



**CORE LNGas
hive**

Project info

*LNG bunkering and small scale services
in Spain & Portugal*




Co-financed by the European Union
Connecting Europe Facility

Coordinator: 

Leadership:



Puertos del Estado 



CORE LNGas
hive

Foreword

**Marcelino Oreja**

*Chief Executive Officer Enagás
Coordinator of CORE LNGas hive*

CORE LNGas project is an example of how innovation can help us to be more efficient, sustainable and competitive. It is a pioneer initiative, a turning point for the development of liquefied natural gas (LNG) as fuel, notably in the Iberian Peninsula maritime sector.

Enagás' commitment to this project, further to the overall coordination, is in line with the company innovation and sustainability strategy. LNG is one of the most environmental friendly fuels and we are convinced that it can strongly contribute towards a low-carbon economy and fulfil Paris Agreement Target. Moreover, the Iberian Peninsula counts with a geostrategic position and modern and safe gas infrastructures; the development of initiatives such as CORE LNGas hive has the potential to consolidate it as an LNG European reference.

This publication includes CORE LNGas hive main action lines and activities, as well as its contribution to the more sustainable model in which we are working on and with which we are fully committed.

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01. About the project

CORE LNGas hive is an initiative co-financed by The European Commission through the 2014 Connecting Europe Facility (CEF) Transport Call.

The aim of the project is to develop a safe, efficient and integrated logistic chain for the supply of LNG as a fuel for the maritime sector in the Iberian Peninsula. It fosters the use of this alternative fuel not only in vessels but also in the port environment.

Coordinated by Enagás with the leadership of Puertos del Estado, the project involves 42 partners from Spain and Portugal. It is a public-private partnership. With 21 public partners: 8 state-owned institutions and 13 port authorities. The 21 private partners are industrial companies such as ship owners, LNG operators and suppliers of different services in the value chain. The total budget is €33.3m and its execution is planned to last until 2020.

Project representatives at media event presenting the first electric connection to a vessel from a dock using an engine powered by natural gas.



02. LNG as an alternative fuel





LNG is a down-to-earth alternative fuel in the maritime transportation sector.

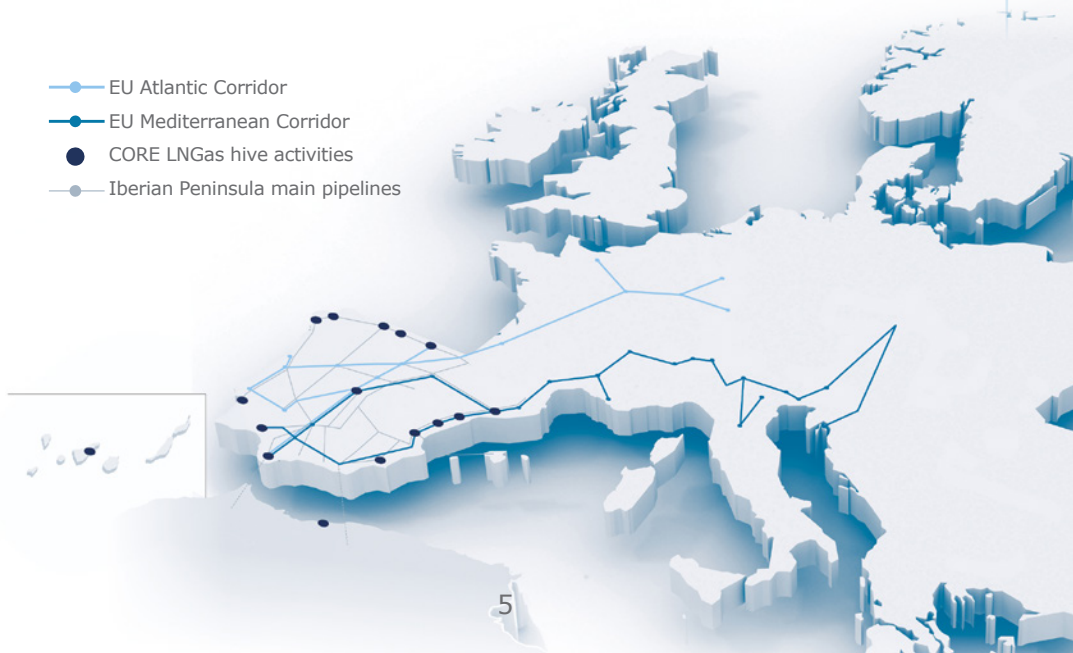
In accordance with EU Directive 2014/94 on the deployment of alternative fuels infrastructure (Clean Power for Transport), the project establishes the infrastructure needed to supply LNG as fuel to the maritime sector in the Iberian Peninsula.

LNG is one of the most environmentally friendly fuels. It helps the decarbonisation process of the European economy and allows for the reduction of our dependence on traditional fuels. Moreover, it eliminates emissions of sulphur oxides (SOx), particulate matter (PM) and reduces drastically nitrogen oxides (NOx), which will facilitate complying with increasingly tight environmental regulations in the maritime sector.

With 8 LNG terminals, the Iberian Peninsula possesses an LNG logistics know-how of almost 50 years, which is key to the development of the project and the consolidation of the region's leadership in this field.

On the other hand, due to its geostrategical position as a very relevant cross point in global shipping routes, the Iberian Peninsula must address the maritime necessities in terms of sustainability, efficiency and operation.

-  EU Atlantic Corridor
-  EU Mediterranean Corridor
-  CORE LNGas hive activities
-  Iberian Peninsula main pipelines



03. Studies proposed

The project involves 25 studies, to be conducted by the partner companies for adaptation of infrastructure and logistical – commercial development in order to offer small-scale supply services and bunkering.

14 studies, the “software” of the project. They allow identifying the standards needed for an adequate development of LNG as a fuel, defining training programmes required and accreditation processes, or the National Policy Framework.

11 studies with integrated pilots, known as the “hardware” of the project. They test real parts of the LNG logistic chain needed to supply bunker services of LNG. They include the adaptation of LNG Terminals to offer bunker and small-scale services, the development of logistic equipment (as bunker barges or multimodal transport), and the use of LNG within the port environment.

Bilbao Port: “Oizmendi” completes first pilot LNG bunkering (ship-to-ship loading) operation in the Atlantic and Mediterranean corridors.



04. Documents presented to the European Commission (Form D)

Connecting Europe Facility 2014-2020

Transport calls for proposals 2014

General description of the global project including needs and objectives

CORE LNGas hive is a proposal focused mainly on LNG deployment for maritime transport and ports along the Spanish and Portuguese sections of the Atlantic and Mediterranean core corridors of the Transeuropean Transport Network aiming at support the implementation of Directive 2014/94 on the deployment of alternative fuels infrastructure besides the monitoring of Directive 2012/33 regarding sulphur content of marine fuel.

Accordingly, the global project is the Core Network Corridors (CNCs) development by means of the correspondent Work Plans (WPs) and especially the subset where this proposal will be focused, meaning Mediterranean CNC-3/WP and Atlantic CNC-7/WP with its maritime dimension and extension to peripheral regions and neighbouring territories included. Furthermore, implementation of Directive 2014/94 on the deployment of alternative fuels infrastructure is considered also part of the global project.

Both CNC-3/WP and CNC-7/WP have been published in December 2014 by each corridor Coordinator. Within these documents, specific needs and objectives are settled. In both WPs, the relevance of the maritime dimension of the corridors is highlighted as well as specific references to LNG deployment and challenges regarding limitations on sulphur content of marine fuels in the short/mid/long term coming from the International Maritime Organization (IMO). Moreover, coordination has been the key factor of the approach for each WP, by means of the celebration of the so called corridors Fora during 2014.

CORE LNGas hive definitely contributes to the needs and objectives of Mediterranean and Atlantic Core Corridors WPs by gathering into a corridor approach different initiatives on the deployment of LNG as fuel for maritime transport and port operation.

On the other side, the needs and objectives of the Directive 2014/94 are clearly mentioned in the legal document. To be highlighted the



EU Corridors



Atlantic Corridor



Mediterranean Corridor

obligation for the Member States to adopt by November 2016 a National Policy Framework (NPF) with measures for the development of clean fuels for transport market and the corresponding infrastructure, meaning investment plans, technical specifications for the deployment and utilization of such infrastructure and regular reports for the follow up, among others. Article 4 of the Directive refers specifically to LNG. Furthermore, Directive 2013/33 aims at promoting low sulphur technologies on maritime transport to reduce sulphur emissions, to which LNG deployment contributes.

Again, **CORE LNGas hive** definitely contributes to the needs and objectives of these two Directives by testing the technical, economical and commercial viability of innovative Pilots in order to roll out an implementation plan for all the ports and develop the appropriate technical specifications on the different technologies that prove viable. Furthermore, the basis for the LNG subset of the NPF will be developed within the project as well as the basis for an observatory aiming at monitoring and reporting the results of the NPF implementation.

Description of the proposed action

General description of the proposed Action including needs and objectives

CORE LNGas hive could be described briefly as the start up for the future roll out of LNG as fuel for maritime transport and port services in the Spanish sections of the Atlantic and Mediterranean core network corridors by means of piloting at first place the market viability for innovative LNG supply and consumption solutions, including logistics, while developing the LNG subset of the Spanish National Policy Framework as provided in the Directive 2014/94 on the deployment of alternative fuels infrastructure.

To achieve these goals, **CORE LNGas hive** gathers in a one complex but coordinated consortium all owners of LNG Terminals in the Iberian Peninsula (Spain and Portugal), relevant stakeholders from the LNG industrial sector in Spain, and also Portugal, along with the institutional and public bodies with competences in maritime transport and port policy development under the leadership of Enagás, the main LNG operator in Spain and one of the most important in the EU and worldwide. The participation in the consortium of the LNG operator in Portugal (REN) opens the door for an integrated approach on these goals in both countries.

The proposal is submitted to the priority of innovation under the funding objective nº2 of the multiannual call whose overall objectives better cover the specific Action purposes and contents.

CORE LNGas hive proposes 16 studies and 11 pilots, plus the project management, impact assessment and dissemination activities which are common to any Action, and the structure is being design with the following main criteria:

- **Interaction:** the studies and pilots feed into each other to build the soundness of the final results, namely the contribution to the National Policy Framework and the LNG implementation plan, by means of a holistic approach.

- **Innovation:** the trials included in the proposal cover different technologies, in different market and operational contexts in order to prove technical, safety, environmental, financial and commercial viability of the solutions for the further roll out. An effort has been made in order to keep the innovative component as defined in the Call avoiding the overlap between pilots.

- **Corridor-wide approach:** The structure of studies and pilots is design to ensure the corridor approach of the Action. It focuses mainly on the core network, with particular emphasis along the Spanish and also the Portuguese sections of the Mediterranean and Atlantic corridors, including the external dimension and the extension to peripheral regions. Exceptionally, some comprehensive ports that are relevant to the proposal as they contribute to enable LNG seagoing ships to circulate throughout the core network are included (namely Ferrol, Vigo, Santander and Melilla), considering the provisions of the Directive 2014/94.

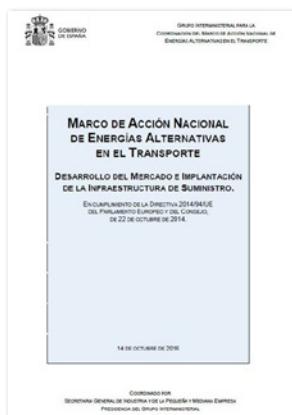
- **Specific results/objectives:** CORE LNGas hive aims at specific contributions to EU and national policy development of LNG as fuel for transport towards the concept of corridors-wide approach as forerunners of a sustainable transport system. To be highlighted specific contributions to:

- The National Policy Framework, as provided by Directive 2014/94, addressing the needs that are described in the considerations and articles of the Directive related to LNG policy, technologies and legislation in the field of maritime transport and ports, including the further reporting and reviewing needs (see A-D94).
- The Roll out of innovative solutions on LNG infrastructure and equipments for maritime transport and port services.
- The further updates of the Work Plans and studies of the Atlantic and Mediterranean core network corridors recently published by the EU coordinators and the expected Work Plan on Motorways of the Sea.

Besides the above mentioned, a specific need to be addressed with the Action is the lack of a harmonised and coordinated approach to LNG logistics, infrastructure and equipment development that prevents the economies of scale on demand and supply for the roll out of LNG as fuel for transport.

For one of each of the previous main objectives, and because of its nature, there will be a clear indicator easily assessing the achievement, namely:

- The adoption of the Spanish National Policy Framework (NPF) by November 2016 including CORE LNGas hive in the field of LNG as clean fuel for maritime transport and ports, including the launching of an Observatory to feed into the further reporting and review on the implementation of the framework, with a first report to be delivered by November 2019.



- An implementation/investment plan on LNG infrastructure and equipment development for maritime transport and port services in the Spanish port system.
- Specific reports to be addressed to the Atlantic and Mediterranean corridor coordinators and the Motorways of the Sea coordinator in order to contribute to the update and development of their respective Work Plans and studies.

Moreover, the direct link of the Action, as described, with specific EU policy and priority objectives justifies the EU support and added value of the proposal.

Finally, the current of play of the goals to be achieved could be considered quite advance, as the main investments on regasification plants and basic infrastructure is done in Spain. Indeed, Spain has the 40% of the LNG storage capacity in Europe, almost 29% of the regasification capacity and 7 LNG maritime terminals (a fourth of the LNG terminals in Europe), mostly owned by Enagás, the coordinator of the Action and the leading natural gas transmission company in Spain and Technical Manager of the Spanish Gas System besides one of the world's largest LNG terminal owners. This facts, along with more than 45 years of experience in LNG operating (since 1969, when the first LNG terminal in the port of Barcelona came into service) gives the perfect floor for the next move towards LNG applications in the transport sector, particularly in the field of maritime transport and ports. In this context CORE LNGas have builds upon a powerful national-wide LNG basic infrastructure, where ports play a relevant role, and walks towards a "last mile" adaptation by driving the required technology into specific market solutions and bringing mutual consensus between industrial and institutional stakeholders into a harmonised and coordinated framework.

Barcelona LNG Terminal.



Contribution of the proposed Action to the Global Project and expected results

As described in section one, CORE LNGas hive Action is framed in a global project consistent on the Work Plans (WPs) of the Mediterranean and Atlantic TEN-t core corridors and the implementation of Directive 2014/94 on the deployment of alternative fuels infrastructure.

Moreover, CORE LNGas hive proposal is specifically conceived with regards to these three legs of the referred global project in order to better achieve the challenges that they represent. It worth to say that the proposal relies on the idea that a coordinated and comprehensive approach is the best way to address effectively these challenges.

So the first contribution to the global project, as described, could be the holistic approach on which the Action is built and, in consequence, the added value of consensus and robustness on the results given the participation of almost all relevant stakeholders, public and private, for LNG deployment in the field of maritime transport and ports in the Iberian Peninsula.

The contribution of the Action to the implementation of the Directive 2014/94 is obvious, as one of the expected results is precisely the marine LNG subset of the future Spanish National Policy Framework (NPF) to be presented by November 2016. This date is indeed the next phase of the implementation process of the Directive and the NPF is mandatory so the contribution of the Action is relevant.

Specific contributions under this umbrella could be the determination of LNG refuelling points in ports by December 2025, the improvement of standards and rules for marine LNG as ship fuel covering technical, operational, safety, training and environmental aspects of LNG bunkering or the launching of an Observatory in order to be able to measure and report the level of achievement on the implementation of the NPF regarding LNG in maritime transport and ports. First report is expected by November 2019, also within the period of the Action, and could be seen as a second phase of the implementation process of the Directive.

