



Case study:

Enagás

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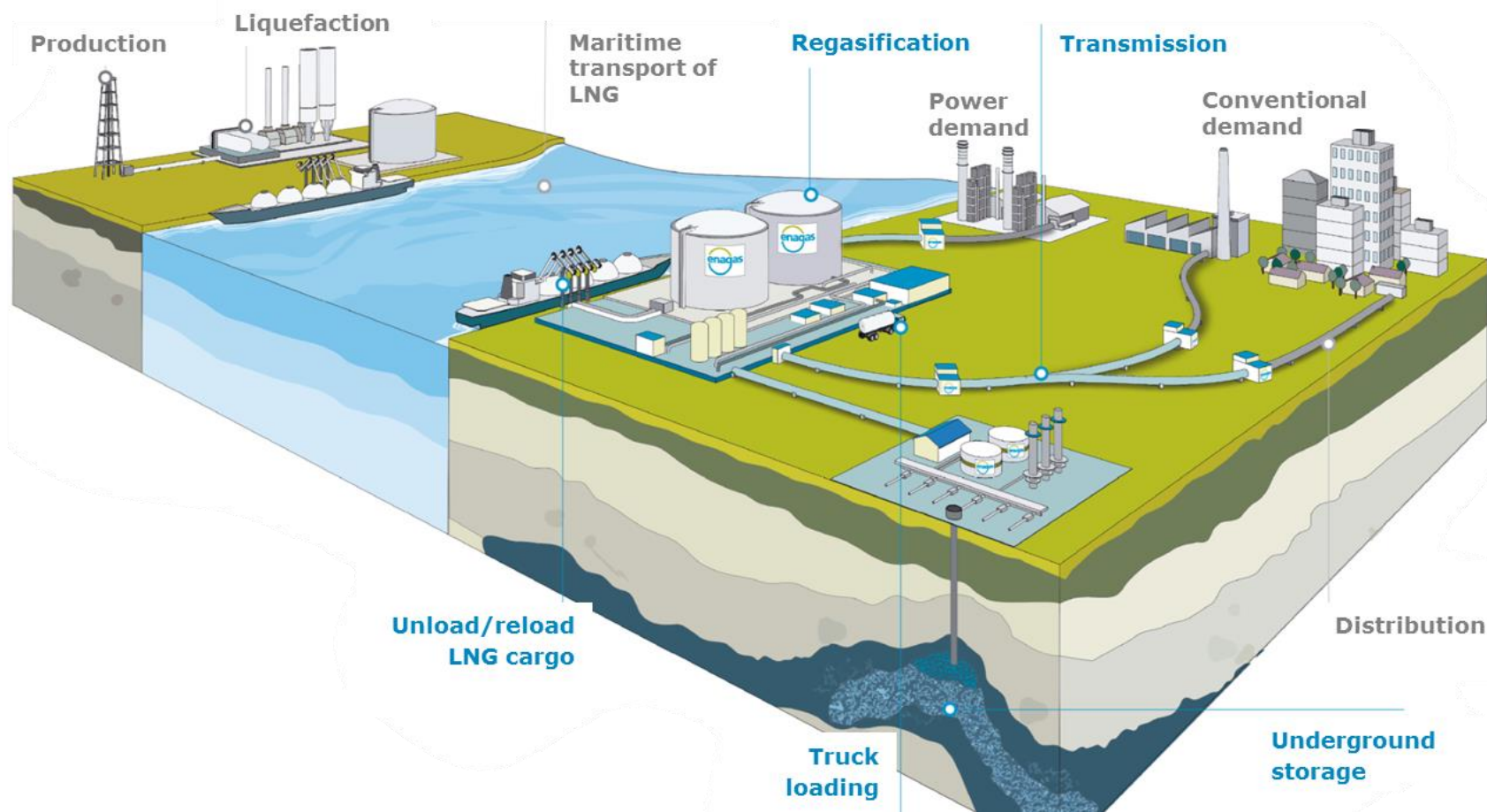
Geneva, 27th March 2017

Enagás: 45 years' experience

A midstream company

Leader in natural gas and LNG infrastructures

Major International player as a result of our technological expertise, gas infrastructure construction skills, highly effective operations and maintenance programs and sound financial structure.



Enagás is the main gas infrastructure operator in Spain.

Technical Manager of the Spanish Gas System.

