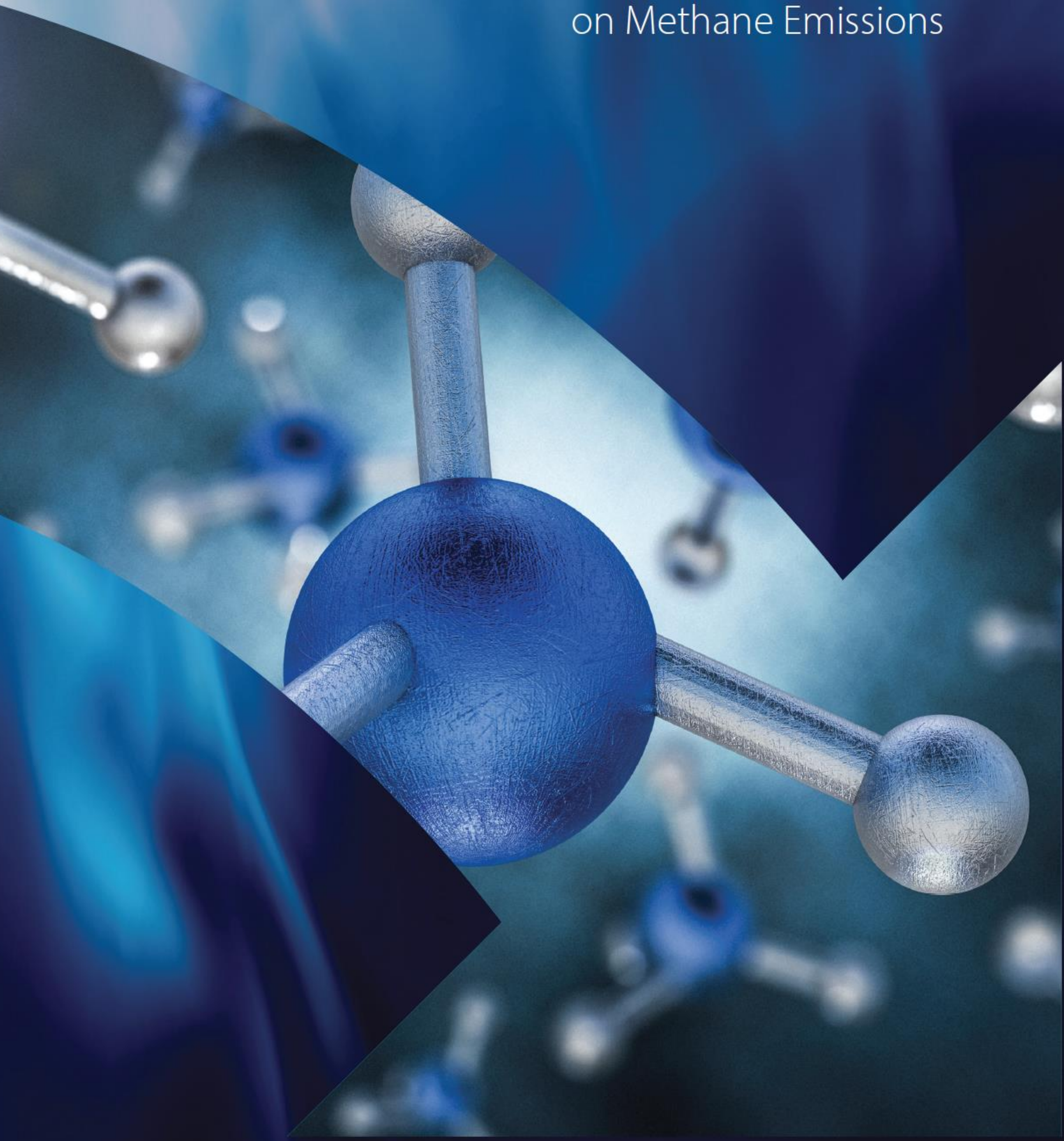
# Frequently Asked Questions
## on Methane Emissions



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International Association of Oil & Gas Producers

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## What is methane and why is its impact so important?