With regards to the corridors WPs, both Atlantic and Mediterranean, the Action specifically contributes to their final completion by means of:

- An implementation plan for LNG infrastructure and equipment development for maritime transport and port services in the Spanish core network, with particular emphasis in the Mediterranean and Atlantic corridors.

- An update on the evolution of demand and supply logistic chain needs with regards to LNG as fuel for maritime transport and ports in three relevant areas for both corridors: Atlantic, Mediterranean and Strait of Gibraltar.

Both results shall feed into the expected updates of the WPs, along with the corridor studies, in order to improve and fine tuning the WPs studies and the projects implementing lists with regards to marine LNG infrastructure in both corridors. The updates, which are indeed the next phase of the WPs, are expected by December 2016 and 2018, both within the period of the Action. The same contributions will be extended to the Work Plan of Motorways of the Sea expected by 2016.

Finally, by proposing a harmonised and coordinated approach at national level to LNG deployment in the field of maritime transport and ports, the Action not only contributes effectively to the implementation of the Directive 2014/94 and final completion of the WPs of the Atlantic and Mediterranean core corridors, but to their own objectives, in particular the ones that have to do with sustainability of the transport system.

Description of the Activities of the proposed Action (including their interdependencies)

The Action is composed by a total set of 4 activities, including 14 work packages and 25 sub-activities (referred as initiatives further in this paragraph). The next table identifies each of them in order to give a first idea of the scope of the Action:

Repsol and Enagás supplied a ship with LNG fuel directly from a regasification plant, first time in Europe. (Cartagena LNG Terminal)



Activity 1: Management	Activity 2: Studies	Activity 3: Studies w/ integrated Pilot	Activity 4: Impact, Results
WP1. Administrative	WP2. 1 Transversal	WP3. 1 CNC Mediterranean	WP4. 1 Observatory on Directive implementation
WP1. Technical	ET0 National Policy Framework	EPM1 Barcelona: Dedicated LNG flexible hoses for bunkering	WP4. 2 Roll-out and Investment Plan
WP1. Financial	ET1 Technical, Safety and Environmental specifications on LNG	EPM2 Barcelona: Barge retrofit for LNG bunkering within the port	WP4. 3 Impact ACT-2
WP1. Stakeholders	ET2 LNG demand and supply chain analysis for the Roll out (MED corridor)	EPM3 Barcelona: Straddle carrier retrofit	WP4. 4 Impact ACT-3
	ET3 LNG demand and supply chain analysis for the Roll out (ATL corridor)	EPM4 Cartagena: dedicated LNG mooring jetty for small scale services	WP4. 5 Dissemination of results
	ET4 LNG demand and supply chain analysis for the Roll out (Gibraltar Strait and peripheral regions)	EPM5 Valencia: LNG/ CNG mixed station for vehicles and small boats	
	ET5 LNG social acceptance	WP3. 2 CNC Atlantic	
	ET6 LNG advance training requirements and vocational programme	EPA1 Bilbao: Adaptation for LNG small scale services in big scale jetty	
	WP2. 2 Feasibility	EPA2 Bilbao: Barge retrofit for LNG bunkering in the Cantabrian coast (navigable)	
	EV1 Engineering for new dedicated LNG jetty in regasification plant of Ferrol	EPA3 Bilbao: New tugboat powered by LNG	
	EV2 Rescue boat powered by LNG	EPA4 Ferrol: Adaptation for LNG mixed bunker/big/ small scale services in existing jetty	
	EV3 Port locomotive powered by LNG (Tarragona)	WP3. 3 Transversal	
	EV4 Tugboat powered by LNG (Barcelona)	EPT1 LNG powered electricity generator mobile unit for OPS	
	EV5 Adaptation for LNG bunkering/small scale services in regasification plant of Sagunto (Valencia)	EPT2 Multimodal transport for LNG logistics supply-chain (rail/road/sea)	
	EV6 Tugboat powered by LNG (Valencia)		
	EV7 Multimodal LNG bunker berth in port of Huelva		

The activities and the work packages are the main vectors of the project. Due to the complexity of some of the work packages, particularly WP2.1, WP2.2, WP3.1, WP3.2, WP3.3 dealing with major studies and pilots, several sub-activities have been identified to allow clear setting of milestones and start/end dates for each one. Moreover, when needed, there have been identified tasks that not only helps the setting of the different milestones through.

To be highlighted, before the description of each of the previous initiatives, that:

The completion of the Action is expected by December 2019, while the start of most of the initiatives is expected by October 2015, some as from April 2015 (EPA1, EPM4 and EPM1) and few already started in 2014 (EPA3, EPA2 and EPM2).

The period of the Action extends from 1th January 2014 to 31th December 2019. This period is coincident with the eligibility period proposed for the Action.

With regards to the sub-activities that are already started, it should be mentioned:

- EMP2 started in October 2014. The works during this year have been focused on some preliminary studies, prior to the main feasibility/ engineering studies needed for the piloting of the barge retrofitting. In particular, two regarding the barge structure resistance to the LNG tanks loads and stability plus a study on possible scenarios for in service operation of the barge.
- EPA2 started in January 2014. Prior to the definition and feasibility studies of the action to be piloted, a general approach was made in order to determine the best option for LNG bunkering in the port of Bilbao. As a result of the study, the retrofitting of an existing barge was found as the best alternative and the decision towards the real-life trial was made.
- EPA3 started in May 2014. The works during this year have been focused on a preliminary study in order to determinate the main aspects of the technical definition, prior to the specific engineering and feasibility studies needed for the piloting of the barge retrofitting. As a result the responsible made the decision for a real life-trial.

CORE LNGas hive proposal arises in late 2014 when the need for a harmonised and coordinated approach to LNG logistics, infrastructure and

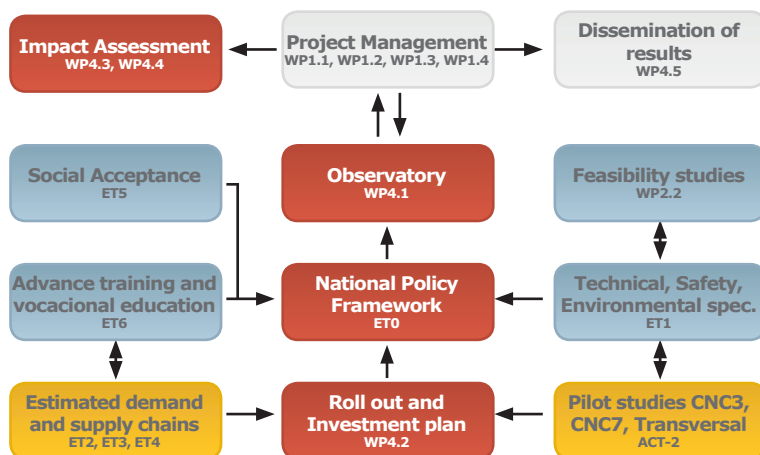
equipment development is clearly identified in both the publication of the Directive 2014/94 on the deployment of alternative fuels infrastructure and the elaboration process of the working plans for the core network corridors, particularly Mediterranean and Atlantic, by means of the corridors Fora and the final publication in December 2014. When this coordination need arises, some initiatives are already ongoing (EMP2, EPA2 and EPA3, as mentioned), and to cover them under the global approach the proposal extends the start date to January 2014. During the first part of 2015, until October 2015, where most of the initiatives start, the big effort will be focused in the preparation works, basically the project management, in order to develop the appropriate framework to ensure this harmonised and coordinated approach of the initiatives and final results of the Action.

The figure below represents the main interdependencies between the different initiatives under the Action, where main results are also highlighted.

In order to monitor the evolution of the different activities, work packages and sub-activities, the proposal has defined Project Milestones and Technical Milestones. The first control the evolution of work packages as the main vectors of the Project and the latest monitor the evolution of each sub-activity. Besides that, a Deliverable Plan will ensure that every milestone has a related Deliverable.

CORE LNGAS HIVE PROPOSAL **(Estructur and main interdependencies)**

In red: main results // In yellow: main inputs to the Roll out



05. Activities

Project Management

The main objective of the activity is to ensure the quality of the final results of the Action and conformity with the EC agreement by means of the appropriate administrative, technical and financial management of the project, including audits, documents required by EC agreement, coordination and follow-up of the studies, costs justification, expenses monitoring, etc. It should deal with a complex consortium integrated by 42 beneficiaries so the activity has been splitted into four work packages, dealing specifically with administrative, technical and financial management. Additionally, as the proposal has gathered a relevant list of stakeholders supporting the Action with potential influence on the quality of the project, a specific work package for stakeholders' management has been considered.

Description

WP1.1: Administrative Management: To cover all aspects related to management and administration including relationships between partners and with the EC, dealing with formal contractual matters, collecting and delivery on due time of contractual commitments (ASR, SAP, etc.), organization of regular meetings, etc. A first place, it will propose the consortium agreement.

WP1.2. Technical Management: To cover the quality of the technical progress, intermediate and final results of each of the initiatives of the project, including monitoring of milestones and deliverables. A common form for each work package and sub-activity will be prepared in order to have a pattern reference for validation. The main approach will be consistency, integration and real interaction between the different initiatives in order to ensure the coherence and effectiveness of the Action results.

WP1.3: Financial Management: To cover all aspects regarding economics and financing, including reimbursements within the Consortium and reporting to the EC as required, monitoring the financial performance of the applicants participating in the project. Preparation of required cost or financial Statements, etc.

WP1.4: Stakeholders Management: To cover a permanent contact with the list stakeholders (see annex A-SHS) in order to gather their active support and contribution to the project, considering the most appropriate work packages and sub-activities to feed into.



Meeting of CORE LNGas hive working group.

Studies

Main objective is to collect most of the studies of the project facilitating a common approach of this type of initiatives and the way they must feed into and progress towards the final results of the Action. Although they do not consume the biggest part of the budget they are the cement of the Action and key for the integrated approach and mutual consensus of the final results, in particular the so called transversal studies. The activity is splitted by the nature of the studies in two work packages. WP2.1 drives a set of studies that are transversal to the Action as they feed into or feed from almost all the initiatives of the project. On the other hand there is WP2.2, dealing exclusively with feasibility studies that feed into/from a specific sub-activity in WP2.1 on technical, safety and environmental specifications.

Transversal studies: As mentioned, this work package collects key studies for the Action. Due to the complexity of the whole set, it has been splitted into six sub-activities, each one consisting on a specific but related study, some of them critical to achieve the main results of the Action.

CORE LNGas hive is a project focused mainly on LNG technology and innovation development for maritime transport along the Atlantic and Mediterranean core corridors of the Transeuropean Transport Network aiming at support the implementation of the Clean Power for Transport Package (Directive 2014/94) besides the monitoring of Directive 2012/33 regarding sulphur content of marine fuel.

Moreover, the proposal gathers into a corridor approach a number of LNG studies and studies with integrated pilots, mainly on the private side, in order to force for the coordination and the alignment of all the initiatives. This coordination effort is totally aligned with the methodology driven by the Core Network Corridors (CNC) Coordinators for the elaboration of the Work Plans (WPs) through the Corridor Fora.

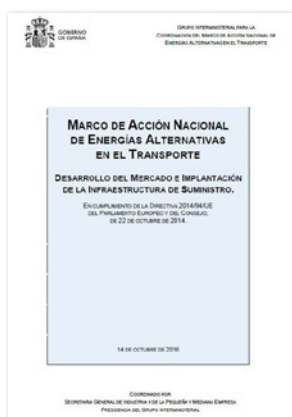
This public-private approach is the core of the proposal, and ET0 along with ET1, WP 4.1 and WP 4.2 give the floor for the institutional and industrial side to converge into this global, coherent, and robust approach for a legislation development.

National Policy Framework

ET0

ET0 main objective is to develop a National Policy Framework (NPF) as provided in the Directive 2014/94 on the deployment of alternative fuels infrastructure, with the emphasis on LNG.

This document summarizes the “Spanish National Policy Framework for the development of the market as regards LNG in the maritime transport sector and the deployment of the relevant infrastructure”.



Partners involved



The Framework has been officially included in the “MARCO DE ACCIÓN NACIONAL DE ENERGÍAS ALTERNATIVAS EN EL TRANSPORTE - DESARROLLO DEL MERCADO E IMPLANTACIÓN DE LA INFRAESTRUCTURA DE SUMINISTRO” and it has been partially transposed to the Spanish legal system through the Royal Decree 639/2016 dated 10/12/2016.

● **ET0:** CORE LNGas hive is a project focused mainly on LNG technology and innovation development for maritime transport along the Atlantic and Mediterranean core corridors of the Transeuropean Transport Network aiming at support the implementation of the Clean Power for Transport Package (Directive 2014/94) besides the monitoring of Directive 2012/33 regarding sulphur content of marine fuel.

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This public-private approach is the core of the proposal, and ET0 along with ET1, WP 4.1 and WP 4.2 give the floor for the institutional and industrial side to converge into this global, coherent, and robust approach for a legislation development.

In particular ET0 drafted the National Policy Framework (NPF) as provided in the Directive 2014/94 on the deployment of alternative fuels infrastructure, with the emphasis on LNG. To be highlighted as main contents:

- An assessment of the current state and future development of the market as regards alternative fuels in the transport sector (inputs from ET1, ET3 and ET4).
- Targets, objectives and measures, including technical specifications and reviewing/reporting/assessment processes (main inputs from ET1 and Pilots and main outputs to WP 4.1 and WP 4.2).

ET0 will be the recipient in which most of the tasks of the proposal will give its results and findings, in particular demand analysis, supply procedures and industrial pilots. On the other hand, it will be also where ACT-4, mainly the observatory, the roll out implementation plan and the impact assessments will find its main inputs.

Technical, safety and environmental specifications on LNG

ET1

The project aims to provide a tested and proven set of standards and requirements in relation to the procedures and equipment for LNG supply (local storage, handling, transport and bunkering activities).



Partners involved



The project is currently in the ITT process, once the tender is awarded, works will continue following the foreseen schedule.

● **ET1:** The sub-activity with update the existing standards on technical, safety and environmental requirements in relation to the procedures and equipment to supply LNG (land-ship) for different uses. The scope of the analysis is the local storage, handling and transport of LNG, as well as the current bunkering activities in sea ports and also land storage facilities. The external human risks posed by the individual components in the supply chain will be dealt in connection with ET6 (LNG training and education programme).

Key reference for CORE LNGas hive proposal is the Directive 2014/94 on the deployment of alternative fuels infrastructure. And key subject of the Directive is the compliance of the infrastructure to be deployed or renewed with technical specifications, as provided. Besides annex II of the Directive, it empowers the Commission to:

- Pursue the development of standards, including detailed technical specifications for refueling points for LNG for maritime transport.
- Supplement the technical specifications provided in annex II, if necessary, and also to update the standards if applicable.
- Adopt delegated acts to lay down requirements for interfaces of bunker transfer of LNG in maritime transport or related to safety aspects of the onshore storage and bunkering procedure of LNG in maritime.

All aspects converge into the proposal giving the floor for a study on technical, safety and environmental requirements in relation to the procedures and equipment to supply LNG (land-ship) for different uses. The scope of the analysis will be the local storage, handling and transport of LNG, as well as the current bunkering activities in sea ports and also land storage facilities. The external human risks posed by the individual components in the supply chain will be dealt in connection with ET6 (LNG training and education programme).

International initiatives developed in USA, Australia or the Baltic region will be analysed and updated in first place, as well as standardization institutions elaborating standards, recommendations, etc. will be contacted in order to feed the Pilots actions. In particular, the European Sustainable Shipping Forum (ESSF) sub-group of experts on marine LNG will be contacted for coordination on the standards development for marine LNG as ship fuel covering technical, operational, safety, security, training and environmental aspects of LNG bunkering.