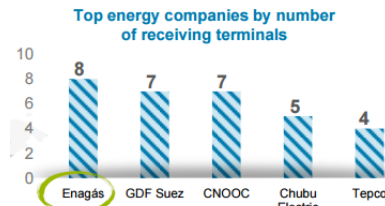
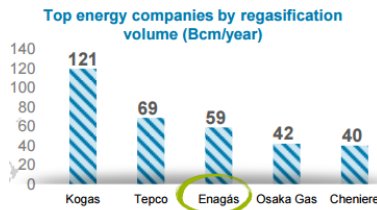


Enagás: Infrastructure operator

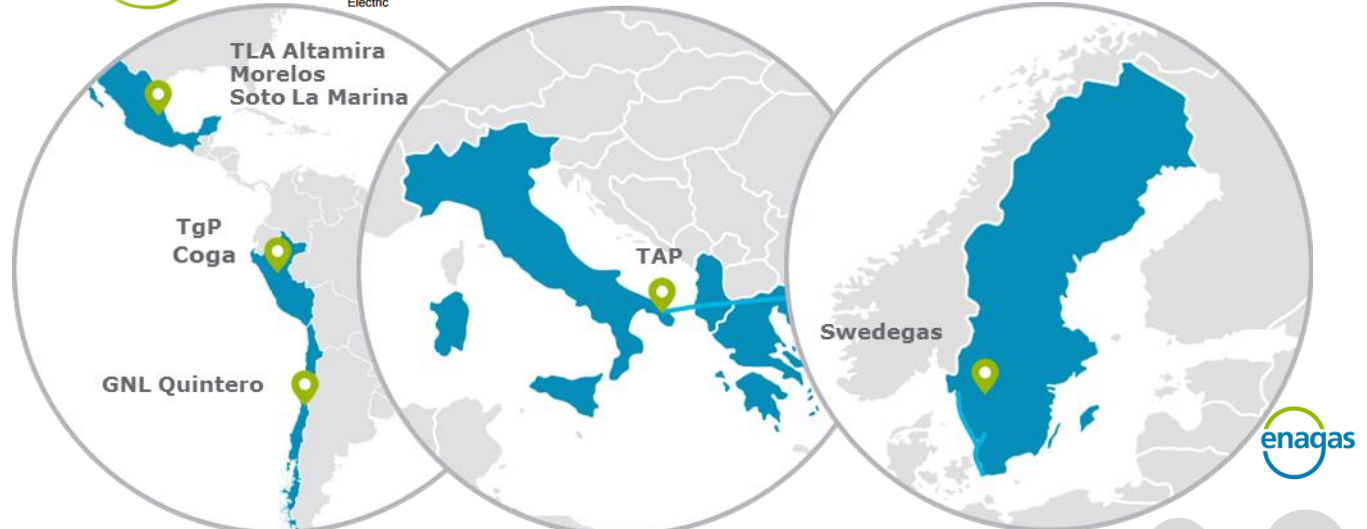
Spain

- 6** LNG terminals (+2 under development)
- ~12,000** km high pressure pipelines
- 3** underground storage facilities
- 19** compressor stations
- 6** international connections

Enagás is well positioned to leverage on its global leadership in LNG infrastructure and seize opportunities in new growing markets.



International



2015-2020 Efficiency Plan



Improve efficiency in midstream infrastructure and minimise carbon footprint

What?



Reinforce NG short-term **competitiveness** as a transition energy and LNG as fuel for a **decarbonised future**

Why?



How?

- Use of residual energy to **self-generate** power
- **Energy intensity** minimisation in our processes
- CO₂ and CH₄ **emission reduction**

2015-2020 Efficiency Plan

Reduction in natural gas consumption thanks to BOG compressors

- When operating at minimum send out
- During reloading operations



Reduction in electricity consumption

- Energy procurement management
- Variable frequency drivers in cryogenic pumps

Use of residual energy

Installation of an electricity generation system using Turboexpanders, which exploits the pressure difference produced in the natural gas at the regasification plant's sending out.