Methane ($CH_4$) is the second most important greenhouse gas (GHG) after carbon dioxide ($CO_2$). It is a more potent greenhouse gas than $CO_2$ but has a much shorter atmospheric lifespan (on average 8-12 years). $CO_2$ persists in the atmosphere for centuries.

Methane emissions mitigation plays an important role in meeting global GHG reduction efforts and contributing to meeting the Paris commitments[1].

## What is the gas industry doing to reduce methane emissions?

Methane emissions management and reduction are among the top priorities of the European gas industry. The industry is committed to minimise methane emissions and actively contribute to short-term mitigation of climate change and to accelerate environmental commitments. In this context, it should be stressed that natural gas consists essentially of methane, therefore - different from $CO_2$ - $CH_4$ has a positive market value across the globe providing an incentive to reduce its emissions.

In June 2019, GIE and MARCOGAZ published the report "Potential ways the gas industry can contribute to the reduction of methane emissions" *[1]* with contributions from representatives of the entire gas value chain, from production to utilisation, including biomethane production. This report provides an overview of the current status of methane emissions in the EU gas sector and the actions undertaken by the gas industry until now. The report also contains information on ongoing initiatives and a number of proposed commitments for future actions for the industry.

The gas industry is working with policy makers to put in place a harmonised and robust MRV (monitoring, reporting and verification) system to improve the accuracy, transparency and credibility of the data. This will help enabling the identification of methane emissions, prioritisation and efficient allocation of capital and human resources to target and mitigate methane emissions at the lowest cost.

There are a large number of so called "best available techniques" (BAT) to reduce methane emissions that much of the gas industry is already implementing on a voluntary basis. There are already many reference documents in place with relevant information on BATs for the gas industry, e.g. GIE and MARCOGAZ report *[1]*, Oil and Gas Methane Partnership Technical Guidance Documents *[2]*, Methane Guiding Principles best practice toolkit *[3]*, UNECE Best Practice Guidance for effective methane management in the oil and gas sector *[4]*.

Many gas companies have set themselves emission reduction targets. These targets are an example of the commitments of the gas industry to achieve additional methane emissions reductions.

Collaboration initiatives, cooperation among the gas industry players and training programmes are important in sharing information, experiences and data. There are already very good examples in place such as the Methane Guiding Principles Outreach Programme[2].

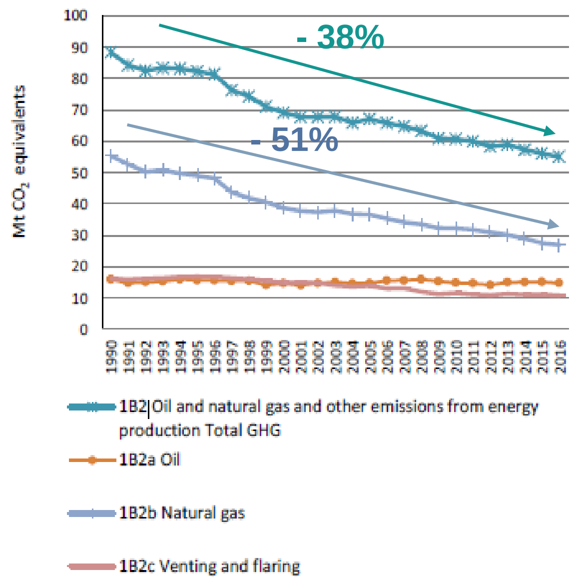
[1] United Nations Climate Change:
https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[2] Methane Guiding Principles Outreach Programme
https://methaneguidingprinciples.org/courses/

## What is the current status of $CH_4$ emissions in the gas sector in the EU?

In accordance with the annual EU GHG inventory *[5]*, methane emissions from oil and natural gas supply chains (from exploration, production, processing, transport, and handling of oil and natural gas) accounted for 1.3 % of the total GHG emissions in 2016 and decreased by 38 % between 1990 and 2016. This trend was mainly due to the reduction of fugitive methane emissions from natural gas activities, which decreased by 51 % over that period.

