG) system reduction plans managing to reduce the BOG losses from 2.5% to 0% of reloaded LNG from 2011-2014, following a zero BOG losses policy. At first reloading operations, flared BOG was unavoidable as the terminal was not prepared to recondensate all the BOG generated during operations. Once again experience and different terminal structure allowed Enagás to obtain 0% of BOG losses while operating the terminal under normal conditions, meaning that under a reasonable regasification rate alongside the reloading.

Some measures to reduce the generation of BOG were: Installation of pressure control valve to manage the BOG of every tank at different pressures; insulation improvements at cryogenic pipelines; and new line to use BOG as auto consumption.

Some measures to optimize BOG recovery were: Design of a On-Line Process Simulation to improve the recondenser performance; removing insulation of the delivery pipeline of BOG compressor (due to high temperature) to improve the recondenser efficiency; and new pipeline to deliver the BOG to the low pressure local network using the recondenser BOG compressor.

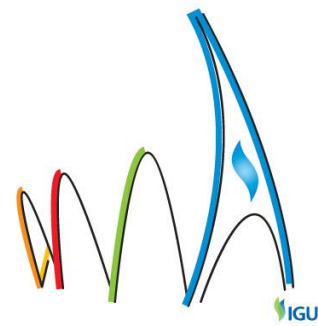
Additionally, the company has decided to invest on BOG compressors at all its terminals to extend that zero BOG losses on reloading operations at very low or even zero regasification operational rate without depending on the sending out rate

c) Reducing carbon emissions: As a consequence of methods a) and b), carbon emissions at the terminals are reduced following a zero emissions policy.

3.- Adding Efficiency to the classical value chain integrating new logistic services

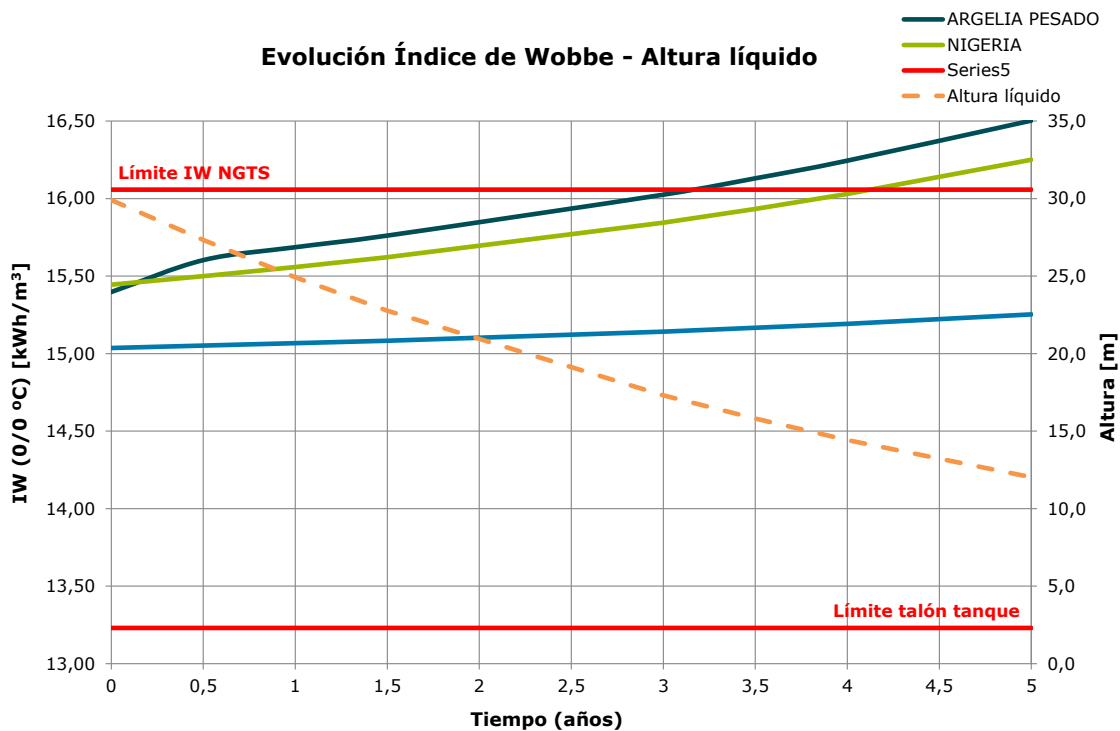
3.1.- Big Scale processes:

