Factsheet

Exploring Methane Emissions in Europe

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Key Messages

The role of gas in the energy mix is crucial to the transition to a lower carbon economy. When used for electricity generation, natural gas results in 40-50% lower carbon dioxide (CO_2) equivalent emissions than coal – even when methane emissions (CH_4) are taken into account. The CO_2 emissions can be further reduced through the deployment of Carbon Capture and Storage (CCS) and renewable gases. **Gas combustion also improves air quality as it has very low nitrogen oxides (NO_x) and no sulfur dioxide (SO_2) emissions.**

While CO_2 remains the main focus of long-term climate change mitigation, addressing emissions of other greenhouse gases (GHG), such as methane, also deserves attention. **In the EU, the two largest sources of methane emissions are enteric fermentation and anaerobic waste.[1] Together, they accounted for 53% of methane emissions in 2015.[2]**

In comparison, methane emissions from the gas industry are relatively low: the European Environment Agency (EEA) stated that in 2015, methane emissions from the gas operations represented 5% of total EU methane emissions – equivalent to 0.6% of the total EU GHG emissions.[3] **Between 1990 and 2015, methane emissions from gas operations decreased by 46%.[4]** This reduction is a result of the efforts undertaken by the gas industry to minimise methane emissions.

The gas industry is promoting and implementing mitigation measures and good practices to further reduce methane emissions. GasNaturally members contribute to transparency via studies and initiatives to overcome some of the misgivings about methane emissions from the various parts of the gas value chain.

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1 Enteric fermentation and anaerobic waste = flatulence of cattle and gas emanating from sewage and landfill

2/3/4 Annual European Union greenhouse gas inventory 1990–2015 and inventory report 2017: https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2017

Methane: one of the greenhouse gases

Methane (CH_4) is a greenhouse gas (GHG) emitted by both natural and man-made sources.

In the past, scientific research dealing with climate policy focused mainly on carbon dioxide (CO_2), but these emissions represent only one of the ways in which human activities affect global climate. Methane is one of the six GHGs[5] that also plays a role. In this context, EU Member States already report their methane emissions to the United Nations Framework Convention on Climate Change (UNFCCC) and to the European Commission (EC), under the GHG monitoring mechanism.[6]

Methane has an atmospheric lifetime of about 12 years, meaning that current methane emissions will affect the climate for just over a decade.[7] The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5)[8] estimates that methane is the second largest contributor to total anthropogenic radiative forcing and is equivalent to 58% of the radiative forcing of CO_2. The IPCC AR5 also estimates that methane's global warming potential is in the range of 28–34 times that of CO_2 on a 100-year timescale.[9] The ability to lower the near-term rate of global warming through reducing methane emissions provides society with a valuable mitigation option for climate risk management. However, it is important to note that CO_2 remains the key focus for long-term climate change mitigation. According to the IPCC, the long-living gases (CO_2, for instance) would require immediate reductions in emissions from human activities of over 60% to stabilise their concentrations at today's levels. Methane would require a 15-20% reduction.[10]

While CO_2 remains the key focus for long-term climate change mitigation, mitigating emissions of other climate forcers, such as methane, will provide additional GHG mitigation opportunities.

[5] Basket of Gases: This refers to the group six of greenhouse gases regulated under the Kyoto Protocol. They are listed in Annex A of the Kyoto Protocol and include: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6).

[6] Decision 2000/479/EC Decision on the implementation of a European pollutant emission register (EPER) according to Article 15 of Council Directive 96/61/EC concerning integrated pollution prevention and control (IPPC).

[7] Short-Lived Promise? The Science and Policy of Cumulative and Short-Lived Climate Pollutants, MYLES ALLEN Oxford Martin School, University of Oxford, 2015.