**Figure 1 – Oil and gas emissions data trend in the EU**

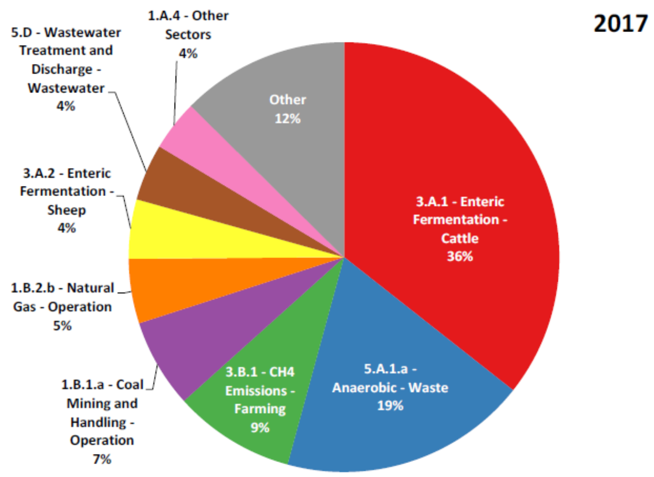



Source: EEA Annual EU GHG inventory 1990–2017 and inventory report 2019 *[5]*

In the case of the European Union, methane emissions from gas operations in 2017 represented 5% of the total methane emissions from all sources in the EU.

The following figure shows the EU $CH_4$ emissions per source.

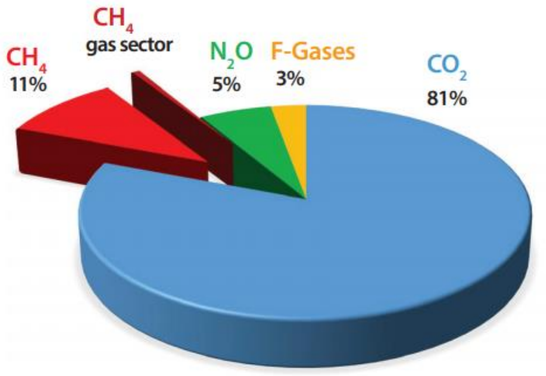
**Figure 2 – Anthropogenic $CH_4$ emissions per source**




Source: EEA Annual EU GHG inventory 1990–2017 and inventory report 2019 *[5]*

Methane emissions occasioned by the EU gas sector operations account for 0.6% of the total EU GHG emissions in 2017.