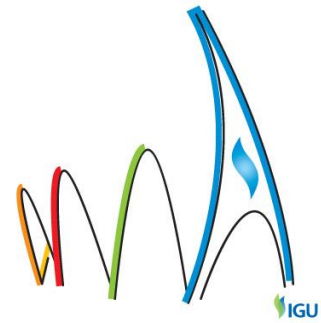
a) Adapting LNG terminal scheme to allow the terminal to reload LNG from the tank to the cargo. Some Spanish LNG terminals, such as Huelva, have been able to reload LNG into the vessel since 1997, but others have been recently adapted such as Barcelona. Some of the measures were new 16" headed line, new bidirectional check valve and new specific SSD to reloading operations and other operational solutions. Currently all Enagás infrastructures are able to reload LNG. b) Improving the reloading rate of the LNG arms. Experience has proved that reloading rate can be increased by different technical modifications on the process chain. Additionally the fact of carrying out reloading operations in different terminals has helped others to detect best operational practices and to standardize them.



c) Slots programming efficient development to assure supply and availability. The activity increase regarding reloading activities implies a double increase in terms of slot management at the terminals, as any reloading needs a previous unloading, meaning also an increase of 8% of unloading. The slot assignment procedure has been improved to include efficiently all new operations of unloading on reloading guaranteeing the security of supply of LNG for final consumption.

d) In relation to behavior of GNL ageing in tanks during long period of time, Enagas has studied the evolution of Wobbe Index and liquid height for several gas qualities, the final outcomes show, as is showed in chart below, GNL can remain in tanks during long period of time (close to 3 years) without problems.





3.2.- Small Scale processes:

a) Process Re-engineering : Enagas' terminals has carry out several studies in relation to stress analysis and a hazard and operability study (HAZOP) in order to identify and evaluate problems that may represent risks to personnel or equipment, or prevent efficient operation

b) LNG Custody transfer metering accuracy: Major investments have been carried out in all Enagas' terminals to update the installed LNG metering devices to the state of the art. Those updates are necessary to ensure that energy reloaded is accurate while carrying out reloading activities.

The rationale behind it is as follows: Operational conditions during LNG reloading differ from those at a liquefaction terminal. Particularly, the temperature of the LNG to be reloaded is usually higher. For safety, efficiency and/or contractual reasons, carriers usually decrease the tanks pressure, thus the final LNG temperature, by sending a significant amount of return gas to the receiving terminal. LNG flashes in the cargo tanks producing a difference between the final composition of the LNG reloaded in the ship and the LNG quality obtained from the terminal's sampling system. The difference between these two LNG compositions introduces a significant systematic error, which Enagas estimates it can be up to 0,25% of the total energy transferred. The unaccounted for gas value might go beyond the allowed limits threshold, therefore resulting in an inaccuracy of the energy reloaded, implying less profits for our clients and economic losses for the terminal operator. Enagas in cooperation with other European Operators has proposed an alternative method for determining the LNG composition, to the method described in the currently published version of Custody Transfer Handbook (CTH). As a consequence, some procedures have been modified with the purpose of getting a reliable and accurate measurement of the reloaded energy.

4.- Regulatory matters:

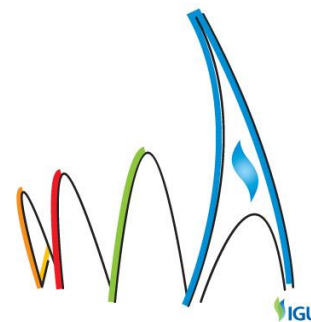
a) Commercial, regulatory & legal development of the new services along with the regulators. Enagás infrastructures are regulated and subject to national standard regulation, that needs to be amended to include the new LNG services that have appeared on the market such as:

- Reloading service;
- Transshipment;
- Bulk breaking and maritime Small Scaling;
- Bunkering;

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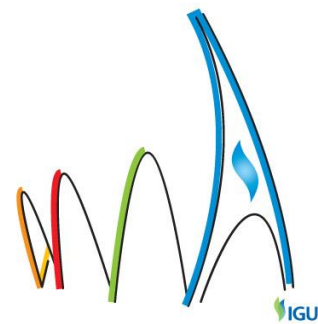
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- Parking Gas;
- LNG trucking; and
- LNG on train.