Transmission network

- Reduction in gas consumption as fuel in CS's
- Use of residual energy → cogeneration plants
- Electric compressor

Under Study

- Natural gas promotion in the transport sector (NGV)
- Other innovative projects

Enagás' Carbon Footprint



Enagás calculates and reports annually its verified Carbon Footprint

Enagás carbon footprint (scope 1 and 2) (tCO₂e)

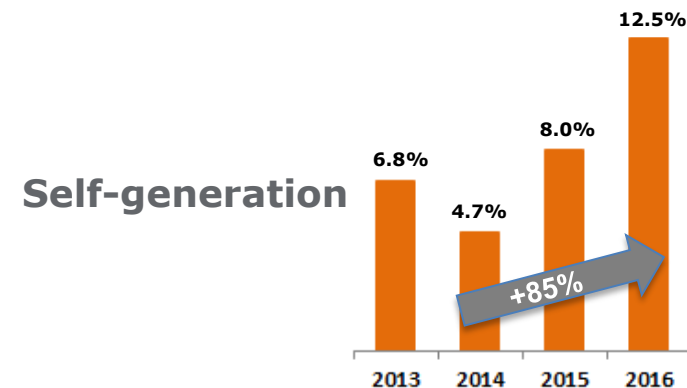
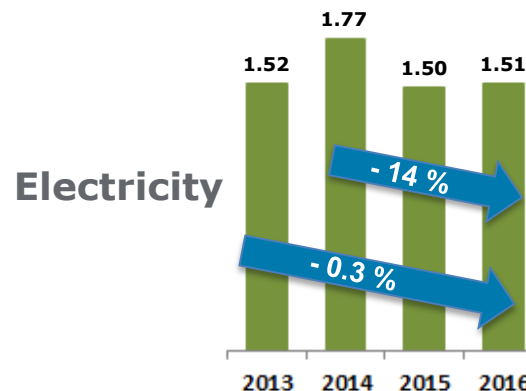
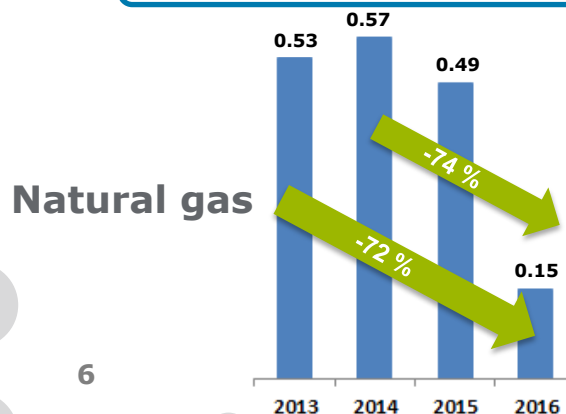
Enagás' GHG emissions were reduced by 47% in 2015 and by ≈5% in 2016

Direct measures

Huge efforts have been made in order to reduce emissions from:

- ✓ **flaring** ↓99%
- ✓ **venting** ↓39%
- ✓ **stationary combustion** ↓15%
- ✓ and **fugitive emissions** ↓8% vs 2015

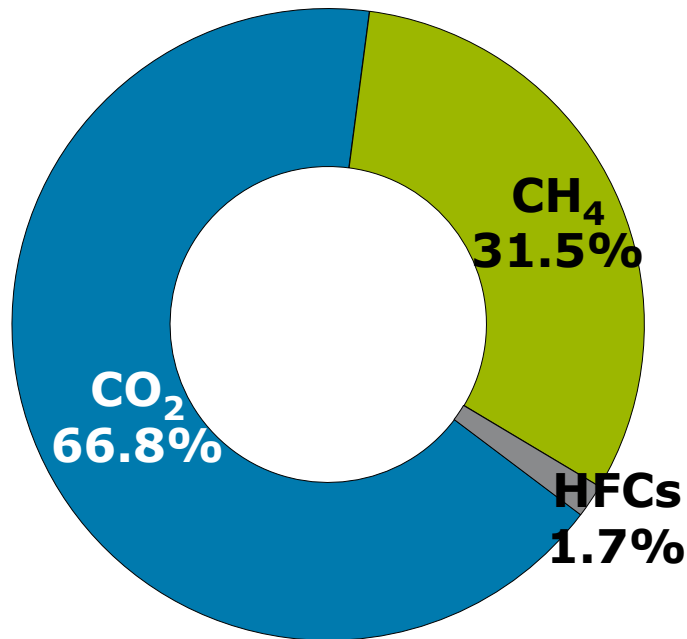
Indirect measures



Enagás' Carbon Footprint



31.5 % of our GHG emissions are methane emissions



Enagás' methane emissions are due to :