**Figure 3 – Total EU GHG emissions in 2017 (in $CO_{2\text{-}eq}$)**

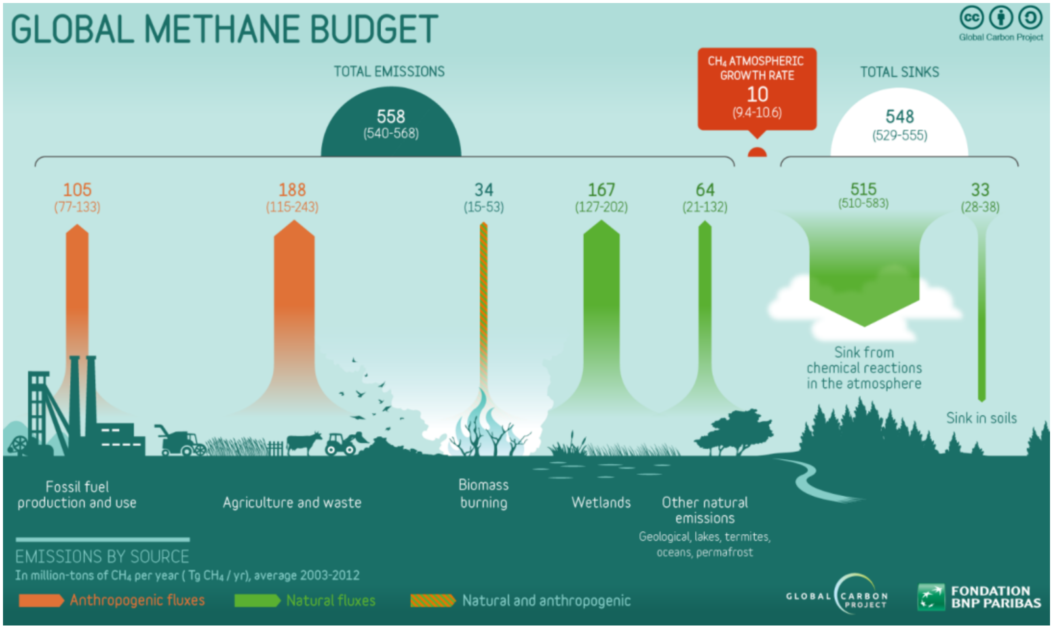



Source: Elaborated by the authors based on EEA GHG report *[5]*

## What % of global $CH_4$ emissions are due to the gas sector?

Roughly 60% of total global methane emissions come from anthropogenic (human) activity, and the other 40% occur naturally (e.g. from wetlands). In order of magnitude, the biggest sources of anthropogenic methane emissions are from agriculture, waste and fossil fuels.

**Figure 4 - Methane emissions per source**




Source – Global Carbon Budget *[6]*

The above stated 105 million-tons of $CH_4$ emissions p.a. from fossil fuels correspond roughly to 20% of global annual $CH_4$ emissions.

On a normalised $CO_2$ equivalent basis, the above 105 million tons of $CH_4$ emissions p.a. from fossil fuels correspond to 3.3 billion tons of $CO_2$ equivalent. On this basis, $CH_4$ emissions from fossil fuels (including coal) correspond to about 10% of the approximately 33 billion tons of energy related global $CO_2$ emissions in 2017 *[7]*. $CH_4$ emissions from oil and gas operations only (i.e. excluding from coal) therefore correspond to approximately 6% of energy related global $CO_2$ emissions.

## What are the sources of methane emissions in the gas industry?

In order to effectively manage methane emissions, the gas industry firstly identifies the sources of methane emissions through the development of detailed emission inventories. The emissions of methane from the gas supply chain during operation can be divided into three major categories:

- **Fugitive emissions** result from methane that "leaks" unintentionally from equipment or components.
- **Vented emissions** are intentional releases of methane, due to safety considerations, equipment design, incidents or operational procedures.
- **Incomplete combustion emissions** are small amounts of un-combusted methane in the exhaust of natural gas combustion equipment and flares.

## What climate metric should be used to account for the climate impact of $CH_4$?

Climate metrics are used to normalise different GHG emissions to '$CO_2$ equivalent' emissions. Climate metrics can be expressed in different time horizons, and there is neither a single climate factor, nor a single time horizon that is appropriate for all applications and situations. Over the years, scientists have explored and formulated the advantages and disadvantages of using different metrics.

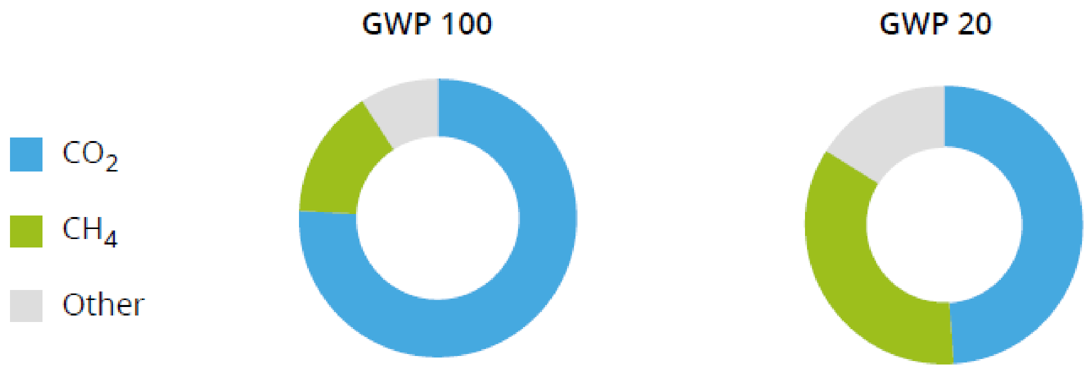
Global Warming Potential (GWP) 100 is the most well-known metric and is used widely, including for national and international emission reporting, such as the United Nations Framework Convention on Climate Change (UNFCCC). Whilst it is accepted that there is no single correct metric, the consistent use of GWP100 at least allows consistent comparisons to previous studies and reports. As per the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), the GWP100 for methane is in the range 28-36 times that of $CO_2$ and the GWP20 is 84-87 times that of $CO_2$.