Enagás has closely collaborated with regulatory authorities, being the result a stable regulatory framework during the period 2015-2020, guaranteeing fix tariffs for customers to settled long and mid-term stable businesses.

Additionally, an important regulatory breakthrough has been the approval of the Royal Decree-Law (RDL 18/2014) which grants TSOs the possibility to negotiate access conditions at a terminal, including tariffs, for new LNG logistic services. These singular temporary economic regimes for LNG logistic service would be approved for services which main objective is not the supply of Spanish demand, under long term contract and following the principle of objectivity and non-discrimination and the economic and financial sustainability of the Spanish Gas System. If additional investments are needed, they will be covered by Terminal Operator.

b) Integrated network codes: As a key and integrated midstream operator, one of the key roles is to integrate the LNG terminals on the new network codes, increasing LNG liquidity, and prepare the LNG terminal to be integrated in a Iberian Gas Hub.



Results

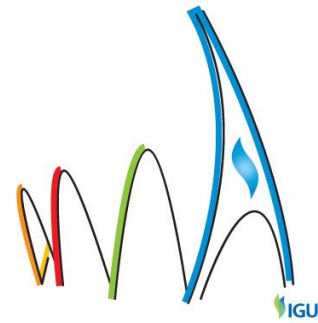
Terminal adaptation has obtained results into five different fields, having an impact on all players of the natural gas chain:

1. Enagás:

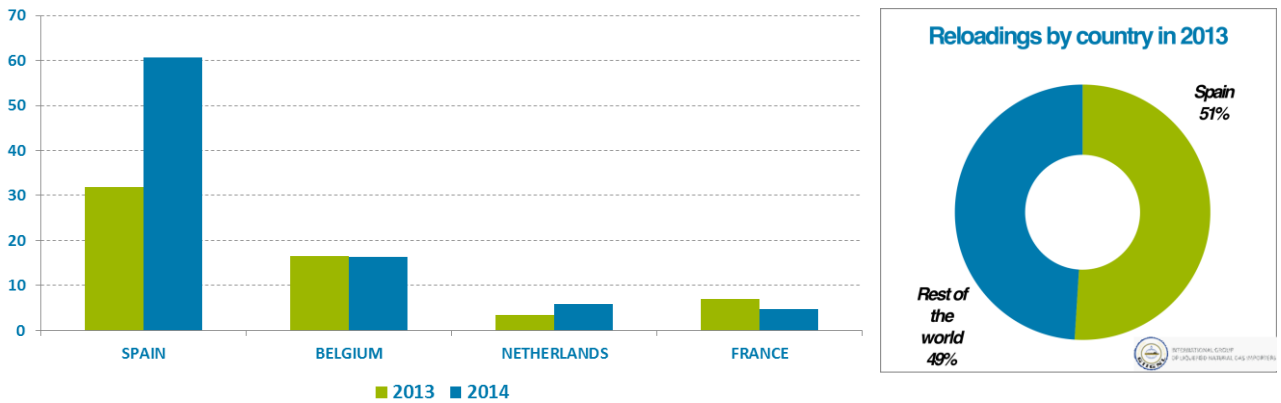
a) **Improvement of flexibility and operational efficiency:** Improvement of technical ratios during 2008-2014 periods:

- Reloading rate: Modifications on terminal processes have paid out an increase of the reloading rate by 500% at Huelva and by 300% at Cartagena LNG Terminals. Additionally, acquired experiences have been used to design the latest Enagás LNG terminal at El Musel, Gijón, with unloading arms of 20" which are expected to almost double the reloading rate in comparison with current operational LNG Terminals.
- Boil-off gas losses: Technical modifications have allowed a reduction of operational BOG losses during reloading operations from 2.5% to 0% of reloaded LNG while operating the terminal under normal conditions (under a reasonable regasification rate). **Environmental benefits:** The reduction of boil-off gas losses implies a benefit not only in economic terms but on environmental benefits, as CO₂ emissions during a vessel reloading slashed by 4,080 tonnes. Carbon emission reduction implies additionally a second economic reduction as CO₂ prices represent an additional cost to terminal operator, while BOG loss is a cost to the customer.
- Reduction of OPEX by 15% due to efficiency implementations and development of power self-production.
- Maintaining availability of the terminals during the processes modification period. All settlements, technical modifications and tests were applied during the normal operation of the terminals, hence not affecting the provision of services to our clients.