[8] IPCC (2013). Climate Change 2013. The Physical Science Basis. Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). www.ipcc.ch/report/ar5

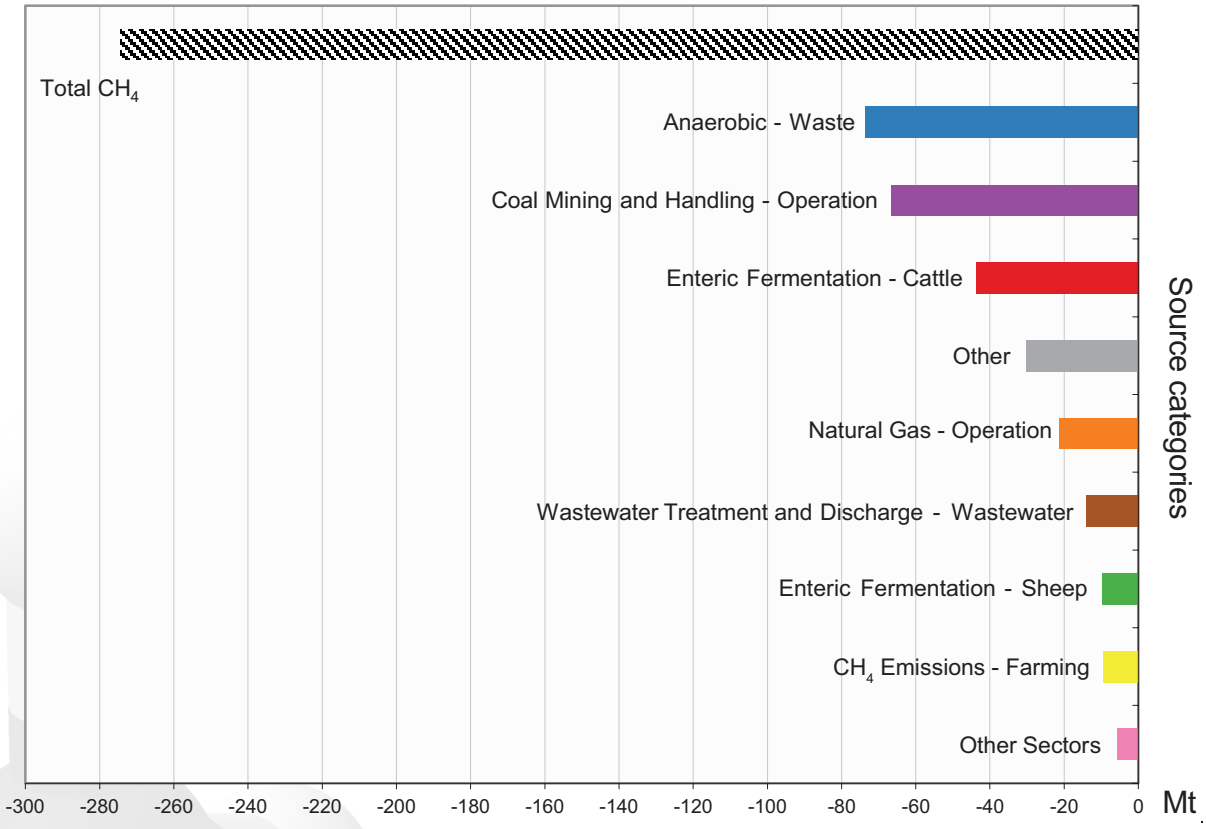
[9] The United Nations Framework Convention on Climate Change (UNFCCC) adopted the IPCC AR4 values in 2011. Subsequently, national governments have adopted the same values for consistent reporting to the UNFCCC and also for national regulations.

[10] IPCC (2013). Climate Change 2013. The Physical Science Basis. Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). p. 436.