Study on LNG demand and supply chain analysis for the roll out (Atlantic, Mediterranean and Gibraltar & peripheries Corridors)

ET2, ET3 & ET4

This project will analyze potential LNG demand for transport and possible supply chains in the Atlantic, Mediterranean and Gibraltar & peripheries area.

In order to facilitate the works and obtain better results, all the demand studies have been unify in one study and the same was done with the supply chain studies.



*Demand studies finalized.
Supply chain studies ongoing.*

Partners involved

 **Puerto Bahía de Algeciras**
Autoridad Portuaria de la Bahía de Algeciras

 **CEPSA**

 **Puerto de Cartagena**
Autoridad Portuaria de Cartagena

 **Puerto de Melilla**
Autoridad Portuaria de Melilla

 **Puerto de Huelva**
Autoridad Portuaria de Huelva

 **inega**
Instituto Energético de Galicia

 **Puerto de Santander**
Autoridad Portuaria de Santander

 **Puerto de Gijón**
Autoridad Portuaria de Gijón

 **reganosa**

 **Bilbao PORT**

 **REN**

 **enagas**

 **Port de Barcelona**

 **Autoridad Portuaria Santa Cruz de Tenerife**

 **Puerto de Vigo**
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Autoridad Portuaria de Valencia

 **FUNDACIÓN valenciaport**

 **renfe**
Mercancías

Demand studies were assigned and developed by DNV. Results obtained shows an increasing trend in LNG use in a short period.

Supply chain studies have been awarded to SBC and the first part of the works is finalized (supply chain characterization).

● **ET2, ET3, ET4:** Studies on the actual and potential LNG demand for maritime transport and port services and the evolution of LNG efficient, secure and strong supply logistic chains in the Spanish and Portuguese core network with particular emphasis in the Atlantic and Mediterranean core corridors, including the extension to peripheral regions and third countries by means of a specific approach to the Gibraltar strait. The studies are proposed to address the specific needs for the Roll out of the innovative solutions to be piloted in the Action (WP.4.2) and the requirements of the Directive 2014/94 by means of the National Policy Frameworks in order to designate LNG refuelling points in the ports (ET0). Moreover, these studies could feed into the next update of the working plans and studies of the coordinators of these corridors and the working plan of the coordinator of Motorways of the Sea.

Key reference for CORE LNGas hive is both the corridor approach and the roll out of the different technologies being tested in the Pilot Actions as part of an implementation LNG infrastructure plan in the port/maritime sector, not only in the corridors but with a special emphasis along them.

Moreover Member States, by means of its National Policy Frameworks (Directive 2014/94), shall:

- Ensure an appropriate number of refueling points for LNG in maritime ports with an adequate coverage of the TEN-T Core Network by December 2025.
- Designate the maritime ports that are to provide access to the before mentioned refueling points for LNG, on the basis of market needs.

It is not possible to address a roll out plan neither designate refueling points for LNG without studying the actual and potential LNG demand for transport and the possible evolution of supply logistic chains.

Some key aspects would be:

- Expected evolution of LNG for maritime transport and port operations.
- Requirements to become distribution hubs for LNG supply.
- Development of LNG logistic chain.
- Infrastructure needed in the existing regasification plants.
- Industrial models for LNG supply to match different port acquisition conditions.

- **ET2** aims at doing this job with a corridor approach, not with commercial or market purposes, but rather to paint possible scenarios in order to fine tuning this LNG infrastructure planning along the corridor. For that reason Puertos del Estado (PdE) participate in the activity along with the main stakeholders and Port Authorities representing the LNG and maritime dimension of the corridor, in order keep the market edge of the exercise controlled by an institutional and common approach (PdE will be participating also in ET3 and ET4).

ET2 is focused on the **Mediterranean Core Network Corridor** (CNC-3) where 8 LNG regasification plants are located, 3 of them in Spain (Barcelona, Sagunto and Cartagena), 2 in France and 3 in Italy. Those facilities should be the hubs to supply LNG to the CNC-3 Corridor and the Mediterranean Sea nodes of the TEN-t network, having not only a national dimension, but also being one of the best gateways of LNG to the north of Europe, meaning that also rail-road logistic chains could be an option for supply logistic chains. Moreover, there are 12 core ports representing the major gateways of the Corridor regions for the intercontinental trade and revealing also the maritime dimension of the CNC3 for intra-EU traffic.

Therefore, ET2 will gather all this potential into a coherent approach to LNG demand and supply logistic chain in order to be able to set a reliable deployment of LNG infrastructure and innovative roll out. The results of the study will feed into the Work Plan of the CNC-3, published in December 2014, aiming at contributing with regards to LNG to the next updates of the corridor study and further deepening of the analysis and the Work Plan expected by December 2016 and 2018.

- **ET3** is focused on the **Atlantic Core Network Corridor** (CNC-7) where 2 LNG regasification plants are located (Sines and Bilbao), besides other 3 plants located in the Atlantic region, also in ports: 2 in Spain (Ferrol* and Gijón) and 1 in France (France). Those facilities should be the hubs to supply LNG to the CNC-7 Corridor and the Atlantic Sea nodes of the TEN-t network, where ECA areas are already settled. In particular, the Work Plan (WP) for the Atlantic Corridor, recently published, refers explicitly to the need of an LNG plan to be prepared for the Corridor in order to guarantee the supply needs in the short/mid-term.

Therefore, ET3 will gather all this potential and needs into a coherent approach to LNG demand and supply logistic chain in order to be able to set a reliable deployment of LNG infrastructure and innovative roll out.

In particular, the Study will feed into the explicit goal for a LNG plan settled by the Atlantic Corridor coordinator, considering the next updates of the corridor study and further deepening of the analysis and the Work Plan expected by December 2016 and 2018.

● **ET4: Gibraltar Strait axis**, from Huelva to Cartagena and from Canary Islands to Melilla, delivers the extension of both the Mediterranean and the Atlantic Core Network Corridors (CNC-3 and CNC-7) to third countries, in particular to north Africa. On the other side, the development of the Transeuropean Network extends beyond the core corridors to ultra-peripheral and extra-peninsular territories, such as Canary Islands to the west, and Melilla to the east, where both core and comprehensive sections and nodes of the TEN-t are located. LNG demand and logistics needs are substantially different when considering the extension to third countries and or these peripheral territories. It also appears the bunkering factor in a massive scale. Algeciras port, where CNC-3 and CNC-7 converge, is the second place for EU maritime bunkering after Rotterdam. In 2014 estimated maritime traffic is about 80,000 vessels crossing the Strait. Moreover, there are 2 LNG regasification plants in the area (Huelva and Cartagena, both located in ports) that should be the hubs for LNG supply in the strait, besides two more plants being in project in the Canary Islands.

The before mentioned proves that Gibraltar is a strategic place both for development of LNG bunkering to maritime transport and innovative LNG supply chain solutions for other territories, external and peripheral, and with a major role on the extension of CNC-3 and CNC-7 as forerunners of sustainable transport system.

ET4 will gather all this potential into a specific approach to LNG demand and supply logistic chain in the strait of Gibraltar in order to be able to set a reliable deployment of LNG infrastructure and innovative roll out planning, completing a global picture for the whole Iberian Peninsula along with ET2 and ET3 studies.

The study is proposed not with commercial or market purposes, but rather to paint possible scenarios in order to develop an efficient, secure and strong logistic chain within the Gibraltar Strait and a LNG innovative roll out within the area of analysis. For that reason Puertos del Estado (PdE) participate in the activity along with the main stakeholders and Port Authorities representing the LNG and maritime dimension in the area of analysis, in order keep the market edge of the exercise controlled by an institutional and common approach.

LNG social acceptance

ET5

The subactivity has provided knowledge on LNG and its benefits to different social sectors in order to increase the positive perception of LNG as a new product in the maritime field.



Subactivity finalized. Results analysis ongoing.

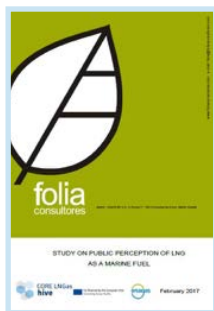
Partners involved



Through a mobile exhibition with an Iveco LNG tractor head borrowed for free to Enagás for this purpose, more than 65 places have been visited from May 2017 to October 2017. During that period, the trailer participated in the events of the sector (LNG summits, Blue LNG rally...) and it was visited by more than 5.500 visits, which were informed on gas, LNG and the benefits of the use of LNG in transport.

This activity have generated a perception study accomplished by Folia consulting too.

● **ET5:** The main target of ET5 is to seek a proper LNG promotion policy towards the social acceptance of LNG as fuel in order to avoid protests against LNG projects. Environmental protection as well as safety and security issues are a common concern for worldwide societies in every industrial project in general, and in LNG projects in particular. Inadequate awareness rising about the project and dissatisfaction with the information conveyed along with the lack of comprehensive social mapping of true stakeholders and 3rd concerned parties may be in the origin of actions against LNG projects. Social problems are converted quickly into political problems, and any LNG project may arise long time against society, so it is necessary, as mentioned, to seek a proper LNG promotion policy, the main target of ET5.



This was done through the LNG perception study, assigned and developed by an external consultant firm, Folia Consultores in order to provide knowledge of the situation in 2016.

Preliminary results of the study showed a Swot Analysis, with different strengths; weaknesses; opportunities and threats. At present some of them are:



PRESENT

NEGATIVE PERCEPTIONS WEAKNESSES

- Acute lack of knowledge of LNG
- Limited scope to improve CO2 emissions. Methane is a potent GHG.
- Air quality is not a top priority on the public agenda.
- Port authorities do not take a uniform approach to LNG.
- Stowage and cargo handling companies see the implementation of LNG as a distant possibility.
- The name is seen as technical, vague, confusing and disturbing.

THREATS

- LNG is not seen as the only marine fuel currently capable of providing a solution for the improvement of air quality.
- LNG carries risks, which easily create the perception of danger and rejection.
- Local authorities lack of support for LNG.
- The time frame for implementation of LNG could give rise to the need for more immediate alternatives (electricity).
- Messages about the benefits of LNG might be regarded with suspicion if they come from a large energy company, and LNG could be seen as a barrier to renewables.

POSITIVE PERCEPTIONS STRENGTHS

- LNG benefits air quality because of its role in reducing Nox, Sox and PM emissions, and the elimination of concentrated marine pollution caused by spillage and discharge.
- We know how to control the risks appropriately.
- There is no deep-seated fear of LNG among the maritime and port community.
- Implementation of LNG in Northern Europe as an example to follow.
- Port authorities see the extension of LNG from ships to port machinery as a natural and desirable development.
- Spain's good position in terms of LNG infrastructures.

OPPORTUNITIES

- LNG is seen as an alternative fuel with the potential for widespread use in the transport and maritime sectors.
- LNG is not yet in the social imagination, which allows space to create a positive image for the product.
- The creation of a new and specialised jobs in the services sector and the consolidation of employment in shipbuilding.
- Environmental organisations are not fiercely opposed to the implementation of marine LNG.
- The likely tightening of air quality policy and regulations may create the right climate for its implementation.
- The implementation of LNG in stowage and internal.

The objective of ET5 is to learn how to manage the social, environmental, and reputational risks associated to the use of LNG, building different reasonable scenarios, taking as reference the reports Mediterranean CNC and Atlantic CNC released on January 2015 by the respective Corridor Coordinators, which explains the different societal perception on products like LNG in the Atlantic area, with an industrial historic background, and the Mediterranean area, with a services and agricultural history.

Due to actual societal perception of LNG as a product with some degree of risks, it seems necessary to elaborate environmental and social management plans targeting a great public audience, in order to avoid a negative social impact which could rise, public campaigns against LNG projects, augmented by the use of existing current social networks, which easily could be transform in political views.

Some projects linked to LNG can affect neighbourhood and local communities in port, coastal and fishing areas by LNG infrastructure deployment. The same applies to facilities or warehouses near urban centres. Modern risk management in extractive industries includes ensuring that project benefits accrue to local communities, by implementing programs to enhance economic development near the plants and pipelines. There are 4 key actions helping to pursue this goal.

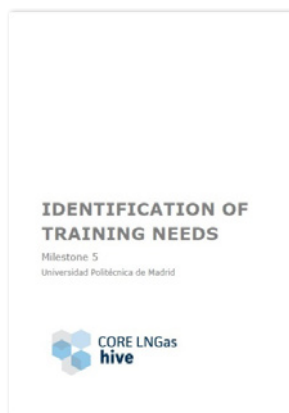
- Business Linkages Program, which will help stimulate the local economy by giving SME opportunities to provide goods and services to LNG project.
- Local Participation Program, the most of local entities has their own economy Development Plan. A pilot program enhancing their ability to plan, and allocate purchasing of products and services, leading to a closer local view of the LNG plant management.
- Stakeholders Participation Management, targeting Sectorial LNG Industry Associations, and other enabled organizations which will teach local people and local organizations an opportunity to evaluate the LNG project performance.
- Innovative Communications Actions Misinformation about natural gas technology, water usage and GHG relating to LNG extraction and production facilities is rampant in many countries, particularly in social media. Traditional publishing means such as newspaper, radio and TV are necessary but they are not enough to successfully deal with this issues.

So a LNG project facing social media attacks, should use the same communications means, at least, the most "serious" of them, the professional networks oriented to enterprises, business and industry. It will be the right arena to "sell" the LNG projects, by a team based on engineers, journalists and social media communicator's specialists.

Study LNG advance training requirements and vocational programme

ET6

ET6 aims to establish different issues related with the training requirements:



- Training needs and levels both on shore and at sea.
- Accreditation process.
- Analysis of employees needed to provide the service.

Proposal accreditation process finalized.

Partners involved



This study is focused in providing training plans for different professional categories of regasification plants to achieve this objective the definition of needs by type of bunkering method is ongoing.

Other important part in this subactivity is to develop and define an accreditation process in order to certificate and validate the different studies.

- **ET6:** The deployment of LNG as fuel for transport services in the next years will need to address a strong and robust training framework, particularly in maritime transport and ports application, including advance training for specific LNG uses and vocational programmes. To that extent ET6 leads with a specific study on LNG training covering, among others, the identification of training needs and different training levels required, the need for LNG training centres, an analysis on the possible employees needed to provide the expected services, with particular emphasis on the corridors, accreditation processes at different levels and definition of courses to gain or validate experience.

The human element is essential to provide LNG bunkering services for maritime transport and LNG supply to both land transport (road, railway and river) and to freight terminal handling equipments. Natural gas as energy source is flammable, and liquefied, a cryogenic product, at -164 °C, that needs trained human element to handle.

The deployment of LNG supply infrastructure oriented to Transport services and bunkering will create new need for training mainly in road, river, rail and maritime transport. Training is needed at different levels in the transport supply chain on land, at port quays and at sea on board. Operators that have to deal with LNG, must be trained to manage transference of LNG, transport or storage conditions, at different training levels depending on the responsibility during the different processes. Training is also necessary at user level: drivers, crew and ship's company should be formed in different aspects, such as security on board, storage and emergency situations.

Particular attention to be paid to crisis situations and special training vocational education programs to firefighters both on land and on board to react to undesirable limit situations with LNG involved. From 1994 the EU has regulated the handling of gases with the ATEX DIRECTIVE 94/9/ EC of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially Explosive Atmospheres - Updated in December 2013, which is fully applicable to LNG operations, probabilistic risk assessments and legislation.

On the other hand, generalization in using LNG must ensure that society has high level training specialists, including the three academic levels, graduate, master and research & doctorate levels, under the responsibility of universities. The level of specialisation of training activities related to LNG requires tight cooperation between industry (both on land and at sea), university establishments, and accreditation agencies.