1. Fugitive emissions (22%)

2. Vents (10%)

- O&M or security venting (94%)
- Pneumatic valves (3%)
- Natural gas analyzers (i.e. chromatographs) (3%)

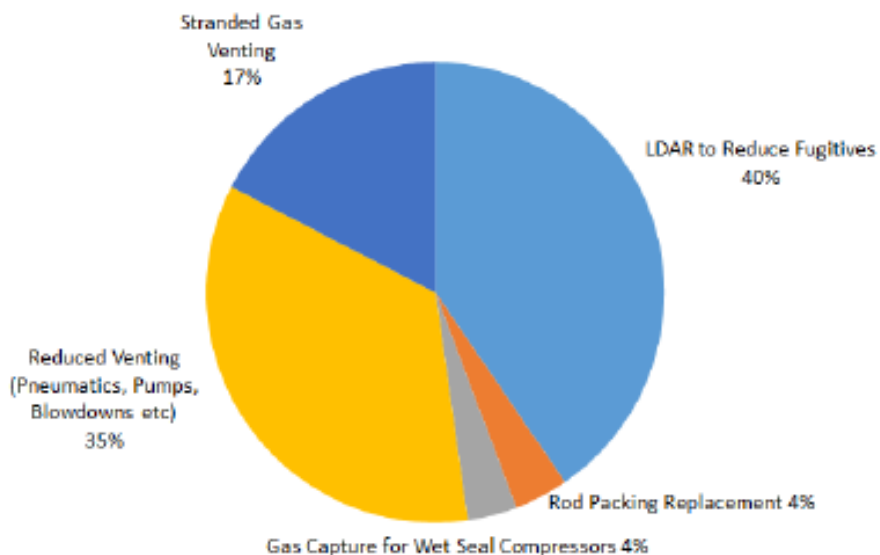
Enagás' CH₄ emission mitigation measures



Enagás has already implemented several mitigation measures to reduce its CH₄ emissions, such as:

- Flaring instead of venting
- LDAR for fugitive emissions
- Replacing wet seals with dry seals
- Hot taps for in-service pipeline connections
- Composite wrap for non-leaking pipeline defects
- Electric motor starters in compressors
- Electrical driven chemical plants
- Converting gas pneumatic controls to instrument air
- Optimising the operation and trying to align it with the maintenance works in order to reduce vents.

Figure 4-3 - Distribution of Emission Reduction Potential



Methane emissions reduction potential

LDAR campaign 2013-2015



- **Detecting fugitive emissions:** Infra-red camera
- All LNG terminals and underground gas storages and a representative sample of the transmission gas infrastructure.
- Quantifying fugitive emissions: 2 options



HFS (High flow sampler)

Both are
recognized and
authorized by

EN15446 and EPA

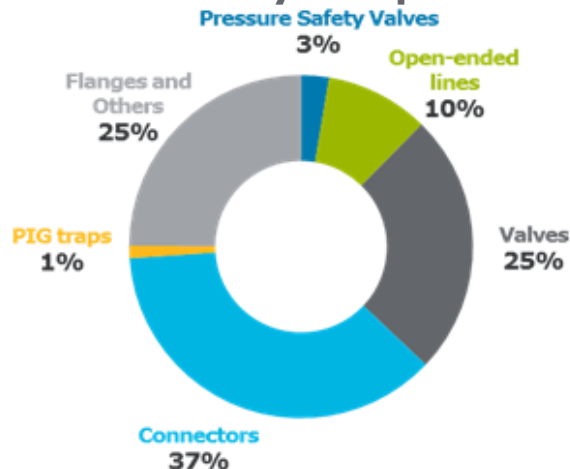


FID (Flame ionization detector)

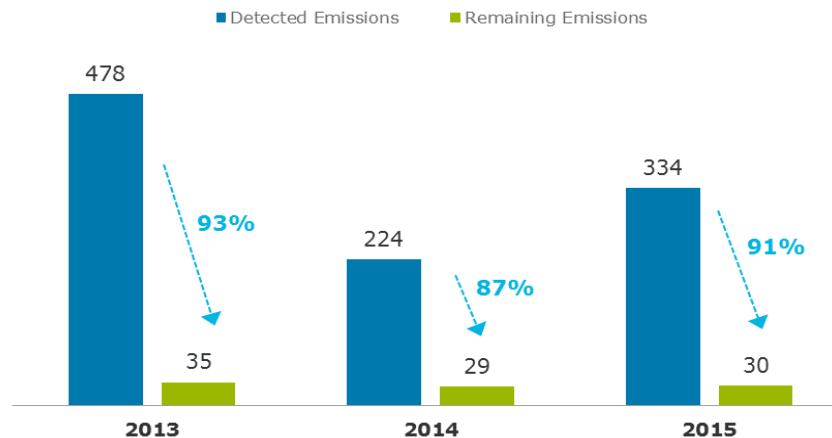
LDAR campaign 2013-2015 - Results



Share of fugitive emissions detected by component



Methane emissions abated during the 3-year campaign (941.5 tons of CH₄)