b) **Improvement of logistic flexibility and logistic efficiency Portfolio of services:**

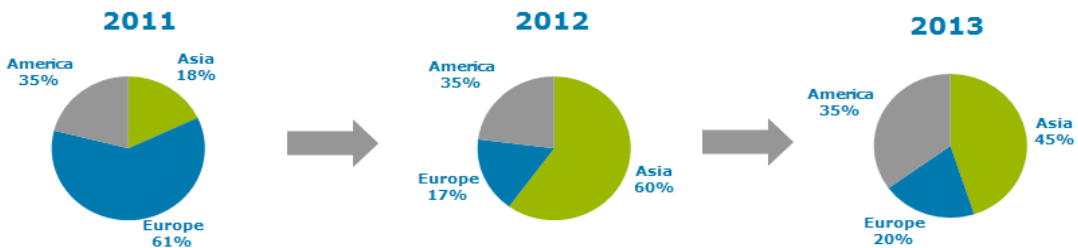


- Slot flexibility has allowed Enagás to be both a pioneer and an industry leader in vessel reloading worldwide. According to the International Group of LNG Importers (GIIGNL), 51% of the world's reloading operations were carried out in Spain in 2013. A similar figure is expected in 2014, even if 2014 report hasn't yet been issued.

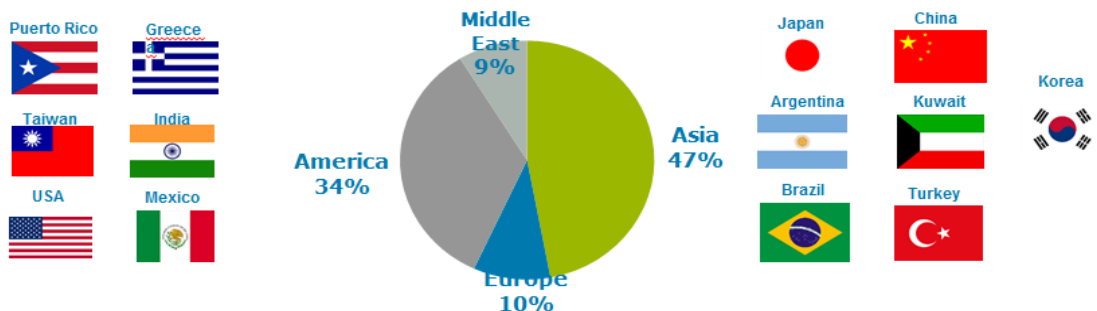


LNG reloading operations by country 2013 and 2014

2011-2013 RELOADING DESTINATIONS



2014 RELOADING DESTINATIONS



Spanish LNG reloading destinations

- LNG truck loading has been in place since 1971, but recent figures depicts the Spanish Gas System as an international leader on LNG truck loading with around 40,000 LNG trucks reloaded per year, equivalent to 13 LNG reloading standard vessels. Spain supplies both internal and European demand, in France, Italy, Switzerland, Macedonia and Portugal.



Barcelona LNG truck loading 26 February 1982

- Diversification of tariffs by products: The regulatory development has allowed the creation of new tariffs such as:

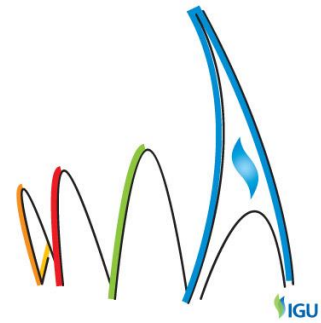
- Reloading service;
- Transshipment;
- LNG small scaling reloading;
- cool-Down and gassing-up;
- LNG trucking; and
- Bunkering through LNG trucking.