TEN-T programs already paid attention to training the human element in maritime transport (TrainMoS) and particular training needed in the use of clean marine fuels TRAIN-MOS II (2013-EU-21012-S), being the objective of this project to establish the content of a modular MSc/Post Graduate Diploma/Certificate/Continuing professional development (CPD) programme. Other TEN-T co-funded initiative, Monalisa 2.0, addressed to emergency situations and to firefighters and marine crews to act in extreme conditions.

The Activity ET6 of the CORE LNGas hive proposal, in tight contact with other related TEN-T co-funded training activities, will focus on technical contents of training programs both on land and at sea at the different educational levels and specific accreditation requirements, in close cooperation with industrial, naval, classification societies, etc., and universities together with accreditation agencies.

An advanced course on analysis of explosions and other hazards at risk in LNG facilities will be considered, addressing the multiple hazards associated with onshore and offshore LNG operations focusing on prevention and mitigation of risks associated to LNG handling. Besides the technological aspects of LNG handling, the Activity ET6 will consider the regulatory side, both legislative and standardization.

Self-financing in the long term of training operations include in ET6 the development of a business plan to study viability of autonomous training centres at different possible locations to be defined.

The main objectives of ET6 include the following:

- 1 – Identification of training needs and different training levels required.
- 2 – Identification of possible existing LNG training centers.
- 3 – Analysis of employees needed to provide the expected services in CNCs.
- 4 – Accreditation processes at different levels.
- 5 – Definition of pilot courses to obtain experiences to validate or modify courses, contents and structure.
- 6 – Support of platforms of knowledge, dissemination and cross fertilization.

Four main tasks identified in ET6:

- Training needs both on shore and at sea.
- Training programs and infrastructure. Accreditations.
- Training the human element in emergency and risk situations.
- University level training in cooperation with the specialized industry.

The reports to be produced in this activity, that will be included in the Deliverables, will be:

- Training programs contents for the LNG supply chains and storage.
- Training program contents for vocational education on land suppliers and receivers.
- Training program contents for vocational education on board suppliers and receivers.
- Accreditation processes for vocational education.
- Firefighting and crisis procedures manual.
- University level training programs together with the industry.
- LNG knowledge platform.
- Business and development plan.

Feasibility studies

WP2.2: Feasibility studies: This work packages splits into seven sub-activities each one related to a feasibility study on different LNG applications to be further implemented. Real-life trials or implementation are not included in this case to avoid overlaps with pilots in ACT-3 and to keep the budget focused on innovation. Moreover, these feasibility studies benefit from the pilots initiatives and their developing as further works will be analysed in the Roll out.

- **EV1:** Engineering study for a new dedicated LNG jetty in the regasification plant located at the port of Ferrol.
- **EV2:** Feasibility study for a new rescue boat powered by LNG.
- **EV3:** Feasibility study for a shunting locomotive retrofit.
- **EV4:** Feasibility study for a tugboat powered by LNG operating at the port of Barcelona.
- **EV5:** Feasibility study for the adaptation to LNG bunkering and small scale services at the regasification plant of Sagunto (Port Authority of Valencia).
- **EV6:** Feasibility study for a tugboat powered by LNG operating at the port of Valencia.
- **EV7:** Feasibility study of a LNG bunker berth in the port of Huelva, considering the option of road transport from the regasification plant (located besides the port) to the berth.

Engineering for new dedicated LNG jetty (Mugardos, Ferrol)

EV1

The aim objective of this subactivity is to develop the basic engineering for a new jetty for LNG bunkering.

The risk analysis is completed and the tender for the mooring study have been launched. It is foreseen that the study will finish by the second semester of 2018.



Partners involved



Puerto de Ferrol



After the finalization of the first deliverable "Definition and analysis of the different scenarios of LNG demand", this show the potential demand of LNG in the northwest of the Iberian Peninsula.

Given this opportunity, it is necessary to establish an action plan to promote the use of LNG as fuel, while the logistics chain that allows supply to consumers is developed.

● **EV1:** The Northwest of the Iberian Peninsula has a geostrategic position on the shipping routes and specifically regarding to the Atlantic Maritime Corridor, which belongs to the Motorway of the Sea of Western Europe. In addition, it constitutes the gateway to the ECA areas in Northern Europe.

Every year approximately 40,000 ships that pass through this corridor, navigate on its coasts. Additionally to them, there are 38,541 vessels based in ports in the region.

Moreover, this geographical area has a remarkable infrastructure. Thus, in this area there is a port belonging to the Basic Network, the port of A Coruña, and two belonging to the Global Network, the ports of Vigo and Ferrol. In addition, the ports of A Coruña and Ferrol have both external ports, with depths of 24 and 20 meters, respectively. Regarding to Liquefied Natural Gas (LNG), the Mugardos LNG terminal, operated by Reganosa, and the European leader shipyard in repairing gas carriers, owned by Navantia, are situated in the Ría of Ferrol.

In view of these capabilities, the LNG Hub project was launched in 2013, which initial studies have been co-financed by the TEN-T program in the Annual Call 2012 under the consortium led by Reganosa and in which are involved Navantia, the Port Authority of Ferrol-San Cibrao, the University of Santiago de Compostela, and the local government, Xunta de Galicia, through Instituto Enerxético de Galicia.

In June 2014 the first deliverable of this project, entitled "Definition and analysis of the different scenarios of LNG demand" was completed. In this study of the potential demand of LNG in the northwest of the Iberian Peninsula, it is estimated that by 2030 a demand of 2.2 million cubic meters will be reached.

In this sense, within this study, it has been developed a roadmap where actions that are essential for meeting both objectives are proposed, being one of the key points the establishment of a minimum infrastructure for the supply of LNG. This is the starting point for development, while allowing the increasing demand and, at a longer term, reducing the costs associated with both the technology and the fuel itself. In order to do this, one of the priority measures set out in the roadmap is the adaptation of the infrastructures of the Port of Ferrol to complete the development of the logistics chain that enables loading LNG from a supply vessel to other vessels (ship to ship bunkering).

For the implementation of this measure two phases are considered. In the first one, which is included within the EPA4 activity, it will be conducted the study including a pilot of a solution that ensures the small scale LNG supply while the specific infrastructure for it is not still finalised.

On the other hand, in a second phase, contemplated within the scope of the EV1 activity, the development of the adaptation of the infrastructures of the Port of Ferrol, which was started in the first phase of the LNG Hub, will be continued. Specifically, this activity will proceed to the engineering needed to make future decisions on investment and implementing a second berth from which to stock LNG supply vessels.

Thus, the proposed engineering works within the activity take as a starting point the conceptual design studies conducted during the initial studies, and they are the necessary and unavoidable prerequisite to develop future infrastructures that allow the distribution of LNG as fuel.

The main activities consist of the following:

- Review of previous conceptual design.
- Development of process diagrams.
- Specification of the necessary equipment and definition of auxiliary systems.
- Development of preliminary implementation plans.
- Estimation of the necessary investment.
- Defining the implementation program for the next phase of the project.
- Control and safety studies.
- Preparation of the documents required for the start of the implementation phase and implementation.

As for the expected results of the implementation of this activity, it should be highlighted the contribution of these to the objective of developing the basic transport network, which should be completed in 2030, promoting the effectiveness and visibility of the trans-European transport network. In particular, the implementation of the proposed action will contribute to the development of the core network corridors, namely the Atlantic Corridor CNC-7, supporting an efficient transport system, while the utilization of the capacity in existing infrastructures is optimised.

Moreover, the considered measures are a way to fight climate change and achieve the targets set in European strategies, as they are geared to the development of a European network of an alternative fuel, LNG, which will significantly reduce emissions and decarbonisation of transport.

The leadership of this activity is assumed by Reganosa, a TSO certified company that operates, maintains and manages Mugardos LNG terminal and its associated pipeline network. Therefore, Reganosa has a wide experience in the design and operation of systems identified in the proposed activities. In the same way, it has experience in adapting the access to the terminal depending on the evolution of the fleet of gas carriers.

Meanwhile, the Port Authority of Ferrol-San Cibrao (APFSC) is the public company responsible for the management of the Port of Ferrol, which is part of the Global transport network. This public administration, in addition to its knowledge of the ships' targeted activities, is responsible for developing the concessions associated with the development of the proposed infrastructures.

Finally, the Port Authority of A Coruña has joined the project as a stakeholder, which is, in addition, one of the main ports of the region and is part of the Basic trans-European transport network.

Rescue boat powered by LNG

EV2

This subactivity will provide a feasibility study of LNG as a marine fuel for maritime rescue fleet.

The scope of the project have been modified during its execution in order to include the retrofitting and new building feasibility study of a rescue boat. Luz del Mar and Clara Campoamor will be the studied vessels.



Partners involved



Salvamento Marítimo



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The analysis of the interest fleet and their operations is already finalized. Likewise, design requirements for the use of LNG technology, regulation and supply facilities related with infrastructure and maritime rescue fleet is completed.

The rest of the activities are expected to finish by 2020.

- **EV2:** In order to support the policy of reducing emissions in maritime transport a specific study of the current situation on the potential use of LNG as an alternative fuel for the maritime rescue fleet will be performed.

Internationally the use of LNG as a marine fuel it is clearly promoted, so its application in maritime units that perform rescue services is an ongoing challenge that requires a technical study.

The project will include first of all a situation analysis of the state of art in relation to the use of LNG as fuel in shipping: available technology, limitations and expected developments. The study will address the potential applications of LNG in the maritime rescue fleet, from building new ships powered by this fuel to the retrofitting of existing vessels, ie LNG technological adaptation.

Also the combined use of LNG with traditional fuels in dual motors will be analyzed in order to maintain the levels of quality on the services rendered by the maritime and rescue fleets; and any other application of LNG in rescue vessels, as it may be in auxiliary engines.

This feasibility analysis will consider, at all times, the peculiarities of this type of maritime units that, because of their activity and missions, require very specific characteristics.

The study will also include the monitoring of technological developments for the duration of the project, to ensure the inclusion in it of the latest developments and innovations in this field.

Tarragona. Port locomotive powered by LNG

EV3

As the Port of Tarragona count with railways for freight transport, the study developed in this port aims to evaluate the technical, the legal and the financial feasibility of implementing liquefied natural gas (LNG) in railway traction within the port domain (shunting locomotives).



Partners involved



The main objective is to pave the way towards the introduction of a more sustainable alternative to current diesel technology in an environment with increasingly stringent environmental requirements.

The final document of the subactivity includes the feasibility and retrofitting study, both of them are currently finished.

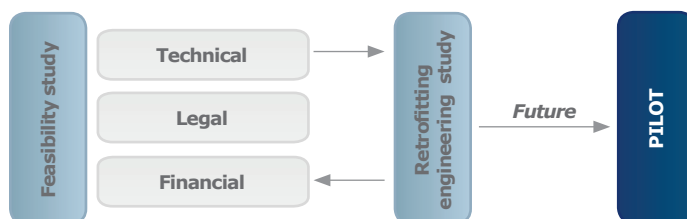
- **EV3:** The aim of this study is to evaluate the technical, the legal and the financial feasibility of implementing liquefied natural gas (LNG) in railway traction within the port domain (shunting locomotives), in order to pave the way towards the introduction of a more sustainable alternative to current diesel technology in an environment with increasingly stringent environmental requirements.

The initiative is innovative in nature in Europe as, whereas there have been some pilots with LNG in railway services, all of them have been carried out in other continents and there are still unresolved constraints concerning shunting locomotives (intensive use, high power requirements, long periods of continuous operation...). In order to shed some light on these issues, all technical and legal barriers will be identified, as well as actions to be implemented to overcome them. A financial analysis also be carried out, identifying the critical variables and the conditions under which the investment offers greater return and offering insights into the future potential for LNG locomotives.

The technical results of the feasibility analysis will feed the complementary retrofitting study, in which all steps to be made for the retrofitting of the engine and the locomotive will be detailed. The retrofitting study aims at identifying engineering and mechanical challenges related posed by the technological solutions selected in the feasibility study as well as setting the path for future implementation of the works carried out. At the same time, the outcomes of the retrofitting study (detailed information on all mechanical adaptations and engineering works needed), will enable a more accurate estimate of the financial analysis included in the feasibility study.

The study provides the solid knowledge base (determining the best propulsion option, legal procedures to be overcome and the best fuel supply methods, among others) that is needed to launch -in subsequent phases- a pilot to test, monitor and verify the results of the operation of a port shunting locomotive powered with LNG (operational performance, fuel consumption, emissions...) and the associated logistics.

Feasibility and retrofitting study for the conversion of a port terminal's shunting locomotive to LNG traction



Feasibility study of a LNG powered tugboat in the port of Barcelona

EV4

To extend the use of the LNG in the port domain, tugboats represent an important point to be considered.

EV4 will evaluate the feasibility of a natural gas-powered tugboat construction, which will be designed specifically for the characteristics of the ports of the Western Mediterranean.



Partners involved



The solution will count with a dual fuel engine solution and the study of the needs and performance of the boat will be completed soon.

Objective:

The objective of this activity is to conduct a feasibility study for the construction of a natural gas-powered tugboat, designed specifically for the characteristics of the ports of the Western Mediterranean.

Specific objectives:

- To break down barriers to speed up the implementation of natural gas as a fuel used in the fleets of the service port operators.
- To contribute to the reduction of pollutant gas emissions and suspended particulates in the port that affects the air quality in the city.

Description:

Operational feasibility study of a new tug gas propulsion engine, directly coupled to the propeller shaft to carry out towing services in the port of Barcelona.

The project aims to complete the specific design of the boat which will have the same performance and potential as the current diesel-powered tugs, along with a detailed analysis of their performance, fuel consumption, emissions and operating costs. The action will be carried out by two towing service companies of the Port of Barcelona and it will help break the initial barriers of the operators to incorporate gas service into their fleets of vessels. The expected penetration of gas engines among the tugs in the Port of Barcelona is estimated to be between 7% by 2020 and 20% by 2030.

In the project options using natural gas in compressed or liquefied will be analysed, which is an important factor because it will determine the forms of the tugboat and the logistics of the fuel supply.

LNG may be supplied from a pipe, truck or barge and be stored in a storage tank (much like gas oil) which may be placed under the deck. In this case of CNG, the gas supplied and stored in properly stowed bottles. LNG will require working with cryogenic liquids, but it will also open a range in the methods of fuel supply to the vessels and optimize logistics according to the characteristics and needs of the port.

Other aspects to consider when deciding on the use of natural gas-powered tugboats are autonomy, consumption and energy efficiency. These parameters are closely related, since lower consumption translates into increased autonomy and energy efficiency. Moreover, consumption

is linked to the operating profile of the tugboat, which is marked by the needs of the port of Barcelona in terms of numbers frequency of operations to be performed, their duration, type of operation (vessel arrival, vessel departure, change of the mooring, etc.), number of tugs working at once, etc..

We must also take into account the reduction in emissions that will result through the use of a cleaner fuel. Currently, the fleet of 8 tugboats in the harbour emits an estimated 130 tons of NOx and SOx 6.2 tn. Through the use of natural gas, SOx emission will be reduced by 100% and for NOx by 85%.

Adaptation for LNG bunkering/small scale services in Sagunto

EV5

EV5 will study the requirements for the possible adaptation to LNG bunkering and small scale services at the regasification plant of Sagunto.



Partners involved



The Basic Engineering of the bunkering supply facilities has been carried out. The system includes flexible hoses for loading, boil-off management and cooling. Several safety subsystems (elements for spill containment, detectors, sensors and fire extinguishing systems) have also been included.