Enagás' ratios (TIER 3) are much lower than the **IPCC ratios (TIER 1)** in some cases and in other cases in line with the lowest range

IPCC 2006 ratios

LNG Plants



0.005-0.1% of throughput

Storage



0.05-0.7% of working gas capacity

Compressor stations



6,000-100,000 m³/MW.year

Meter®ulation stations



1,000-50,000 m³/station.year

Pipeline



200-20,000 m³/km.year

● Enagás' ratios



Next steps



- The **new LDAR campaign** has been launched (duration: one year)
- The detection will be done with an **infra-red camera developed internally** ("GSS Julieta" commercialised through VIRA Gas Imaging)



- Measurement of fugitive emissions of **all our infrastructure**
- **Update emissions factors for our components/devices**
- Enagás will **continue** working to **reduce methane emissions** by analyzing and evaluating various initiatives and in addition **cooperating with the main European and international initiatives**.

Gas Sensing System Julieta – VIRA Gas Imaging

Optical information and image processor	
IFOV (mrad)	0.8 (20 mm) y 0.35 (50 mm)
Interchangeable lens	Available (upon demand)
NETD	23mK @ 308C
Gas enhance vision image processing and optimization.	Proprietary system
FOCAL Plane Array (FPA)	Spectrally optimized Uncooled IR FPA 640 x 480 pixels
Pixel pitch	17 µm
Cooling detector system	TECLESS
Processing and visualization Device	
Integrated system	Tablet rugged (IP 6X & MIL STD 810G)
Screen	LED Screen 12"
OS	Windows 7
CPU	Intel Core
Measurement	
Dynamic range of images	Range -408C to 1808 C. Other alternatives under demand.
Accuracy	+/- 18C (from 08C to 1008C)
Detection Threshold (CH4)	< 0,8 gr/hr CH4 in specific lab conditions. Other hydrocarbons can be detected without special calibration.
GPS	Integrated in tablet PC
Image Format Storage	AVI files
Thermographic analysis of the image	
Regions of Interest (ROI)	3 ROIs
Profiles	3 Lines
Isothermic areas	2 areas
Emissivity adjustment	Variable
Adjustment of measurement	Available and included in the SW.
Configuration commands	Electronic gain.
Environmental & Marks	
Operating temperature range	Range -208C a + 508C
Limits of temperature range	Range -308C a +608C
Relative moistureIEC 68-2-30/24 H	95% in range +238C to +408C
CEM marking and USA marking. Other marking available under demand (optional)	EN 61326 UNE-EN 61010-1:2011 ANSI ISA-12.12.01 & CSA. 22.02 (Tablet) MIL STD 461F (Tablet)
Sealing protection system	IP 34 or IP-x3 (IEC 60529)
Other markings (Under demand)	Bump: 25 g (IEC 60068-2-29) Vibration: 2 g (IEC 60068-2-6)



GSS JULIETA

The flexible and cost-effective OGI instrument for monitoring fugitive emissions of natural gas and hydrocarbons, based on new spectrally adapted high sensitivity uncooled infrared technology for gas leak.

Conclusions

- Gas industry should carry out **LDAR campaigns** and **measure on-site** its emissions on frequent basis. Enagás experience shows that **measured emissions are lower than the once calculated with emissions factors**.
- **Emissions** should be **verified and validated** by a third party in accordance to reference standards.
- Gas industry should work together and have a **harmonized methodology for methane emissions** (BREF documents, updated emission factors, ...)
- **Best Practices** to reduce methane emissions should be **implemented** by the gas industry.
- **Technology development must play a more relevant role** in a future low carbon economy.
- **National Authorities should closely cooperate with the gas industry** in order to follow up on the emissions and to improve the national inventories.

Thank you very much!