Methane emissions by sector

According to some estimates, about 40% of total methane emissions come from biogenic (natural) sources, such as wetlands, while the other 60% are anthropogenic, or man-made. The largest source of anthropogenic methane emissions is agriculture.[11] According to the EEA greenhouse gas inventory for the EU, published in 2017, total methane emissions have been reduced by 37% since 1990 and represent 11% of the total GHG emissions in the EU. The two largest sources are enteric fermentation and anaerobic waste (Figure 2).[12] They accounted for 53% of total EU (CH_4) emissions in 2015.[13]

Figure 1 - Absolute change of methane emissions by large key source categories 1990 to 2015 in CO_2 equivalents (Mt) for EU-28 and Iceland and share of largest source categories in 2015.



Source: EEA - Annual European Union GHG inventory 1990–2015 and inventory report 2017

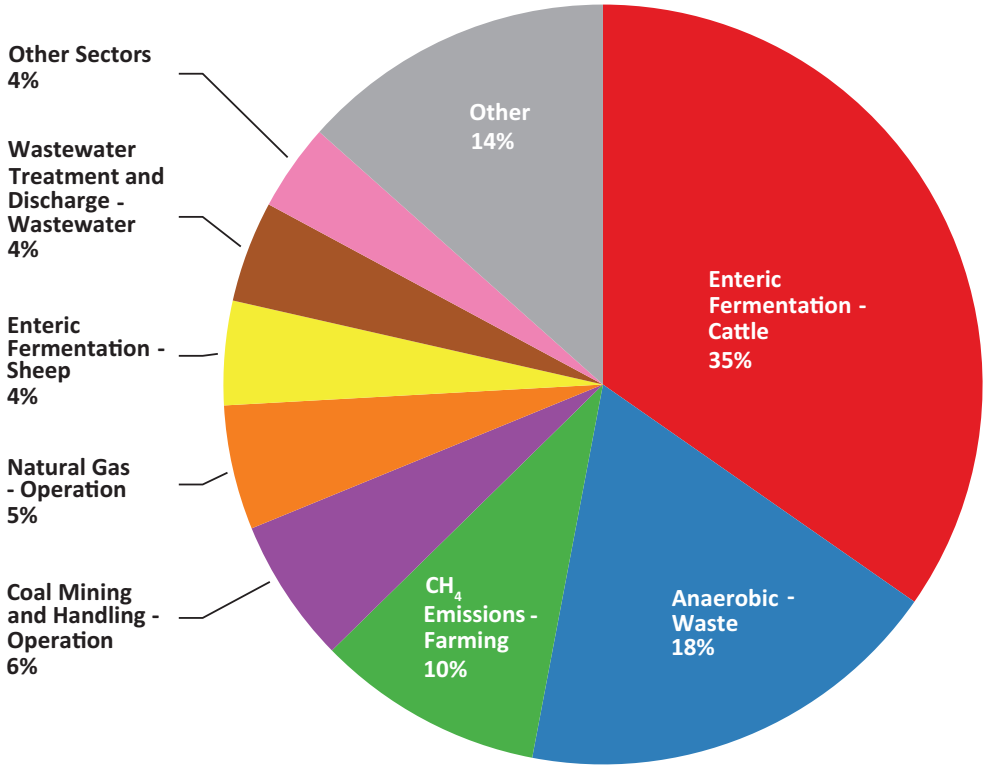
11 World Energy Outlook 2017, IEA, p. 403-404

12 Enteric fermentation and anaerobic waste = flatulence of cattle and gas emanating from sewage and landfill

13 Annual European Union greenhouse gas inventory 1990–2015 and inventory report 2017: https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2017

In comparison, methane emissions from the gas industry are relatively low. The European Environment Agency (EEA) stated that in 2015, methane emissions from gas operations represented 5% of the total methane emissions (Figure 2) – equivalent to 0.6% of the total EU GHG emissions.[14]