The objective of **EV5** is to carry out the technical studies required to adapt the SAGGAS facilities in order to be able to provide the expected LNG demanded volumes in the period from 2020 until 2035.

The first activity concerns the technical and financial feasibility analyses of the compatibility and adaptation of the quay at the SAGGAS facilities, as this regasification plant needs to adapt its berth line and terminal to be able to load LNG on LNG bunkering vessels (these being ships much smaller in their dimensions than the usual LNG carriers calling at the terminal).

From the technical point of view, mooring conditions should be addressed in relation with operational safety and efficiency. Speed of LNG supply using this option will also be a determinant factor as STS may not be legally allowed during stevedoring operations. This would imply that STS supply should take place before or after loading and unloading of the vessel, bunkering time hence being critical as it risks forcing the ship to remain for longer periods of time at port and therefore altering the shipping line schedules. Another important factor to be studied is berthing availability to determine the best bunkering points and also to estimate daily bunkering operations.

The capacity of bunkering barges is another factor to be taken into account. This factor will be related to the number of bunkering vessels to supply, the distance between SAGGAS and the Port of Valencia and the estimated average LNG bunkering volume needed per vessel.

Regarding the engineering analysis and plan of the installation of bunkering loading equipment for LNG barges at SAGGAS. Undertaking this second part will be subject to having obtained positive results both on the technical analysis and on the financial feasibility study previously carried out. The options could be:

- The design of the adaptation of the existing facilities.
- The design of the new facilities required to supplying LNG bunkering barges in other are of the jetty terminal.

If the analyses of the each adaptation of the quay at the SAGGAS facilities conclude that technically the installation of bunkering loading equipment for LNG barges is not possible or that investing in such equipment is not financially profitable for the company, part 2 of the sub-activity will not be carried out and its corresponding budget will not be spent.

Valencia. Tugboat powered by LNG

EV6

Continuing with the implementation of LNG in the port domain, EV6 will design a LNG tugboat. The ship will also implement other innovative technologies addressed to improve its optimal use of power.

In this case, the scope of this prototype will only cover the basic engineering.



Partners involved



The final engineering study of prototypes and pilots is already finalized.

The objective of **EV6** is to design a LNG fuelled tug boat. The ship will also implement other innovative technologies addressed to improve her optimal use of power. The scope of this prototype will only cover the basic engineering.

Tugs are usually fuelled by marine diesel oil. However, this fuel produces a number of polluting emissions. This new vessels will be designed by the Spanish tug owner Boluda and Engineering company Seaplace. This is one of the first tugs to be fuelled by the much more environmentally friendly liquefied natural gas (LNG) to eliminate sulphur emissions, bring particulate matter emissions down close to zero and reduce the discharge of CO₂ and NO_x by 26 per cent and 80-90 per cent respectively.

The new tug will be powered by lean-burn gas engines. These powerful gas engines are particularly robust, with a high degree of reliability and long intervals between overhaul. The lean-burn principle delivers high efficiency coupled with reduced exhaust emissions and low specific energy consumption.

Gas engine technology is not new having been proven in both land-based and large ship installations but the LNG fuelled tugs are trailblazers in this sector of the marine market demanding a significant step-forward in technical know-how above that of the average tug building yard. Always at the forefront of innovation and technological advance, Boluda is aimed to lead on all other specialist tug operators in the search for more eco-friendly and economic tug operation.

The systems will have had to meet the International Code of Safety for Gas Fuelled ships and the Bureau Veritas Classification Society rules. These involve such requirements as independent engine room spaces with ventilation of 30 air changes per hour, gas detection, automatic shutdown of gas supply and disconnection of electrical equipment, excess flow shutdown, ventilated double (sheathed) piping. Other special knowledge will be incorporated into the installation of the capacity double walled tank, cold boxes and gas heating systems.

Multimodal LNG bunker berth

EV7

Due its strategic location, the Port of Huelva could became one referent in vessels bunkering.

This is the reason of performing a study of the possibilities for bunker berth in this port. Once selected the best option, with a multimodal view, the aim is to produce a basic project.



Partners involved



Puerto de Huelva

The study will consider the different possible solutions, including an adaptation of the existing jetty and the construction of a new one.

- **EV7:** The Port of Huelva has a very important geostrategic location, closed to the Gibraltar Strait and facing Atlantic Ocean. Together with existing LNG Regasification Plant, Port of Huelva is very well positioned in supplying of LNG as a bunker fuel.

Therefore, it is necessary to study how Port of Huelva will be able to supply not only bunker barge supplying Gibraltar Strait, but also alternatives to give LNG bunker directly, taking into account the different alternatives that offer to have a Regasification Plant.

On the other hand, this LNG facility has a berth with two sets of loading arms: one compatible with ships up to 80,000 m³, and another one that allows ships up to 173,400 m³. So it is necessary to study if it is feasible to use small loading arms, taking into account that share berth with the bigger ones. On the contrary, it could be necessary to take advance of closed berths to the Plant that could offer different ways of giving LNG bunker: pipe to ship, truck to ship and transfer of containers.

Firstly, EV7 will study alternatives of a bunker berth in the Port of Huelva, with a multimodal view and, once selected the best option, will start engineering works to produce a basic project of the solution.

Integrated Pilot Studies (IPS)

Main objective and approach.

The main objective of this activity is to develop real-life trials on multiple LNG applications related to maritime transport and port services in order to test different technologies in different market/geographical areas and operational contexts to gain experience and show how to scale up the trials and create market conditions for deployment on large scale. Moreover, the activity is structured in order to ensure that the trials and the market solutions for the scale up are related to a corridor context in order to roll-out the innovative solutions onto a significant part of the core network corridors (namely the Spanish sections of the Atlantic and Mediterranean corridors), as claimed by the text of the multiannual funding objective 2 call for the innovation priority. To that extent, and due to the complexity of the activity, it has been splitted into three work packages. WP3.1 for pilots in the scope of the Mediterranean corridor; WP3.2 for pilots in the scope of the Atlantic corridor; and WP3.3 for transversal pilots concerning both corridors. In order to keep the innovative component of each pilot, a special care has been delivered to ensure that they test different technologies and/or applications in different market/geographical contexts. Moreover, the pilots have been structured not only by corridor but considering for each corridor a set of LNG supply-demand related applications making possible a market start up after the trials better than if non related pilots would be conceived.

WP3.1: **Integrated Pilot Studies in the Mediterranean corridor:**

This work package includes different LNG pilot applications in the scope of the Spanish sections of the Mediterranean corridor. The WP3.1 has been splitted into five sub-activities concerning each of the pilots.

LNG supply by flexible elements (hoses) in small scale mooring jetty at Regasification Plant of Barcelona

EPM1

Adaptation of an existing jetty in Barcelona for LNG small scale services and bunker supply to ships of up to 80,000 m³ by means of flexible hoses.

The testing of the jetty will include a barge-loading real-life trial which be done in collaboration with other subactivity of the project, EPM2.



Partners involved



Port de Barcelona

Detailed engineering is already finished and the construction process has started. It is foreseen to be available to start with bunkering operations in May/June 2018.

● **EPM1:** This IPS will deploy, looking for market conditions, a LNG technology in the port of Barcelona in order to adapt an existing jetty for LNG small scale services to include the possibility for LNG bunkering applications by means of flexible hoses, without being necessary the build of new facilities/infrastructures, allowing as a result both LNG small scale and bunker supply to ships up to 80,000 m3. This real-life trial will include the loading of a barge (see EPM2).

In the supply of potential demand for LNG bunker at the Port of Barcelona and its vicinity, Regasification Plant of Barcelona will play an important role, being basis installation from which feed barges (feeders) or potential LNG ships, which are powered by LNG directly.

The existence of two jetties at the plant, gives the plant the possibility to offer different services both big-scale, as small-scale.

In this way, and linked to the supply barge collected in the action EPM2 of this project, is needed to realize pilot to test loading barges and ships, which consume LNG from Regasification Plant.

To do this, EPM1 will adapt small scale mooring jetty of Regasification Plant of Barcelona (32H berth), being necessary to install flexible elements and test the technical feasibility of supplying LNG to small vessels from a Plant.

LNG bunker barge to supply LNG inside the Port of Barcelona

EPM2

EPM2 aims to develop a barge for conventional and LNG bunkering (two LNG tanks onto the deck) to cover the early stages of penetration of LNG as propulsion and auxiliary fuel for vessels.

The pilot will represent the first multi-products barge in the Mediterranean area.



Partners involved



The barge construction has already started and it is currently ongoing.

- **EPM2:** This IPS will deploy, looking for market conditions, a LNG technology in the port of Barcelona by creating a barge, for conventional and LNG bunkering to larger vessels by adding two LNG tanks of 100 m3 onto the deck of the barge. There is currently no mixed barge with multi-products to cover the early stages of penetration of LNG as fuel for propulsion and auxiliary fuel for vessels in the Mediterranean corridor.

Retrofitting of two straddle carrier in the Port of Barcelona

EPM3

EPM3 aims to adapt 2 existing straddle carriers (one hydraulic and one electric) within two container terminals in the Port of Barcelona in order to analyse their feasibility and benefits before a larger scale deployment.



Partners involved

Applus[®]
IDIADA

Naturgy


Port de Barcelona


HAM

 HUTCHISON PORTS
BEST


TCB

The terminals that are adapting their straddle carriers are TCB Terminal and Best Terminal. Both modifications are ongoing.

- **EPM3:** This IPS develops an innovative solution consisting on the adaptation to LNG fuel of two different technologies straddle carrier (hydraulic and electric) currently in use within two different container terminals in the port Barcelona. As a result, its feasibility and suitability as well as its added value before deploying it on a larger scale will be analysed. No straddle carrier equipment powered by LNG operates in the Mediterranean corridor at the moment (to be notice the recognition to the Green cranes EU project as main precedent).

This pilot sub-activity consists of a design and implementation of two straddle carriers powered by natural gas in a container terminal. The project seeks to break down barriers to put into service gas powered container terminal equipment at medium term.

It is the study of diesel-electric and diesel-hydraulic engines of two existing off-road machines, each operating in one of the two container terminals in the port, in order to see the viability of having them replaced with a LNG or CNG gas engine, and subsequently the feasibility of its approval.

As a result of this study, two pilots will be carried out which will consist of modifying the diesel engine by a gas-powered one, and by replacing the diesel tanks with the LNG or CNG ones.

Once the engine is coupled to the machine, testing and monitoring of their performance will be conducted.

The two container terminals of the port of Barcelona will participate in the pilot, each one handing over a Straddle Carrier machine to make the transformation.

Cartagena-dedicated LNG mooring jetty for small scale services

EPM4

This subactivity will adapt a dedicated mooring jetty for small scale LNG supply in Cartagena.

In this jetty, the first pipe to ship bunkering operation from terminal was held. The ship was Damia Desgagnés, an asphalt vessel that was on its way to Canada.



Partners involved



The construction works have started and bunkering operations are foreseen to be available in September of 2018.

- **EPM4:** This IPS looks for market conditions on the deployment of LNG technology, in this case in the port of Cartagena, consisting on an adaptation of a dedicated mooring jetty not for bunkering but for small scale LNG supply, meaning a different market application and technology than EPM1.

The strategic position of Port of Cartagena, makes its Regasification Plant an important LNG supplier in the Strait of Gibraltar, North Africa and the Mediterranean corridor.

On the other hand, the existence of two mooring jetties for loading/unloading LNG vessels, gives to the plant enormous possibilities to attend different services, both big-scale, as small-scale.

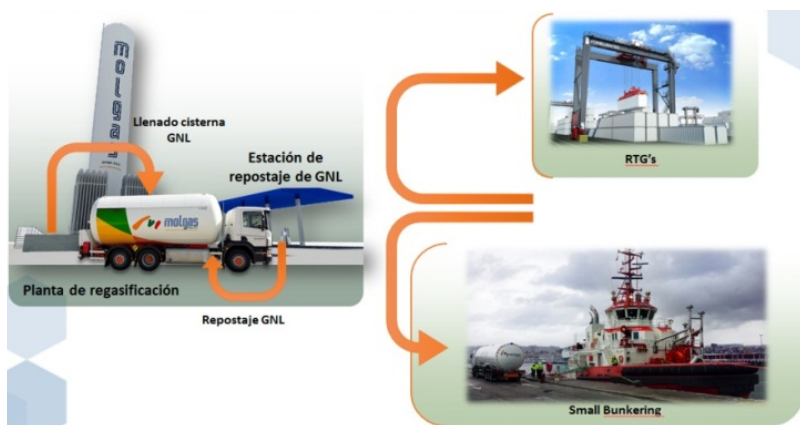
It is necessary to adapt the plant small mooring jetty E-300 to carry on small-scale services for ships from 1,000 m³.

Valencia-LNG/CNG mixed station for vehicles and small boats

EPM5

EPM5 aims at building a mixed station (land-maritime vehicles) within the port domain, contributing to LNG penetration in Valencia Port activities.

The station will include an innovative system for increasing the methane number, meeting the knocking requirements of alternative engines.



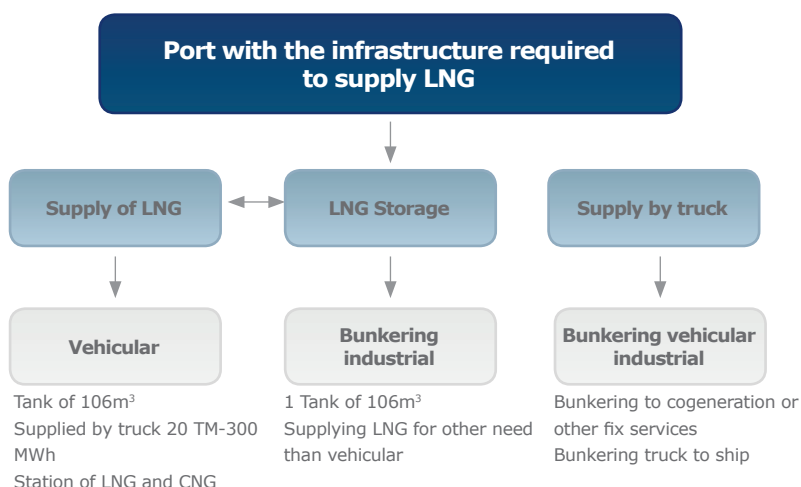
Partners involved



- EPMS:** This IPS aims consist on an innovative approach to LNG/CNG supply by the development of a mixed station for vehicles and small boats within the port service, contributing to the LNG penetration in the port activities. The trial aims at gaining the experience on this type of solutions and creating the market conditions for its deployment on a larger scale. Moreover, the station will include an innovative system to produce natural gas with higher methane number, meeting the knocking requirements of alternative engines.

The objective of EPMS is to propose an innovative approach for small scale LNG terminals with solutions, both on technical and economical point of views.

A small scale LNG logistics chain normally refers to LNG distribution to local users. In practice this means truck transportation to end user local LNG tanks, which are typically tens of m3 in size. The scheme of the installation can be represented as follow:



LNG can be stored in cylindrical metal tanks designed to typically resist pressures of up to 10 bar. The benefit of having pressurized tanks is that the boil-off gas, which is inevitable no matter how good the thermal insulation is, can remain in the tank and act as a pressure source for gas feed. When the excess pressure is controlled by releasing gas through a control valve, the evaporation inside the container lowers the temperature and keeps the container in equilibrium.

As a result, the tank arrangement is extremely simple, having no compressors or rotating equipment of any kind. It simply consists of the tank, an emergency pressure relief valve, regasification heat exchangers, and an outgoing gas pressure stabilisation valve.

On one hand, the small scale LNG terminal basically consists of a tank of 106 m³ for refuelling heavy vehicles running on LNG by a gas pump. Additionally, LNG will be regasified in a process plant for a later pressurization up to 200 bars for supplying vehicles running on CNG.