Additionally, Enagás is working on tariff development for other services such as:

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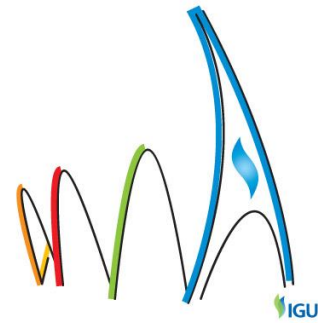
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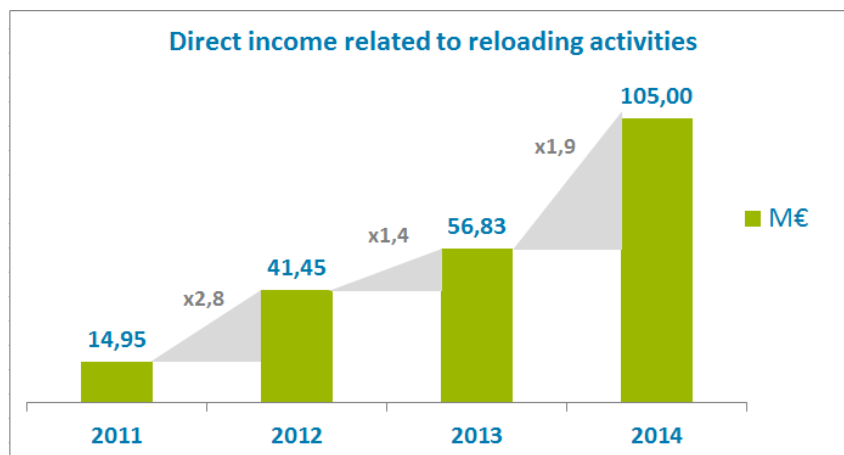
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- Direct bunkering at the terminal;
- Parking Gas;
- LNG on train.



2. The Spanish Gas System :

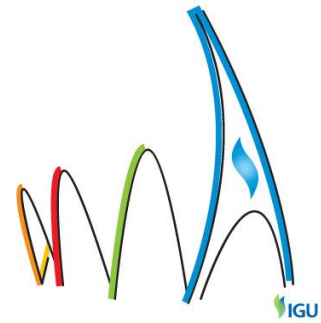
a) Spanish Gas System benefits: Reloading operations are additional to national demand ones, representing new direct incomes to the Spanish Gas System that revert on medium term on smaller tariffs for all users. An overall estimation of direct reloading incomes during the period 2011-2014 is up to 218.34 M€.



Direct incomes from LNG reloading services 2011-2014

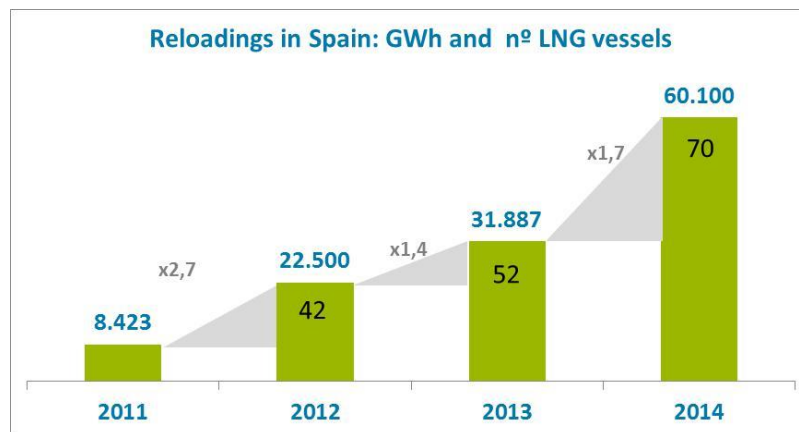
b) Customer's benefits:

- Our customers increased their profits thanks to the operations carried out, and reduced their costs due to the improvement of technical and environmental ratios.
- **Improvement of the efficiency and the reliability of the measurements** for the terminal users while carrying out reloading operations. Enagás estimates that this inaccuracy can be up to 0,25% of the total energy transferred, and by improving the LNG Custody transfer method, this difference has been tackled.