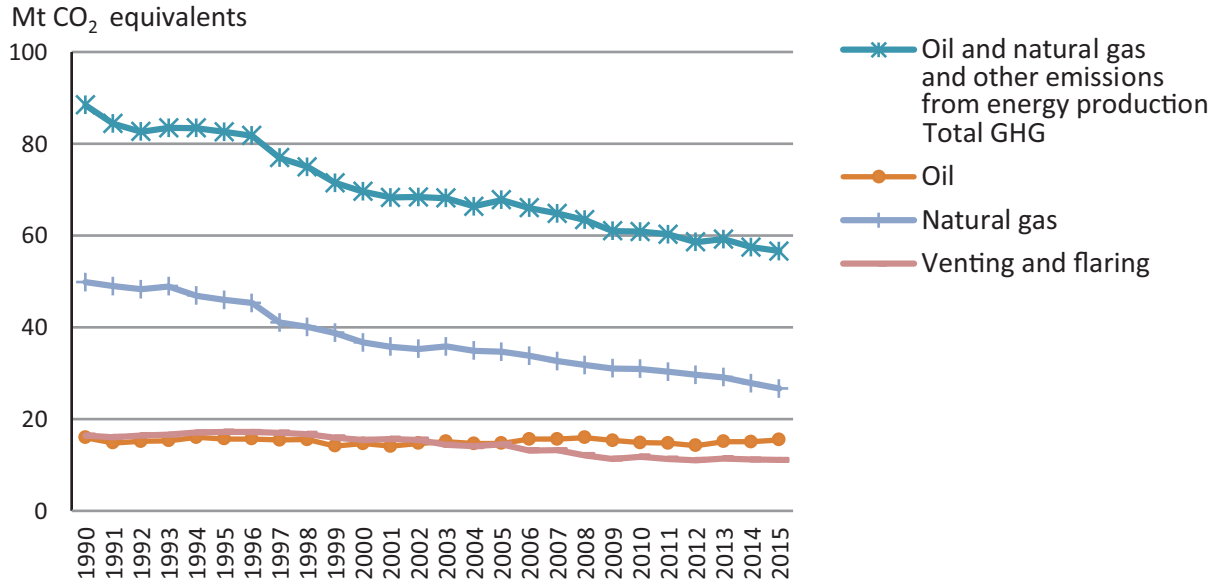
Figure 2 - Share of largest source categories of methane emissions for EU-28 and Iceland in 2015.



Source: EEA - Annual European Union GHG inventory 1990–2015 and inventory report 2017

Between 1990 and 2015, fugitive methane emissions from natural gas activities decreased by 46% (Figure 3).[15] This reduction is a result of gas industry efforts to minimise methane emissions.

Figure 3 - Fugitive emissions oil and natural gas: trend



Source: EEA - Annual European Union GHG inventory 1990–2015 and inventory report 2017

[14 / 15] Annual European Union greenhouse gas inventory 1990–2015 and inventory report 2017: https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2017

Methane emissions studies

GasNaturally members promote transparency via studies and initiatives on methane emissions. The aim is to overcome some of the misgivings about total methane emissions from the various parts of the gas value chain.

Some examples of gathering data on methane emissions:

A study by ***thinkstep*** (a sustainability consulting firm) for the Natural Gas Vehicles Association Europe (NGVA) has assessed that the total well-to-tank emissions for an EU-based CNG vehicle is: 12.5 g CO_2 eq/MJ, of which 3.4g CO_2 eq/MJ (27%) is due to methane emissions. Overall, well-to-tank methane emissions for the CNG supply are 0.651%. The EU total carbon footprint of LNG, in tank, is 19.9 g CO_2-eq/MJ.