On the other hand, the terminal will have an extra storage tank of 106 m³ for refuelling by truck industrial services and port machinery. A cryogenic pipe will be installed for bunkering small vessels in the future. It is highlighted that this small scale terminal will be equipped with a decantation system able to separate the LNG according to quality, assuring LNG with a high number of methane will be available for ships.

WP3.2: Integrated Pilot Studies in the Atlantic corridor:

This work package tests different LNG applications in the scope of the Spanish sections of the Atlantic corridor. Same as WP3.1, this work package has been splitted into sub-activities concerning each of the pilots (four in this case).

Bilbao: adaptation for LNG small scale services in big scale jetty

EPA1

This subactivity has adapted an existing jetty for big scale applications to also offer LNG small scale services, as a first step to allow ship-to-ship bunkering in Bilbao.



Project finalized. Tests ongoing.

Partners involved

ENERGIAREN
EUSKAL ERAKUNDEA
ENTE VASCO
DE LA ENERGÍA



 **itsasGas**
BUNKER SUPPLY

The jetty is currently operational and last 30th of January of 2018 the first bunkering test was realized between a docked vessel at this jetty, Ireland, and Oizmendi (EPA2).

● **EPA1:** This IPS will deploy, looking for market conditions, a LNG technology in the port of Bilbao in order to adapt an existing jetty for big scale applications to also offer LNG small scale services, allowing also bunkering on biggest barges.

One mean to achieve a sustainable and efficient transport is the use of liquefied natural gas (LNG) as fuel.

Traditional efforts to supply LNG fuel to marine vessels have been dominated by stop-gap methods like truck refueling. But for LNG to emerge as a legitimate fuel source for many marine operators, large-scale sources of fuel supply must emerge.

This action contains a first step focusing on the modification of the existing mooring jetty in Bizkaia Bay Gas (BBG) regasification terminal, currently used for unloading LNG tankers between 70,000 and 200,000 m³. The reform aims to adapt the BBG LNG import-terminal jetty for an additional use as LNG bunkering station for barges and Coastal vessels.



A second step will be the development of a new mooring jetty in Bizkaia Bay Gas (BBG) regasification terminal to give additional service to the LNG bunker barge and others coasters ships. This step is within the global project, but not in the current proposed action.

Finally, It should be noted that this action is completed with other two:

- The adaptation of an existing ship to LNG bunker barge to provide a Ship to Ship LNG bunkering service to ships sailing the Cantabrian Coast within the southwest Atlantic Corridor (see EPA 2).
- Make the port of Bilbao a Green Port. The project includes, as well, a pilot project for the incorporation of the first LNG powered tugboat in the region: A LNG powered tug for daily operation in the Bilbao Port. (see EPA 3).

Bilbao: barge retrofit for LNG bunkering in the Cantabrian Coast

EPA2

This subactivity has completed the retrofitting of a 100m-length existing barge for conventional fossil fuels and LNG bunkering. The new name for this vessel is Oizmendi.

Its LNG bunkering capacity is 600 m³, thanks to two 300 m³ tanks, but it could be extended with the installation of more tanks.



Project finalized. Tests ongoing.

Partners involved

ENERGIAREN
EUSKAL ERAKUNDEA
ENTE VASCO
DE LA ENERGÍA



 **ItsasGas**
BUNKER SUPPLY

The barge is currently operational and the first bunkering test was realized between a docked vessel, Ireland, and Oizmendi on 30th of January of 2018.

Oizmendi is the first navigable LNG bunker barge in the Atlantic sea.

- **EPA2:** This IPS will deploy, looking for market conditions, a LNG technology by retrofitting an existing barge, currently in use, for conventional and LNG bunkering not only in the port of Bilbao but also along the Cantabrian coast, as the barge, of a 100m length, will have navigation capabilities in open sea. It will be the first navigable LNG bunker barge to operate within the scope of the Atlantic corridor, with a significant total LNG bunker capacity of 1000 m3. In order to test the navigation capabilities, the pilot will include a loading operation at port of Ferrol (see EPA4).

Adaptation of an existing ship to LNG bunker barge, ready to bunkering operations (ship to ship) at the Port of Bilbao and Cantabrian coast within the southwest Atlantic Corridor, in order to contribute to sustainability objectives through the supply of alternative fuels and the promotion of transport with low carbon emissions.

Fuelling for LNG fuelled marine vessels has traditionally been accomplished by tanker truck while at the pier. For vessels with tank capacities of roughly 160 cubic meter, this has typically been an acceptable option, despite involving up to four tanker trucks. Beyond this boundary however, refuelling becomes difficult. In addition to the logistical headaches of coordinating multiple trucks, this operation can add greatly to fuelling time and may delay passenger or cargo loading operations.

Although, for some operations fuelled marine vessels by tanker truck is and remains a perfectly acceptable option, based on the findings and conclusions of the comprehensive feasibility study developed, bunkering operations (ship to ship) has been identified as the most suitable for implementation in the port of Bilbao.

This action aims to adapt an existing ship to LNG bunker barge to provide a Ship to Ship LNG bunkering service to ships sailing the Cantabrian Coast within the southwest Atlantic Corridor in order to contribute to sustainability objectives through the supply of alternative fuels and the promotion of transport with low carbon emissions.

The purpose of this action is the retrofitting of "Monte Arucas/finally called Oizmendi" which is originally intended for oil recovery and bunker fuel oil, re-designed the cargo area with the installation of two high pressure tanks carrying a total amount of 1000 cbm LNG.

The result of the retrofitting will be a new LNG bunker vessel with the following capabilities:

- Ship-to-ship transfer oil and LNG fuel to ships sailing the Cantabrian Coast within the southwest Atlantic Corridor.
- Oil Recovery capacity at sea.
- 100% compatibility with Cantabrian LNG imports terminals.

Finally, It should be noted that this action is completed with other two:

- Design of resources, infrastructure and procedures necessary to supply LNG as fuel in Bilbao Port to ships sailing the Cantabrian Coast within the southwest Atlantic Corridor (see EPA1 sub-activity).
- Make the port of Bilbao a Green Port. The project includes, as well, a pilot project for the incorporation of the first LNG powered tugboat in the region: A LNG powered tug for daily operation in the Bilbao Port (see EPA3 sub-activity).

Bilbao: New tugboat powered by LNG

EPA3

The existing and future maritime fleet needs to be adapted in terms of technology of engines and storage in order to continue with the transition towards a more environmentally-friendly shipping sector through the use of LNG as alternative fuel.

The general aim of this concrete action is the development of a LNG powered harbour TUG and its incorporation to Bilbao port tugs service.



Partners involved

ENERGIAREN
EUSKAL ERAKUNDEA
ENTE VASCO
DE LA ENERGÍA



The tugboat construction will be executed by R. Ibaizabal and it is foreseen to be finished by the Q2 of 2019.

- **EPA3:** This IPS will develop an innovative solution consisting on the first LNG harbor powered tugboat within the EU and its implementation in order to test its feasibility and suitability as well as its added value before deploying it on a larger scale. The tugboat will be incorporated to the Bilbao port service.

The transition towards a more environmentally-friendly shipping sector through the use of LNG as alternative fuel requires a double axis action. On one side, the existing and future maritime fleet needs to be adapted in terms of technology of engines and storage. On the other, terminals and other facilities at ports need to be upgraded or developed in order to deploy a full supply chain providing enough security of supply.

Objectives of this action are:

- The development of the first LNG-powered tugboat within EU.
- The promotion and use of LNG as fuel, reducing the marine environmental impact and energy consumption at the Port of Bilbao.
- As the marine LNG fuelled engine market has been dominated in its relatively short life by a small number of players, the action aims to push for both application of new LNG techniques and technologies.
- In this action will be analysed and assessed the possible options for design and supply of “cold box” for LNG-fuelled vessels in the Basque Country (Spain) as alternative to those technologies already positioned in the market.
- Last but not least, this action aims to enable Bilbao port investors, EU policy-makers, citizens and industry to understand and decide which technologies generate the best socio-economic value and have the highest potential for rapid deployment across the EU.

Finally, It should be noted that this action is completed with other two:

- Design of resources, infrastructure and procedures necessary to supply LNG as fuel in Bilbao Port to ships sailing the Atlantic corridor. (see EPA 1).
- The adaptation of an existing ship to LNG bunker barge to provide a Ship to Ship LNG bunkering service to ships sailing the Cantabrian Coast within the southwest Atlantic Corridor (see EPA 2).

Ferrol: adaptation for LNG mixed bunker/big/small scale services in existing jetty

EPA4

The studies for the adaptation of these infrastructures are the subject of the EV1 activity.

Moreover, while this adaptation is under development, it is necessary to adopt solutions to ensure the supply of LNG in the short term. The study of a solution that allows small scale LNG supply during this period from the terminal of Mugardos is the target of this activity.



Partners involved



The objective is to adapt the existing LNG big-scale jetty in Ferrol to enable it to supply LNG for small scale and bunkering applications (<15,000 m³) through flexible elements, while keeping its big scale supply function.

● **EPA4:** This IPS will deploy, looking for market conditions, a LNG technology in the port of Ferrol in order to adapt an existing jetty for LNG big scale applications to a jetty which could be capable to supply LNG small scale and bunkering applications ranging under 15000 m3 by using flexible elements while keeping it big scale supply capabilities. The feasibility and suitability of the new jetty will be tested with the LNG barge at EPA2 coming from the port of Bilbao. Relating two ports within the scope of the maritime dimension of the Atlantic corridor will give also an idea for possible business models to be further implemented with regards to LNG maritime bunkering in the corridor.

The Northwest of the Iberian Peninsula has a geostrategic position on the shipping routes and specifically regarding to the Atlantic Maritime Corridor, which belongs to the Motorway of the Sea of Western Europe. In addition, it constitutes the gateway to the ECA areas in Northern Europe.

Every year approximately 40,000 ships that pass through this corridor, navigate on its coasts. Additionally to them, there are 38,541 vessels based in ports in the region.

Moreover, this geographical area has a remarkable infrastructure. Thus, in this area there is a port belonging to the Basic Network, the port of A Coruña, and two belonging to the Global Network, the ports of Vigo and Ferrol. In addition, the ports of A Coruña and Ferrol have both external ports, with depths of 24 and 20 meters, respectively. Regarding to Liquefied Natural Gas (LNG), the Mugardos LNG terminal, operated by Reganosa, and the European leader shipyard in repairing gas carriers, owned by Navantia, are situated in the Ría of Ferrol.

In view of these capabilities, the LNG Hub project was launched in 2013, which initial studies have been co-financed by the TEN-T program in the Annual Call 2012 under the consortium led by Reganosa and in which are involved Navantia, the Port Authority of Ferrol-San Cibrao, the University of Santiago de Compostela, and the local government, Xunta de Galicia, through Instituto Enerxético de Galicia.

In June 2014 the first deliverable of this project, entitled "Definition and analysis of the different scenarios of LNG demand" was completed. In this study of the potential demand of LNG in the northwest of the Iberian Peninsula, it is estimated that by 2030 a demand of 2.2 million cubic meters will be reached.

Given this opportunity, it is necessary to establish an action plan to promote the use of LNG as fuel, while the logistics chain that allows supply to consumers is developed. In this sense, within this study, it has been

developed a roadmap where actions that are essential for meeting both objectives are proposed, being one of the key points the establishment of a minimum infrastructure for the supply of LNG. This is the starting point for development, while allowing the increasing demand and, at a longer term, reducing the costs associated with both the technology and the fuel itself. In order to do this, one of the priority measures set out in the roadmap is the adaptation of the infrastructures of the Port of Ferrol to complete the development of the logistics chain that enables loading LNG from a supply vessel to other vessels (ship to ship bunkering).

The studies for the adaptation of these infrastructures are the subject of the EV1 activity. Moreover, while this adaptation is under development, it is necessary to adopt solutions to ensure the supply of LNG in the short term. The study of a solution that allows small scale LNG supply during this period from the terminal of Mugardos is the target of this activity.

Specifically, within this EPA4 sub-activity it is proposed the adaptation of the jetty of the terminal, designed to supply large scale LNG ships up to 260,000 m³, in order to allow the loading of vessels with less than 15,000 m³ capacity. The proposed solution consists of a loading system using flexible hoses that allow to supply LNG barges. Thus, the consumers in the Atlantic Corridor will be ensured access to this fuel until the development of the definitive infrastructure for this purpose is completed.

The first part of the activity is the development of the adaptation project whose results will define the scope of the actions to be developed in the second part, among which the following are envisaged:

- Making the necessary connections to existing process piping.
- Installing a loading system with flexible hoses that allows the loading of ships with a capacity of between 0 and 15,000 m³.
- Installing fast connections that allow an easy handling of the hoses.
- Installing security elements, such as emergency shutdown systems.
- Necessary modifications in auxiliary and shared facilities.
- Upgrading of existing facilities to moor small vessels in safe conditions.

Specifically, the necessary modifications to adapt a ship for LNG supply will be made, including a flexible loading system for stocking up on any LNG terminal, even if the terminal is not adapted to loading small ship. The ship considered for this modification is based at present at the Port of

Ferrol, belonging to the Global Network, and it operates in this port and in A Coruña, which is part of the Core Network.

As for the expected results of the implementation of this activity, it should be highlighted the contribution of these to the objective of developing the basic transport network, which should be completed in 2030, promoting the effectiveness and visibility of the trans-European transport network. In particular, the implementation of the proposed action will contribute to the development of the core network corridors, namely the Atlantic Corridor CNC-7, thus supporting an efficient transport system, while the utilization of the capacity in existing infrastructures is optimised.

Moreover, the considered measures are a way to fight climate change and achieve the targets set in European strategies, as they are geared to the development of a European network of an alternative fuel, LNG, which will significantly reduce emissions and decarbonisation of transport.

The leadership of this activity is assumed by Reganosa, a TSO certified company that operates, maintains and manages Mugardos LNG terminal and its associated pipeline network. Therefore, Reganosa has a wide experience in the design and operation of systems identified in the proposed activities. In the same way, it has experience in adapting the access to the terminal depending on the evolution of the fleet of gas carriers.

Meanwhile, the Port Authority of Ferrol-San Cibrao (APFSC) is the public company responsible for the management of the Port of Ferrol, which is part of the Global transport network. This public administration, in addition to its knowledge of the ships' targeted activities, is responsible for developing the concessions associated with the development of the proposed infrastructure.

Finally, the Port Authority of A Coruña has joined the project as a stakeholder, which is, in addition, one of the main ports of the region and is part of the Basic trans-European transport network.

WP3.2: Integrated Pilot Studies Transversal

This work package includes different LNG pilot applications common to both the Atlantic and Mediterranean corridors. This work package has been splitted into two sub-activities concerning each of the pilots.

Mobile unit to supply electricity generated by LNG to ferries, during its stay in port

EPT1

Mobile LNG powered electricity generator to supply ferries' auxiliary engines.

This OPS is able to navigate in a ship or to be placed in the wharf at port, which could be used for more than one vessel.



Partners involved



Port de Barcelona



Autoridad Portuaria
Santa Cruz de Tenerife



The objective of the project is to reduce the emissions that ships produce during their calls in ports by replacing the operation of the auxiliary engines of the ship with mobile LNG units that provide electricity to the ship.

On the 15th of December the Port of Barcelona was the official presentation to the media and the fourth test of the first electric connection to a vessel from a dock using an engine powered by natural gas. Next tests are foreseen in Tenerife (Apr 2018) and Vigo (May 2018).