GWP100 happens to align with the long-term climate change mitigation goals, allowing a more appropriate distribution of resources to meet these goals.

Depending on the timescale selected, there is a wide range of assessments of the climate change impact of methane relative to $CO_2$.

Recalibrating GHG impact estimates from 100-year to 20-year GWP values would increase the calculated global warming impact from methane emitting sectors like agriculture and fossil fuels, while reducing the calculated global warming impact from large $CO_2$ emitters such as coal based power generation.

**Figure 5 –GHG emissions using GWP100 vs GWP20**




Source – IGU "Understanding methane emissions" *[8]*

This demonstrates that the selection of timescale can dramatically redefine the climate problem. Using 20-year GWP values puts a much greater emphasis on short-lived gases like methane, while in relative comparison sharply reducing the weight of long-lived gases, particularly $CO_2$.

Policies that aim to avoid long-term irreversible climate change through the Paris commitments should be based on GWP100. Using GWP20 would alter that aim, by shifting the focus from the long-term magnitude to the short-term rate of change. Consequently, the use of GWP20 would smooth the short-term fluctuations, while missing the long-term temperature target, as $CO_2$ will continue to accumulate.

For an effective approach to emissions reductions and climate change mitigation, both short and long-lived forcers need to be addressed.

## Should top-down methodologies be used to quantify methane emissions in the gas sector?

Two main quantification approaches, bottom-up and top-down, are currently used. While top-down quantifications are commonly based in 'aerial-based' techniques (e.g. techniques to measure methane concentration in ambient air and calculate methane flux as a function of atmospheric and meteorological conditions, allowing to allocate methane emissions due to natural gas industry), the EU gas industry uses a "bottom-up" approach to quantify methane emissions, consistent with the approach historically used for other emissions such as particulates, sulfur oxides, and nitrogen oxides. This is because it is a source-specific best available approach, which allows the quantification of emissions from each individually identified source. As a basis for successful emission management, it is important that emissions are quantified at the individual source level, since an understanding of sources-specific emissions is a prerequisite for evaluating emission reduction opportunities.

Top-down quantifications are relatively new and some studies have demonstrated the limitations of relying on top-down measurements alone to draw firm conclusions on methane emissions from the oil and gas industry. These limitations include the uncertainty of extrapolating short term measurements to annual emission rates; the apportionment of the measured methane concentration between fossil and biogenic methane; the limitations of the reverse flux calculation to derive emission rates from ambient measurements; and the ability to correctly determine the local background methane concentrations for air mass entering the basin/area.

The recent work by the National Academies of Sciences *[9]* found that the time of day when the previous top-down measurements were taken coincided with significant maintenance activity, which caused an episodic release of methane and skewed the measurements. It therefore stressed the importance of finding ways to reconcile top-down and bottom-up measurements, and account for important temporal factors.

One important goal is to identify effective ways of combining and reconciling the two approaches, bottom-up and top-down, to improve the accuracy of the methane emissions data.

## Is it possible to measure all methane emissions?

Although there are some methane emissions from gas operations that can be detected (e.g. using infra-red, laser cameras, spectrometer technology), it is not possible to detect all of them to be accurately measured because of lack of human resources and/or appropriate equipment.

Gas related methane emissions stem from a large number and great variety of sources including venting (intentional emissions related to the controlled release of gases directly into the atmosphere resulting from the process design or unintentional due to incidents), fugitive emissions (unintentional losses to the atmosphere from leaking equipment such as valves, flanges, or fittings) and incomplete combustion/flaring (e.g. of associated gases).

Moreover, methane emissions cannot be calculated as easily as for $CO_2$ emissions, which can be calculated as a direct function of the quantity of fossil fuel used to generate electricity or heat. It is hence not viable to directly measure all methane emissions. Therefore, methane emissions are quantified through a combination of measurement, calculations and modelling to fit each situation.

## Is it true that an important part of the global $CH_4$ emissions could be avoided at no net costs?

$CH_4$ as the principle constituent of natural gas has positive market value across the globe providing an incentive to reduce these emissions. Thus - different from $CO_2$ - methane emission reductions can be amongst the most cost-effective GHG reduction measures. According to the IEA Methane tracker it is estimated that it is technically possible to avoid around three quarters of today's methane emissions from global oil and gas operations. Even more significantly, around 40% of current methane emissions could be avoided at no net cost *[10]*.