Figure 4 -
Well-to-tank – methane emission (EU total):
LNG supply – weight percentage

[g CH_4/g LNG in tank] LNG Supply [wt.%]	EU Total
Fuel dispensing	0.21%
Gas transmission, storage and distribution	0.002%
Feedstock transportation (pipeline, LNG carrier)	0.021%
Gas production, processing and liquefaction	0.84%
TOTAL	**1.073%**

Figure 5 -
Well-to-tank – methane emission (EU total):
CNG supply – weight percentage

[g CH_4/g CNG in tank] CNG Supply [wt.%]	EU Total
Fuel dispensing	0.051%
Gas transmission, storage and distribution	0.209%
Feedstock transportation (pipeline, LNG carrier)	0.1%
Gas production, processing and liquefaction	0.291%
TOTAL	**0.651%**

Source: http://ngvemissionsstudy.eu/

The report of the ***Norwegian Environment Agency*** presents a survey and mapping of direct methane emissions from Norwegian offshore installations, an updated estimate of emission inventories, proposals for improved future quantification of the emissions and an assessment of emission abatement opportunities. The study involved close collaboration with the industry and identified a total of 48 potential emission sources. Only a few of these sources contributed to the dominant proportion of the emissions. Annual direct emissions were estimated to be about 12,500 tonnes of methane (2014), significantly lower than previously reported.

Source: http://www.miljodirektoratet.no/Documents/publikasjoner/M515/M515.pdf

Figure 6 -
Estimated emission inventories of methane for 2014 by main source (tonnes)

Main source:	Methane
Dry compressor seals	2 500
Vent header (measured values)	1 950
Produced water treatment	2 300
HC purge and blanket gas	1 100
Gas leaks / fugitives	1 250
Flare gas not burnt	1 500
Glycol regeneration	550
Compressor wet seals	900
Other sources	300
TOTAL	**12 350**

On behalf of Total, ***CIRAIG*** (the International Reference Centre for the Lifecycle of Products, Processes and Services) did a life-cycle assessment of gas and coal supply chains to produce electricity in the EU and Asia. This analysis included the upstream emissions in the coal supply chain. The results of the base case are summarised in Figures 7 and 8. Overall, the results show that on average life cycle GHG emissions are approximately 50% lower for natural gas chains than for coal chains for the same destination market. Figure 7 also illustrates the proportion of methane in total emissions for each chain. This demonstrates that methane is very common in coal production. The CIRAIG study shows that in the case of Utica shale production (in the US), fugitive emissions would have to reach 11% (against an assessed level of 1%) in order to reach emissions parity with hard coal in Europe.