● **EPT1:** This IPS develops an innovative solution in order to implement a mobile LNG powered electricity generator to supply the auxiliary engines of ferries. As a mobile unit it is able to navigate with ship or placed in the wharf at port, being more versatile as it could be used for more than one vessel. No other solution of this kind exists in Spain. The trial looks for market conditions for deployment on larger scale, focusing on ferry and cruise ship.



This EPT1 sub-activity pilot aims decentralisation and autonomous power supply of auxiliary engines of a ro-ro ferry in the port. Electricity is generated by a gas engine on the wharf. Tests will be carried out in the ports of Barcelona, Vigo and Tenerife.

The specific objectives of this sub-activity are:

- To lower emission levels and thus contribute to the air quality of the city, meeting the objectives of the Clean Air Plan for Europe.
- To develop a feasible, versatile and economical solution for ports and shipowners which will give continuity and development of this measure to reduce emissions in ports located in the vicinity of cities.

EPT1 consists of the design and installation of a mobile gas generating unit that incorporates:

- Generator Engine of 850kW that runs with natural gas.
- LNG feeder tank with gasification equipment.

The two units (motor and tank) installed on the deck of the ro-ro vessel "Bouzas", property of FLOTA SUARDIAZ when it is docked or when it remains in the berth. The ship adapted its electrical box to be able to use the electricity generator replacing the auxiliary engines while in port.

Multimodal transport for LNG logistics supply chain (Rail/Road/Sea)

EPT2

Multimodal transport is now beginning to be applied to LNG logistic chain., due to this situation, EPT2 sub-activity will study technical and economic feasibility of the whole multimodal LNG transport chain (road, rail and ship) in Spain.

Finally, EPT2 will also test results by doing real pilot transportation of LNG by means of ISO container, using truck, rail and ship.



Partners involved



Puerto de Melilla
Autoridad Portuaria de Melilla



Puerto de Cartagena
Autoridad Portuaria de Cartagena



Puerto Bahía de Algeciras
Autoridad Portuaria de la Bahía de Algeciras

renfe
Mercancías



Puerto de Huelva

The real pilot transportation of a LNG ISO container will take place in the following months as the definitive route have been already defined.

● **EPT2:** This IPS will deploy, looking for market conditions, a LNG transport service concerning rail, road and maritime transport in an integrated approach in order to test if this supply logistic-chain is feasible and suitable with regards to security, costs and permitting. An ISO container will be transported using all three modes of transport. Long distance of the trial will assure an EU scale.

Since 1970, distribution of LNG in Spain is done by means of trucks, to supply natural gas to distribution networks and industries not connected to national network. Trucks loaded have risen up to 45,000 in a year, being highest rate up. Moreover, Balears islands have been supplied of LNG by trucks in ro-ro ships.

This mode of transport, developed enough at least in Spain, has demonstrated its reliability, security and capabilities. However, demand of LNG as a fuel for transport, needs to develop traditional logistic chain, taking advance of multimodality and, specifically, rail mode of transport.

This two pillars offer further possibilities, such as efficiency, flexibility, modularity, long-haul or distribution of LNG (from terminal to end user). The vision is not only Spain or the Iberian Peninsula, but also Europe, from the fact that this logistic chain will connect LNG import terminals with the innermost areas of Europe.

This EPT2 will focus on study the technical and economic feasibility of multimodal LNG transport (road, rail and maritime), trying to solve questions about security, logistics, costs and permitting. Finally, in order to test results, an ISO container will be transported using all three modes of transport. Length of transport will assure to be similar to exportation activities, so will allow getting experience about LNG supply to the innermost Europe.

Results, Impact Assessments and Dissemination

- Main objective and approach

The activity main objective is to ensure the Action gives specific results showing their contribution to the EU added value by means of specific impact assessments and disseminating them to the potential beneficiaries in LNG and transport sector, including the Commission. Due to the nature of these initiatives, in order to clearly distinct these final initiatives, the activity has again been splitted into five work packages. WP4.1 will drive the launching of an Observatory LNG aiming to feed into the required reporting and review provisions of the article 10 of Directive 2014/09 with regards to the implementation of the LNG subset of the Spanish National Policy Framework. WP4.2 will specifically drive the Roll out programme for the LNG technologies being tested in ACT-3 onto, at least, the Spanish sections of the Mediterranean and Atlantic corridors with special emphasis on their maritime dimension. These two work packages will be a on-going processes as from 2016 in order to be able to support both the calendar of the National Policy Framework, as provided by the Directive, and the update of the corridors plans and studies expected in 2016 and 2018 by the respective coordinators as well as the Motorways of the Sea working plan. WP4.3 and WP4.4 will give the dimension of the impact of the results achieved within the Action into the EU added value, particularly through the contributions to the needs and goals of the EU policy with regards to clean fuels on transport sector and TEN-t development. Finally, WP4.5 will focus on the dissemination of the results.

- Description

- **WP4.1: Observatory:** One of the main goals of the Action is to settle the basis for the LNG part of National Policy Framework as provided in the Directive 2014/94 on the deployment of alternative fuel infrastructure (ET0). Furthermore, once the NPF is approved (expected by November 2016 as expected), a follow up of the different legal and policy measures, targets and objectives, manufacturing and infrastructure deployments, etc. is needed in order to measure the level of achievement which is required for reporting, as provided in the Directive. To that extent, to facilitate and systematize the methodology for the information required, the idea of an Observatory arises and is included as part of the Action. The main work to be done in WP4.1 is related to the previous steps in order to be able to launch the Observatory, and a first report by December 2018. The aim is that the scope of the Observatory could be the Iberian Peninsula. This work package depends mainly on sub-activity ET0.

- **WP4.2: Roll out and investment plan:** Innovation priority within the funding objective 2 of the multiannual Call explicitly requires for the roll-out of the innovative solutions being tested on pilots, once a market orientated solution is being sought. According to the Commission, the goal of innovative pilots is to intensify to 50% the EU support to the promoters of innovative solutions in order to minimize their risk. In exchange, a study is required analyzing how to scale up the trial for mass application. The aim of WP4.2 is to drive the required analysis in order to address the implementation deployment for each pilot within the Spanish ports network with an emphasis on the Atlantic and Mediterranean corridors development. This work package depends obviously on the pilots included in ACT-3 but also on ET2, ET3 and ET4. Moreover, the Action will try to specify this Roll-out in the form of a specific investment plan relying mainly on the private initiative but with the support of the public entities involved.
- **WP4.3, WP4.4. Impact assessments:** Within these work packages the results of ACT-2 and ACT-3 will be analyzed in order to show their specific contribution to EU added value and the global project, with special focus on the implementation of the Directive 2014/94 and the Regulation 1315/2013 on Union guidelines for the development of the trans-European transport network. The impact assessment has been splitted into two work packages, one for studies (WP4.3) and one for pilots (WP4.4), in order to facilitate the analysis and the programming of the job to be done. At the end, the two assessments will converge.
- **WP4.5 Dissemination of the results:** This work package will drive the required exercise on disseminating results in order to transparently document the whole process, providing a complete and structured documentation with all key aspects and achievements, particularly with regards to the main results, for it to be used as best practices by the Commission and other Member States and stakeholders involved in similar initiatives elsewhere in Europe. At least two main dissemination events will be delivered through the timeframe of the Action, by the end of 2018 and 2019. The main goal of the dissemination work package will be to ensure that the experience gained within the Action is effectively shared to be reused on further initiatives. The dissemination events will be public and the Commission, Member States and relevant stakeholders will be invited, along with regional authorities, in order to give the maximum visibility. In each of the two expected events it will be presented a supporting document providing the latest information on results at the stage of the event. Moreover, the events will be clearly focused to drive information to the stakeholders on the opportunities for LNG deployment found within the Action, particularly showing how to scale up the pilot applications.

Location of the proposed Action

	CN Corridor	Core Network	Comprehensive Net	Nodes
	1 st level	2 nd level	3 rd level	
Mediterranean	Algeciras, Madrid, Valencia, Cartagena, Tarragona, Barcelona.	Huelva.	Melilla, Tenerife.	9
Atlantic	Algeciras.	Gijón , A Coruña.	Ferrol, Vigo, Santander.	7
	8	3	5	16

CORE LNGas hive is a multi-location proposal, covering initiatives related to different locations within the Iberian Peninsula. Pilots concerning real-life trials will be developed at Ferrol, Bilbao, Barcelona, Valencia, Cartagena, Algeciras, Tenerife and Vigo. Moreover, studies will be developed at different locations, with the coordination office in Madrid.



06. Contribution of the proposed action to TEN-T policy objectives and EU Dimension

Contribution of the proposed Action to TEN-T Core Network corridors, or classification as a project of common interest

The proposed Action classifies as a project of common interest, as defined in Article 7 of the TEN-T Guidelines, since:

- It contributes to the development of the trans-European transport network through measures promoting the resource-efficient use of the network and delivers European added value: CORE LNGas hive will work especially the maritime dimension of both the Mediterranean (CNC 3) and Atlantic (CNC 7) Corridors on the Iberian sections. Clean Power for Transport Directive shows a roadmap to migrate from coal and oil transport fuels to other cleaner fuels such as LNG, CNG, and the other 5 defined in the Directive. This proposal will work especially with LNG for transport with a series of Studies and Studies with Integrated Pilots in order to work first on innovation of LNG applications to different ports and maritime services, and then, designing a Roll Out Plan to extend the innovations alongside the Iberian Peninsula Sections of the Corridors and if possible, beyond to the entire Corridor.

On the one hand, the development of the ports of the Mediterranean Corridor, together with an efficient rail connection of these ports to the Core Network, could help reaching a better balance between north and south range and an enhanced sustainability (reducing the costs in time and fuel, as well as the related emissions) of Europe's international trade with other continents. The short sea shipping services between European countries or with northern Africa is also a strong and growing element of the maritime dimension of the Corridor.

On the other hand, the Atlantic Corridor has an important maritime dimension linked to its location in the crossroad of large maritime routes (via the Panama Canal and the Straits of Gibraltar) notably towards North and South America, Neighboring countries and Africa. This maritime component is crucial: ports along the façade are key interconnectors (inland/seaside) to stimulate the high potential for deploying Motorways of the Sea and Short Sea Shipping as an alternative route to the inland backbone along the Atlantic coast. The developments related to the

Transatlantic Trade and Investment Partnership (TTIP) with its EU-US-Canada trade agreement, together with the doubling of capacity in the Panama Canal represents an opportunity for the traffic coming from the Americas, Africa and Asia with destinations in Central Europe due to the important environmental and economic advantages related to more competitive transport costs and lower energy consumption.

- It delivers European added value by contributing to the objectives falling within the following two of the four categories set out in Article 4:

- Contribution to efficiency, by promoting economically efficient transport contributing to further economic growth and competitiveness (see preceding bullet point) (Article 4 (b), (iv)) and testing innovative technological solutions and operational processes in different transport modes (Article 4 (b), (vi)).
- Contribution to sustainability: It has made possible the integration of both the technological and the institutional components of the Clean Power for Transport package and consequently, it will allow for a development of maritime transport in a manner consistent with ensuring transport that is sustainable and economically efficient in the long term (Article 4 (c), (i)), contribute to the objectives of low greenhouse gas emissions, low-carbon and clean transport and reduction of external costs (Article 4 (c), (ii)), and contribute to the promotion of low-carbon transport (Article 4 (c), (iii)).

- It complies with Chapter II, as described in the following articles of the above mentioned Guidelines:

- Article 10: The studies and studies with integrated pilots promote the use of LNG, an alternative and low carbon energy source and propulsion system.
- Article 20 (3): CORE LNGas hive considers the adaptation/construction of equipment associated with maritime transport infrastructure for the use of LNG.
- Article 21 (3): It includes studies and studies with integrated pilots aimed at developing solutions for environmental performance improvement, making available alternative fuelling facilities, as well as the optimisation of processes and procedures.
- Article 23 (d): It analyses and tests the introduction of new technologies and innovation for the promotion of LNG and energy-efficient maritime transport.

- Article 32 (b, d): It promotes the development of sustainable freight transport services, by (b) deploying innovative transport services necessary to achieve environmental related goals of those services, as well as the establishment of relevant governance structures, and by (b) stimulating resource and carbon efficiency, in particular in the fields of vehicle traction.
- Article 33 (a, b, f): The studies and pilots defined in the Action, as well as the roll-out programme and the impact assessments planned, (a) support and promote the decarbonisation of marine and port transport through transition to innovative and sustainable transport technologies, (b) make possible the decarbonisation of marine transport by stimulating the introduction of LNG and providing the corresponding infrastructure, and (f) promote measures to reduce external costs, such as pollution including emissions.
- Article 36: The impact of all activities comprised in CORE LNGas hive will be analysed in terms of their contribution to the implementation of Directives 2014/94 and 2012/33 and the resulting Work Plans of the Atlantic and Mediterranean priority corridors of the trans Basic Network will be aligned with the Union law on the environment, including Directives 92/43/EEC, 2000/60/EC, 2001/42/EC, 2009/147/EC and 2011/92/EU.
- It complies with Chapter III, as described in articles 38 and 39 (b) of the above mentioned Guidelines since it contributes to endowing Spain and Portugal with an adequate infrastructure and operating framework for the deployment of a global supply network of liquefied natural gas (LNG) for transportation uses, ensuring the availability of an alternative clean fuel for maritime transport infrastructure, namely LNG, in 9 Core maritime ports (Barcelona, Bahía de Algeciras, Bilbao, Cartagena, Gijón, Huelva, Tarragona, Tenerife and Valencia) and 4 comprehensive ports (Ferrol-San Cibrao, Melilla, Santander and Vigo) pertaining or linked to the sections of CNC3 (Mediterranean Corridor) and CNC7 (Atlantic Corridor) located in the Iberian Peninsula.
- It will pave the way for determining whether the considered actions aimed at ensuring the availability of LNG (an alternative clean fuel) for maritime transport infrastructure is economically viable on the basis of a socio-economic cost-benefit analysis or not: The Action includes an impact assessment that considers the planning for deployment (roll-out) of LNG supply infrastructure and vehicles that use it as fuel, with recommendations for further commercial deployment.

- It encompasses the entire cycle of the project (feasibility studies and permission procedures, implementation and evaluation): CORE LNGas hive addresses a group of studies aiming at enhancing the use of alternative fuels (in particular, LNG) through the elaboration of recommendations to develop framework conditions for using LNG as a fuel in port environments, training programs at the different educational levels, optimization of LNG logistics chains or feasibility studies for emissions reduction in a specific transport sector. Besides, the proposal includes several real-life pilots to test and validate some of the uncertainties still present about their environmental and operational performance and check whether and under what conditions those projects are feasible (both technically and economically).

It takes all necessary measures to ensure that the projects are carried out in compliance with relevant Union and national law, in particular with Union legal acts on the environment and public procurement.

Contribution of the proposed Action to TEN-T priorities

LNG Gas hive addresses the TEN-T priorities, as defined in Article 10 of the TEN-T Regulation 1315/2013 on Union guidelines for the development of the trans-European transport network and repealing Decision No 661/2010/EU, by (a) promoting the use of LNG, an alternative and low carbon energy source and propulsion system. Indeed, CORE LNGas Hive proposal (Core Network Corridors and Liquefied Natural Gas hive) is a global proposal, whose main objective is to endow Spain and Portugal with an adequate infrastructure and operating framework for the deployment of a global supply network of liquefied natural gas (LNG) for transportation uses.

- Contribution of the proposed Action to the objectives of the priority under which the proposal is submitted.