This is a global estimation based on extrapolated data and different assumptions. However, the abatement cost curves for methane emissions should be carefully analysed and defined at national level and taken into consideration in the national framework (policy and regulation in place, market rules, etc).

It is also important to highlight that the majority of EU gas infrastructure operators are regulated companies. Therefore, the cost related to methane mitigation measures need to be recognised and mitigation measures need to be accordingly incentivised by the regulatory authorities.

## Is the climate impact of natural gas higher than the impact of coal?

When comparing GHG emissions from natural gas versus other fuels, full life cycle emissions should be taken into account.

When combusted (e.g. in turbines to generate power), natural gas - which comprises mostly methane - generates about half as much $CO_2$ as coal for the same quantity of energy generated. It is the most heat intensive and highly efficient fuel, particularly when used directly. Furthermore, methane emissions along the value chain up to combustion, are relatively understudied, especially for coal.

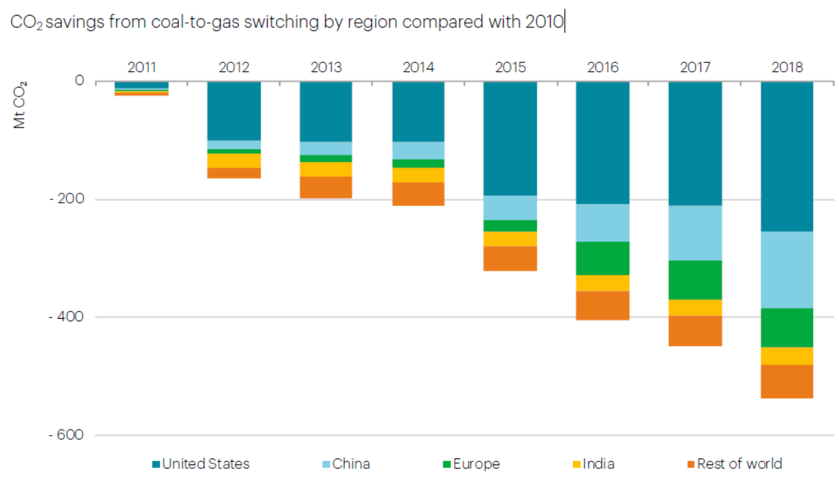
Recent studies *[11, 12]* suggest that methane emissions from active and dormant coal mines are higher that methane emissions along the natural gas value chain up to combustion. The IEA, in its most recent World Energy Outlook (WEO) published in November 2019, set the coal mine methane (CMM) emissions estimate to around half the 79Mt it estimated for oil-and-gas operations in 2018. However, the recent study estimates that CMM in 2020 will be much higher than this, some 135 bcm, equating to roughly 92Mt of methane. The authors also note that, for the first time, they developed a methodology for estimating global methane emissions from old mining sites, suggesting a considerable role for abandoned mine methane (AMM), which in the past has been largely ignored. When factoring this in, coal methane emissions in 2020 rise to 114Mt.

When comparing full life-cycle GHG emissions including $CH_4$ emissions of using natural gas versus coal for electricity or heat generation, GHG life-cycle emissions from using natural gas are significantly lower: the IEA assesses that life-cycle GHG emissions from gas used for power generation or heat generation are significantly lower than those if using coal. The IEA estimates *[12]* that "*98% of gas consumed today has a lower life-cycle emissions intensity than coal when used for power or heat and that, on average, coal-to-gas switching reduces emissions by 50% when producing electricity and by 33% when providing heat*."

Running gas-fired plants instead of coal-fired plants to generate electricity is therefore a 'quick win' for emissions' reduction.