Figure 7 - Natural gas and coal life cycle GHG emissions

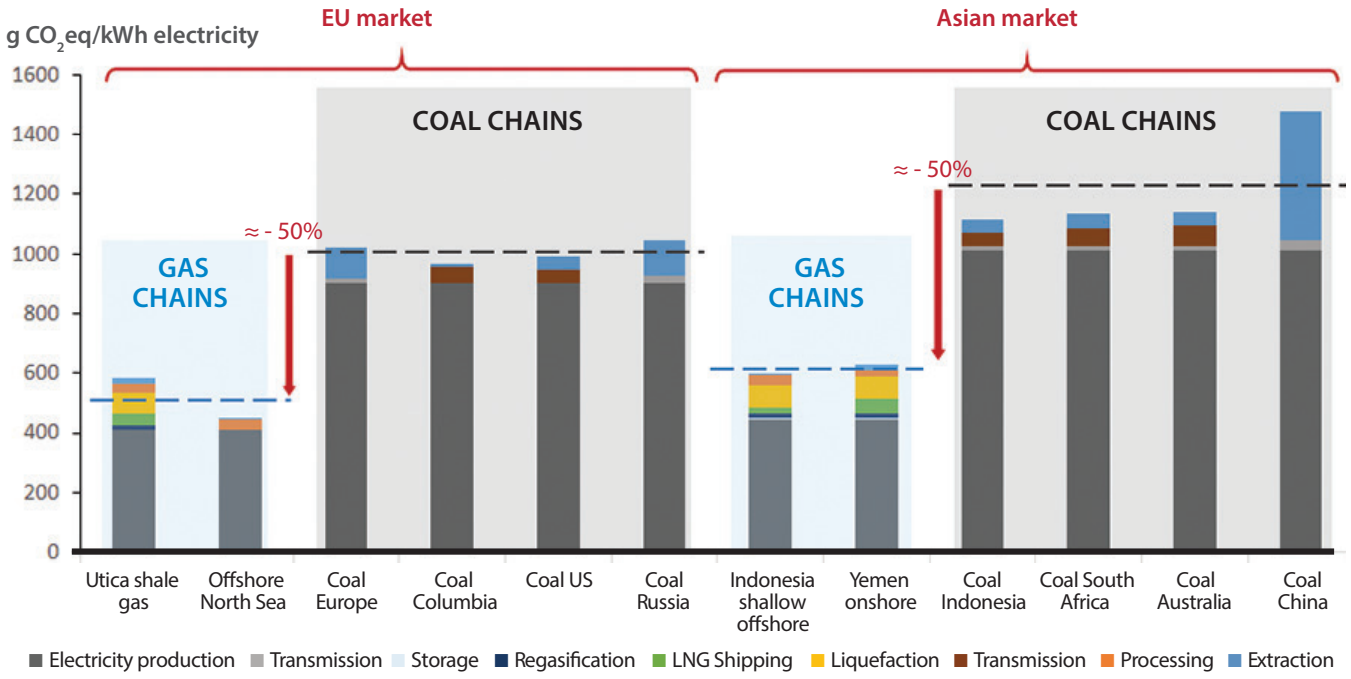
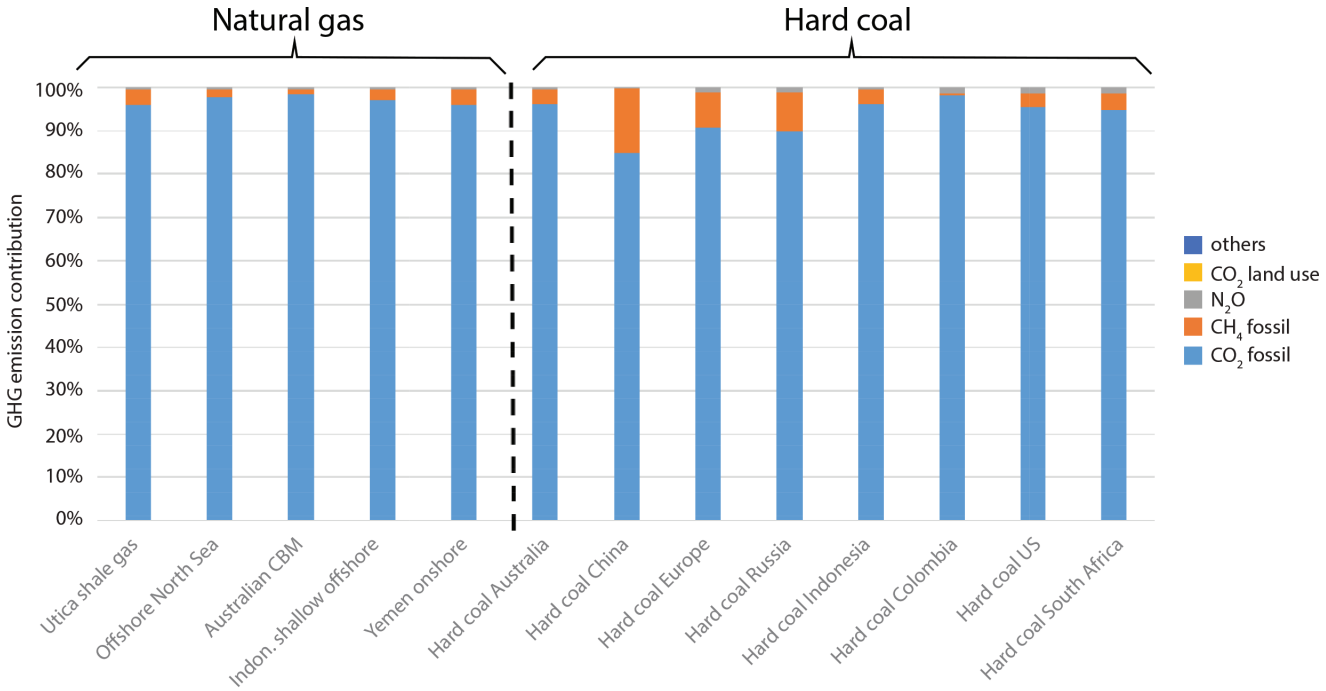