CORE LNGas hive addresses the following objectives of priority 1 of the MAP2.1 ("Deployment of new technologies and innovation in all transport modes, with a focus on decarbonisation, safety and innovative technologies for the promotion of sustainability, operation, management, accessibility, multimodality and efficiency of the network"), as set out in chapter of the Multi-annual Work Programme:

- General and specific objectives of the field (i) "New technologies and innovation in all transport modes": CORE LNGas hive proposes a group of Studies and Integrated Pilot Studies (IPS) to test and validate most of the Measures and Articles of the 3 sectors of Directive 2014/94, the European legislative package Clean Power for Transport (see graphic

in section 2.1 of this proposal): Legislation (international, European and national), Transport technologies (maritime, road and rail) and Policies (transport, energy and environment). Therefore, the Action supports the Member States of the Iberian Peninsula in implementing the Clean Power for Transport Directive notably in the framework of the corridor approach for CNC3 and CNC7. In addition, the Studies and Pilots pursue a market-oriented approach and promote the deployment of innovative technological and organisational solutions in accordance with the provisions of article 33 of the TEN-T Guidelines (see reference to Article 33 (a, b, f) in section 3.1 of this proposal). Furthermore, CORE LNGas hive Studies and IPS will deliver a first report in September 2016 that should serve as input for the preparation of the National Policy Framework to implement supply infrastructure of clean fuels that should be delivered to the EC in November 2016. The monitoring of the results and output of CORE LNGas hive's key activities, which tackle measures facilitating the decarbonisation of marine, road and rail transport modes by introducing alternative propulsion systems and providing corresponding infrastructure, will provide information for the performance audit to be carried out in 2019, coinciding with the end of the project, and help preparing a second report.

- General and specific objectives of the field (ii) "Sustainability and efficiency in the network": CORE LNGas hive comprises Studies and IPS that address innovation and new technologies, considering LNG as an alternative fuel solution for marine, road and rail transport and promoting its implementation and use for freight traffic taking place along the Iberian peninsula sections of the Mediterranean and Atlantic corridors. Therefore, it contributes to the reduction of cost burdens in those corridors, allowing for new market developments and the achievement of a smooth operation of the Iberian Peninsula internal market.
- Contribution of the proposed Action to the internal market, the cohesion policy and the Europe 2020 strategy.

CORE LNGas hive is expected to contribute to the internal market, the cohesion policy and the Europe 2020 strategy as follows:

- Contribution to the internal market: Since CORE LNGas hive's main objective is to endow Spain and Portugal with an adequate infrastructure and operating framework for the deployment of a global supply network of liquefied natural gas (LNG) for transportation uses, supporting therefore Spain and Portugal in implementing the Clean Power for Transport Directive (notably in the framework of the corridor

approach), it clearly contributes to the internal single market. In addition, the expected improvement of transport services as a result of the implementation of the Action should have a direct effect on industry and the economy of the Mediterranean and Atlantic Corridors.

- Contribution to the cohesion policy: By helping to prepare the National Policy Framework of the supply infrastructure ordered by Directive 2014/94 and the Roll-out plan based on the results of innovation of 14 Studies and 11 Integrated Pilot Studies (which will be the base for future commercial replication and deployment of these equipment and systems alongside the Iberian leg of the CNC3 Mediterranean and CNC7 Atlantic Core network Corridors and in the Strait of Gibraltar area), and by enabling at the same time the Iberian Peninsula to move towards the decarbonisation of all transport modes along the core network corridors CNC3 (Mediterranean) and CNC7 (Atlantic), CORE LNGas hive clearly contributes to the cohesion policy, which seeks the reduction of disparities among the Member States (MS) and their 270 regions, focusing specially on its thematic objective 4: Transition to a low CO₂ emissions economy (energy efficiency and renewable energies).
- Contribution to the Europe 2020 strategy: CORE LNGas hive proposal covers one of the five headline targets that have been set for the EU to achieve by the end of 2020, namely climate/energy. This target falls within the Sustainability agenda of Europe 2020 strategy, which takes into consideration energy and mobility and supports the shift towards a resource-efficient, low-carbon economy to achieve sustainable growth. According to Europe 2020 strategy, "To achieve a resource-efficient Europe, we need to make technological improvements, a significant transition in energy, industrial, agricultural and transport systems and changes in behaviour as producers and consumers". The activities of the proposed Action, presented in section 2.3 of this document, clearly contribute to the achievement of a resource-efficient Europe, since it will endow Spain and Portugal with an adequate infrastructure and operating framework for the deployment of a global supply network of liquefied natural gas (LNG) for transportation uses.

Socio-economic benefits of the proposed Action at macro level

Even without the availability of demand forecast studies (scenarios with and without the proposed Action) nor the estimation of some specific transport infrastructure investments and transport system improvements with socio-economic impacts and development, which will be estimated in activities ET0 and WP4.2 taking into account socio-economic factors such as spatial distribution effects on CNC 3 and CNC 7, accessibility to nodes of

the transport network and cohesion indicators, it can be affirmed that the Action will result in at least the following socio-economic benefits for the regional and national economies of CNC3 and CNC7:

- More competitive gas prices through increased supply into the market: CORE LNGas hive clearly promotes the LNG supply into the market, by contributing to the deployment of a global supply network of liquefied natural gas (LNG) for transportation uses.
- Security and diversity of supply: CORE LNGas hive fosters new infrastructures for the supply of LNG and new technologies for traction aligned with the transition to a low CO2 emissions economy policy. It clearly contributes to the security and diversity of supply for transport traction.
- Benefits in the transport markets through the improvement of transport services economics: More competitive gas prices through increased supply into the market (i.e. the improvement of transport services economics) will without any doubt result in benefits in the transport markets.
- Environmental benefits through encouraging a switch from other fossil fuels (coal and oil) to LNG: It is well known that LNG pollutes less than fossil fuels. Therefore, the implementation of CORE LNGas hive will foster environmental benefits.
- Impact on Gross National Product (GNP) and improvement on national, regional and local economies.

Added-value of EU funding on the financing of the proposed Action and the commitment of the different stakeholders.

The potential granting of Union financial assistance under the CEF budget would definitely have a stimulating/leverage effect on the financing of the proposed Action:

- CORE LNGas hive has made possible the integration of both the technological and the institutional components of the Clean Power for Transport package. On the other hand, it has gathered representatives of many status (public and private) and sectors (energy, education, and transport), allowing their different interests consideration in this proposal and working together. The absence of CEF funding would completely invalidate and destroy this integration effort and would endanger the construction of a coherent deployment of a global supply network of liquefied natural gas (LNG) for transportation uses.

- The policy and institutional components of CORE LNGas hive are covered by studies intended to help defining the National Policy Framework for the deployment of alternative clean fuels infrastructure in the Iberian Peninsula. This Framework is mandatory for all EU Member States, which have to present their respective national plans to the European Commission by November 2016, and to report the first 3-years performance on November 2019. The CORE LNGas hive proposal calendar is set in parallel to these national obligations, so that the results of the studies and pilots can directly feed the national policy proposals, ensuring a broad support and acceptance to the progress made at an institutional level and bringing institutional and technological progress to a same pace. According to experience, the absence of CEF funding would clearly delay the carrying out of these studies and Spanish and Portuguese authorities could not benefit from relevant inputs of the energy and transport sectors to define the above mentioned National Policy Framework. The obligation to stick to a calendar that imposes Union financial assistance under the CEF budget is a key issue to ensure acceleration of the studies/pilots.
- International technology issues such as alternative clean fuels and European policy issues such as Core Network Corridors can only be approached from a European perspective. The granting of Union financial assistance under the CEF budget would ensure that both technology and policy issues are correctly dealt with and that its implementation in the Iberian peninsula contributes correctly to cohesion policy and Europe 2020 strategy.

The proposed Action counts on the commitment of Corridor, Project and Pilot stakeholders, as presented in Annex A-SHS (Supporting letters of Stakeholders of the entire Project and specific Integrated Pilot Studies) to this Form D. In addition, the belonging of Enagás, the Action coordinator, to most LNG sector associations of national, European and international range (GASNAM –Spanish–, SEDIGAS –Spanish–, NGVA-E –European–, NGVA-A –USA–, GIE –European–, CEDIGAS –International–, NGE –European–, AFG –French–, AGN –Portuguese–, EBA –European–), will facilitate the participation of those associations as Project stakeholders in case of approval of CORE LNGas hive proposal (some of them have already expressed their interest in participating in the project as stakeholders).

Impact of the proposed Action on regional and / or local development and land use

As stated in the following two citations, the regional development is the key to ensure the future success of the overall European territory:

"(...) Both global economic growth and social cohesion require increasing the competitiveness of Regions, especially where potential is highest. The comparative advantages that drive innovation and investment are as much a Regional characteristic as a national one. For Regions to succeed, they must harness their own mix of assets, skills and ideas to compete in a global market and develop unused potential. (...)" OECD (Conclusions of the Chair, High level Meeting, Martigny, Switzerland, July 2013).

"The European Parliament...underlines that intervention targeting transport development projects should capitalize on Regional assets and capacities and form part of a Regional strategy based on smart innovation...highlights the need for place-based policies and considers that cities and Regions should pursue smart and sustainable specialization..." (EU Parliament resolution, 2011/C 161 E/16).

In this regard, CNC will connect more than 100 EU regions in the 27 Member States. In fact, the Core Network has been estimated in 44.000 kms of length, and Core Network Corridors will cover nearly 18.000 Kms. Particularly, CNC-3 Mediterranean will have 3.000km in 6 countries length and CNC-7 Atlantic will cover 2.000km in 4 countries.

- Impact on competition

Opening up national freight and passenger markets to cross-border competition is a major step towards the creation of an integrated European Transport area and of a genuine EU internal market. Greater technical harmonization of transport systems and the development of CNC will help to break down barriers to a more competitive transport sector, along with better connections between EU and neighbouring markets.

Greater competition makes for a more efficient and customer-responsive industry. EU transport legislation has consistently encouraged competitiveness and market opening, with the first major law in this direction dating back to 1991. The legislation is based on a distinction between infrastructure managers who run the network and the transport companies that use it for transporting passengers and freight. Different organizational entities must be set up for transport operations on the one hand and infrastructure management on the other.

Essential functions such as allocation of CNC capacity, infrastructure charging and licensing must be separated from the operation of transport services and performed in a neutral mode to give new transport operators fair access to the market and to reduce negative impacts on Competition. EU should also have Corridors Regulatory Bodies in place, to monitor transport services and to act as an appeal body for transport companies if they believe they have been unfairly treated.

- Impact on the environment

Mobility is the key to our quality of life and is vital for the EU's competitiveness. But mobility also means costs on society due to the impacts it causes. The concept "Sustainable mobility" aims at disengaging mobility from its negative effects, and has been at the heart of the EU's Transport Policy for several years. It is therefore essential to integrate the development of the TEN-T and hence CNC with the protection of the environment.

Priority MAP-2.1 targeted by CORE LNGas hive includes the GREEN CORRIDOR concept, an attribute of Multimodal Corridors like the CNC, designed and operated with environmental criteria to reduce GHG emissions. Member States, Regions and projects must respect the environmental approach for infrastructure related to any Community co-financing like in CORE LNGas hive.

Regarding environmental legislation and TEN-T implementation, there are 5 Community Directives particularly relevant for the Trans European Transport Network and hence to Core Network Corridors:

- Environmental Impact Assessment (EIA) Directive
- Strategic Environmental Assessment (SEA) Directive
- Birds Directive
- Habitats Directive
- Water Framework Directive

Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives – Both directives are largely intended to improve decision-making. Therefore, they do not predetermine outcomes. They require the evaluation of a wide range of environmental impacts and the consultation with both environmental authorities and the public (including cross border consultations). The success of the implementation of the TEN-T and CEF-T projects is highly dependent on the correctness of the EIA and SEA application, and the continuous consultation with the population concerned by such projects.

Birds Directive and Habitats Directive are highly related to the impacts caused on the Natura 2000 network. This network aggregates a diverse range of sites and species benefiting from a strict protection regime (listed in Annex IV of the Directive). This regime helps the creation of proactive

measures (positive conservation actions that may include management plans), preventative measures (requiring steps to avoid loss of value of sites) and procedural safeguards (to deal with plans and projects that may affect the overall integrity of the sites).

Water Framework Directive is intended for infrastructures with potential risks of water resources deterioration. Article 4.7 of the Directive describes the conditions under which “new activities” like the development of new infrastructures or works (e.g. new roads, new canals, deepening of navigation channels) downgrading the status of water bodies can be accepted. The Habitats and Water Framework Directives also envisage mitigation and in a final stage, compensatory measures (in the case of the Habitats Directive), in the case of overriding public interests.

In addition, the effect on climate change must be analysed. Addressing climate change requires two types of response: the reduction of greenhouse gas emissions (“mitigation measures”) and implementation of adaptation” actions to deal with the unavoidable impacts. Adaptation is particularly relevant for existing transport infrastructure where, for example changes in rain fall and heat patterns may be different from those that were taken into account when infrastructures were designed. Risks of damage and disruption due to storms, floods, heat waves, fires and landslides are expected to increase. The predicted sea level rise clearly has particular implications for Core Network Ports – currently are identified 94 seaports in Europe reducing the sheltering effect of breakwaters and quay walls. It could also have impacts where transport infrastructures are located close to the sea. All Integrated Pilot Studies to be developed in CORE LNGas hive has asked for their respective EIA to Environmental Authorities, to be sure there will be not any negative impact on environment during Pilot development.

Communication and visibility given to the CEF Transport co-financing

In the case of the CORE LNGas hive proposal to be approved, the requirements on communication and visibility are indicated in the related “Grant Agreement” of the Commission. Such requirements are fully adhered to each communication tool, event, meeting, conference, workshop, webpage, power point presentation or PDF document and show clearly the source of funding and the CEF-T programme supporting CORE LNGas hive project.

Dissemination is an important activity for a successful outcome of CORE LNGas hive. Within the project development, a lot of efforts will be put on communication and dissemination, from the very beginning of the

project. Not only participation in international conferences, workshops and meetings are necessary but it is also important to accompany dissemination with high-quality information material, like brochures and videos. These should also be available to download from the project web-site.

An ambitious and successful communication and dissemination strategy has been prepared to be deployed on the Internet. Not only Project Webpage, but also tools like Cloud services to manage the huge information expected, and professional (business) social networks will be designed, following the trend of the European Commission itself. A Communication Manual and Plan have been approved.

Picture of last event in Barcelona, June 2017



07. More on LNG

Natural gas is a major source of energy and one of the least polluting fuel. It is mainly composed by methane, the simplest hydrocarbon molecule, which gives the natural gas significant advantages in safety and emissions against other fossil fuels.

Liquefied natural gas or LNG, is natural gas that has been converted to a liquid form for the ease of storage or transport, by cooling natural gas to approximately -162°C . LNG is odourless, colourless, non-toxic and non-corrosive.

Natural gas is converted into LNG in liquefaction plants from where it is transported to LNG terminals, then regasified and introduced into pipelines for its delivery to the final consumer (industrial, domestic or power plants mainly). This is the traditional chain for LNG.

LNG applications as a final product are becoming more and more popular. Among these other uses, LNG has a huge potential as a down-to-Earth alternative fuel to oil in transportation sector, giving it the opportunity to reduce its emissions, to diversify its energy mix and to reduce its costs.

LNG contributes to a low-carbon economy. LNG is the fuel of the future.

LNG in general and CORE LNGas hive in particular will have an impact on local, regional and national development. In this sense, The Peninsula Ibérica has 8 Regasification plants, 7 of them in Spain. They represent more than 33% of the whole European Union regasification capacity. Furthermore, the Spanish internal market demands less than 10% of this capacity, so the excess (90%) is potentially being offered worldwide. In addition, LNG trade is done mainly by maritime transport, promoting the economic development in all levels.



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