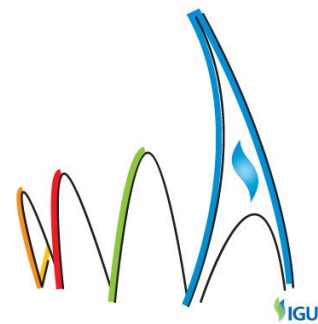


All those technical and economic improvements have been steadily achieved during the past 4 years, and simultaneously the reloading activity has increased paying out the following figures at the Spanish Gas:

- Number of reloading operations at the Spanish Gas System has grown up to 70 operations in 2014.
- LNG reloaded on the vessels measured on energy terms (GWh) has increased x7.1 between 2011 and 2014.



LNG reloading operations 2011-2014



Conclusions

LNG market evolution has incentive Enagás to develop its infrastructures to accommodate the new LNG services maintaining the standard supply to national consumption and provide the services for the new LNG markets on an efficient operational process.

LNG operators, as midstream integrated players, should maximize their terminals developing LNG logistic hubs that help LNG to gain position on the global and European energetic mix. Their position on the natural gas value chain and the relatively small number of them implies they are the key player to provide efficiency at midstream, hence less costs for all incumbents on the value chain. LNG markets on an efficient operational process.

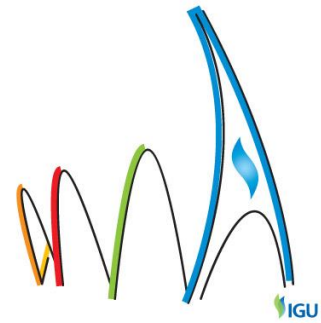
During this evolution at the terminals, the operator has gained a very useful experience to future developments as new services are on the pipeline to be provided. Currently, after obtained results, the following service portfolio developments are forecasted on the Spanish Gas System:

- Bulk breaking and maritime Small Scaling: Currently, the service is available but commercial incentives to different vessel sizes are being analysed jointly with the Spanish authorities.
- Bunkering: conversion of ships from Maritime Fuel to LNG will lead to the development of LNG bunkering station along the coast that will be supplied on Small Scale cargoes to be fulfilled on LNG terminals. Infrastructures are being adapted to this service, and new regulation is needed to approve a competitive tariff to promote this service and LNG use.
- Parking gas: a specific service of storage for a long period has proved necessary last winter in Spain as worldwide market prices need a back-up option for the storage of LNG. This service is available, but to increase its competitiveness there is a general analysis with the authorities to promote the LNG hub at the Spanish LNG terminals.
- Transshipment: Due to logistic reasons (arctic vs conventional vessels) other kind of transfer of LNG between vessels should be carried out, implying a long term regulatory structure to guarantee a continue flux of the LNG to support new business. This kind of long term services is being analysed, and has been partially approved under a new regulation.
- LNG on the train. This service is the newest to be developed, and participating on the development of such market is important to promote the use of LNG as fuel.

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- Increase of the international connection capacity with Europe.
- New underground storage capacity by increasing the Yela field.

These new services have and will promote the Iberian Peninsula LNG Hub to be in place, accommodation both Big Scale and Small Scale activities, creating a coherent LNG price and maintaining its contribution to the Security of Supply (SoS).

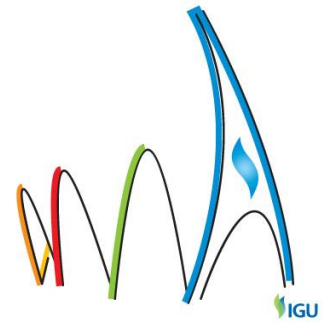
The strategic location of the Iberian Peninsula on the worldwide market, the existence of an experienced and with large spare capacities midstream integrated operator and the development of the LNG market has been a safe environment to develop infrastructures and gain global efficiency.

To sum up, the experience has proved that the LNG re-exports leadership of the Spanish LNG terminals has been a key issue to the development of an Iberian Peninsula LNG Hub and it will help to continue the development in parallel to a market that creates new LNG uses and needs.

We show in the graph below our proposal business model focus on Barcelona LNG terminal as a good example of a multimodal LNG plan taking into account all the combining services we can offer.

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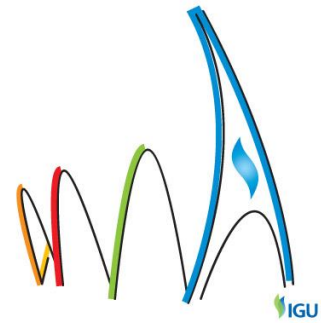


LNG multimodal terminal

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