Figure 8 - Contribution of the specific GHG to the overall natural gas and coal GHG



Source: CIRAIG report http://www.ciraig.org/en/v.php?id=450&locale=en&year=2016&type=2

MARCOGAZ, the technical association of the European gas industry, has a methane emission working group and is collaborating with the European Gas Research Group (GERG) on developing proposals for a Europe-wide set of methane emission estimation methods.[16] These will be based on data from different companies. MARCOGAZ is also working on an evaluation of methane emissions of the European natural gas infrastructure[17] and producing a "best practices" document, which will reference the best available technology to reduce methane emissions.

16 http://www.dbi-gut.de/emissionen.html

17 http://www.marcogaz.org/index.php/component/docman/doc_download/5308

Acting to reduce methane emissions

The gas industry supports the transition to a lower carbon society by minimising GHG emissions. This includes methane emissions released during the industry's own operations and maintenance activities.

The industry has been working for many years to reduce methane emissions through mandatory and voluntary programmes. Among these are the Natural Gas STAR Program, the Global Methane Initiative, the Oil & Gas Climate Initiative or the Climate and Clean Air Coalition.

In addition to collaborative initiatives, gas companies have individual programmes and best practices to reduce methane emissions. These initiatives include leak detection and repair (LDAR) programmes. LDAR works to identify and repair equipment or infrastructure that can be a source of methane leaks. Whilst LDAR in certain jurisdictions can have a specific regulatory definition, it is more generally used to describe the processes and systems used to identify leaking equipment. This enables prioritization and repair. The LDAR programme uses a variety of techniques, including optical gas imaging.

Operational rules can be adapted, after a case-by-case assessment. For example:

- Transmission System Operators can, where feasible, recompress gas during interventions that require emptying a pipeline. Such recompression prevents the release of methane emissions into the atmosphere;
- For gas pressure control systems: use of "auto-piloted" valves instead of "external pilot systems" enables pressure regulation without any gas emissions. And instead of natural gas, compressed air is used for pneumatic actuators. The compressors are electrically driven, in some cases by renewable sources or by cleaner-burning CHP (combined heat and power);
- Closed loop systems for truck transport of liquids to wells and treatment facilities, combined with recompression of natural gas flashing out of produced liquids on production sites and using these fuels for combustion (gas heater, glycol regeneration);
- Usage of hot taps for in-service pipeline connections, replacement or removal of unnecessary old equipment, lowering gas pipeline pressure before maintenance and replacing pneumatic controls with air/electrical actuators.

The EU has in recent years, developed several policy tools aimed at reducing atmospheric emissions of greenhouse gases such as methane. Among these initiatives are the Effort Sharing Regulation and the Fuel Quality Directive. Under existing legislation, methane emissions are expected to drop by about 25% by 2030, relative to 2005.[18]

Agriculture is, by far, the largest emitter of methane. As part of the solution, the gas industry is working with the agriculture sector to solve this problem by developing biomethane for injection in its grid.

Gas companies have significant incentives to prevent methane emissions. Such prevention assures the safety of their personnel and facilities and provides commercial stocks of methane where gas markets exist. The industry will continue to look for new ways to reduce methane emissions and other greenhouse gases, as part of its role in addressing climate change.

[18] European Commission Impact Assessment (SWD(2013)531, Accompanying the Impact Assessment of the Air Quality Package, pages 278-281.

Images courtesy of : OMV, Gasum, GRTGAZ, GASCADE