**Figure 6 - $CO_2$ savings from coal-to-gas switching by region compared with 2010**

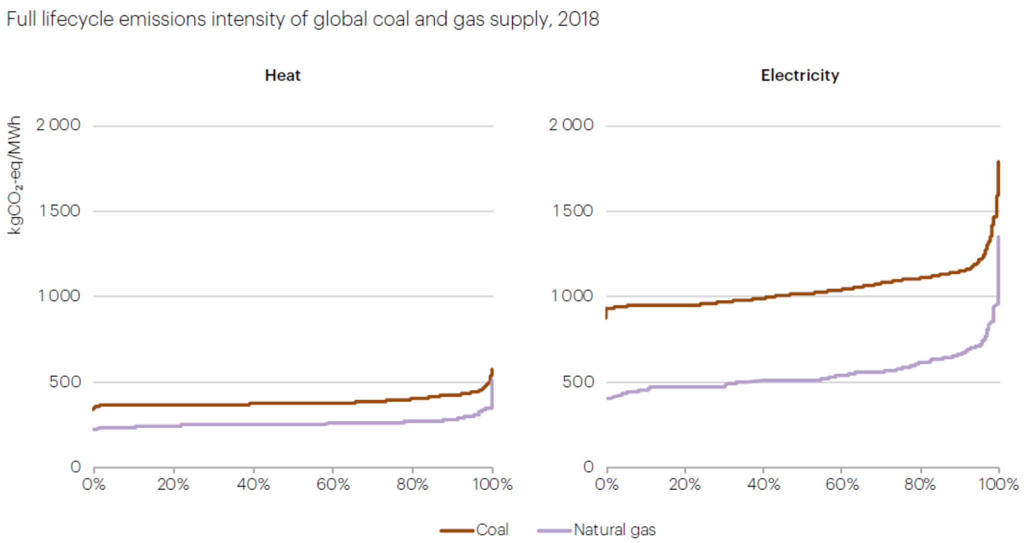
**Coal-to-gas switching has helped prevent faster growth in emissions since 2010…**




Source – IEA "The Role of Gas in Today's Energy Transitions" *[13]*

**Figure 7 – Full LCA of gas versus coal**

**A full lifecycle analysis shows the emissions benefits of gas versus coal …**




Source – IEA "The Role of Gas in Today's Energy Transitions" *[13]*

## References


***[1]*** **GIE and MARCOGAZ "Potential ways the gas industry can contribute to the reduction of methane emissions"**

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***[2]*** **Oil and Gas Methane Partnership Technical Guidance Documents**

https://ccacoalition.org/en/content/oil-and-gas-methane-partnership-technical-guidance-documents

***[3]*** **Methane Guiding Principles best practice toolkit**

https://methaneguidingprinciples.org/best-practice-toolkit/

***[4]*** **UNECE Best Practice Guidance for effective methane management in the oil and gas sector**

https://www.unece.org/energywelcome/areas-of-work/methane-management/activities/methane-management-in-extractive-industries/oil-and-gas-sector/best-practice-guidance/model-framework-for-reducing-methane-emissions-along-the-gas-value-chain.html

***[5] European Environment Agency Annual EU GHG inventory 1990–2017 and inventory report 2019***

https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2019/at_download/file

***[6]*** **Global Methane Budget**

https://www.globalcarbonproject.org/methanebudget/index.htm

***[7]*** **ExxonMobil 2019 Outlook for Energy**

https://corporate.exxonmobil.com/-/media/Global/Files/outlook-for-energy/2019-Outlook-for-Energy_v4.pdf

***[8]*** **IGU "Understanding methane emissions"**

https://www.igu.org/news/understanding-methane-emissions-and-what-global-gas-industry-doing-about-them

***[9]*** **US National Academies of Sciences (NAS) publication - Temporal variability largely explains top-down/bottom-up difference in methane emission estimates from a natural gas production region**

https://www.pnas.org/content/115/46/11712

***[10]*** **IEA Methane Tracker**

https://www.iea.org/reports/methane-tracker

***[11]*** **Journal of Cleaner Production, Volume 256, 20 March 2020, 120489 (Global methane emissions from coal mining to continue growing even with declining production)**

***[12] Carbon Brief "Coal mines emit more methane than oil-and-gas sector, study finds"*** https://www-carbonbrief-org.cdn.ampproject.org/c/s/www.carbonbrief.org/coal-mines-emit-more-methane-than-oil-and-gas-sector-study-finds/amp

***[13]*** **IEA "The Role of Gas in Today's Energy Transitions"**

https://webstore.iea.org/the-role-of-gas-in-todays-energy-transitions


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