The energy security case for tackling gas flaring and methane leaks

International Energy Agency

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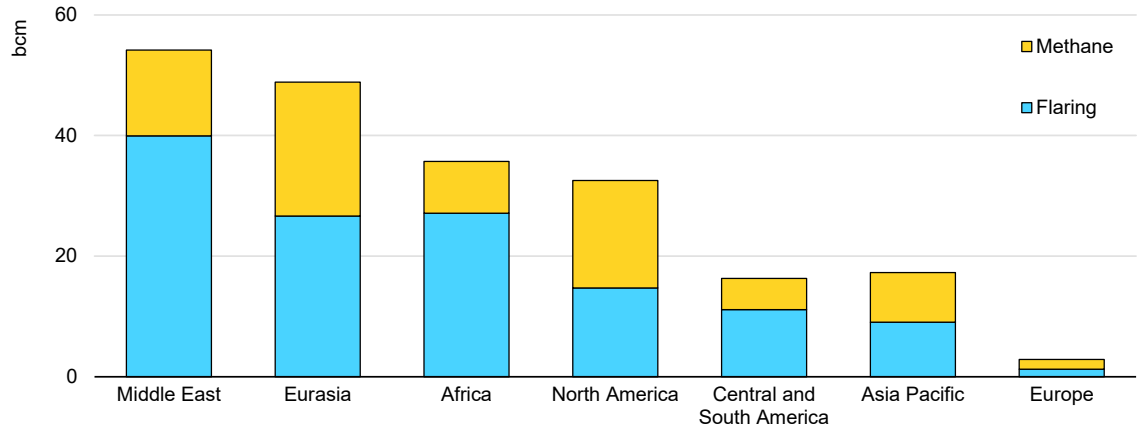
A concerted effort to limit flaring and methane emissions could make nearly 210 billion cubic metres of natural gas available to markets

Russia's unprovoked invasion of Ukraine has had a dramatic impact on the global energy system. Russia was the world's largest oil and natural gas exporter in 2021, and energy markets have been thrown into turmoil, with major energy security and supply risks worldwide.

There are a number of options available to boost gas supplies to reduce the current market tightness. Some gas producing countries and companies are looking to explore and approve new supply projects. However it typically takes many years for such projects to start producing, so they are not a good match for our immediate energy security needs.

Substantial gas resources currently are being produced that do not make it to market because they are lost to flaring and leaks across the oil and gas supply chain. Reducing flaring, venting and methane leaks would offer more immediate relief to gas markets than investing in new supply, bringing a double dividend: relief for very tight gas markets and reduced greenhouse gas emissions.[1] We estimate that nearly 210 billion cubic metres (bcm) of natural gas could be made available to gas markets by a global effort to eliminate non-emergency flaring and reduce methane emissions from oil and gas operations.

Gas volumes from eliminating non-emergency flaring and curtailing methane emissions



Note: Methane abatement estimates take into account that flaring reductions would reduce methane that is emitted due to incomplete combustion in flares (8% of natural gas and natural gas liquids entering flares is not combusted).

[1] A third option is for major gas producers to reduce their own consumption, notably in the power sector, via increased deployment of low-cost renewables.

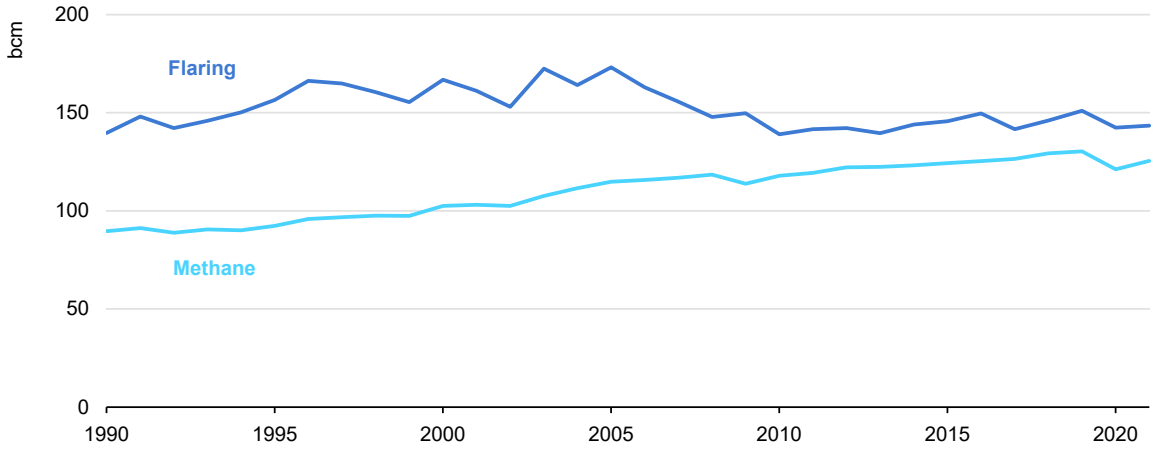
Reducing emissions of methane, the main component of natural gas, is one of the best opportunities available for limiting the near-term effects of climate change. Limiting flaring to emergencies would also lower local air pollution and cut black carbon emissions, which is another contributor to climate change.

If countries that currently export natural gas to the European Union were to implement these two measures, they could increase gas exports by more than 45 bcm using existing infrastructure, equivalent to almost one third of Russian gas exports to the EU in 2021. If all other liquefied natural gas (LNG) exporters – such as Egypt and Australia – were to do the same, they could provide an additional 8 bcm to global gas markets without needing to construct any new LNG liquefaction terminals.

Over 260 bcm of natural gas was flared, vented or lost in leaks in 2021

Over 140 bcm of natural gas was flared in 2021 and a further 125 bcm was vented or leaked to the atmosphere from oil and gas operations. This waste of natural gas is happening against the backdrop of tight and volatile gas markets.

Worldwide flaring and methane emissions, 1990-2021



We estimate that it is technically possible to avoid over 70% of today's methane emissions and 90% of flaring from global oil and gas operations. This wasted gas could often easily reach markets: over 54% of all flared volumes are within 20 km of an existing gas pipeline.

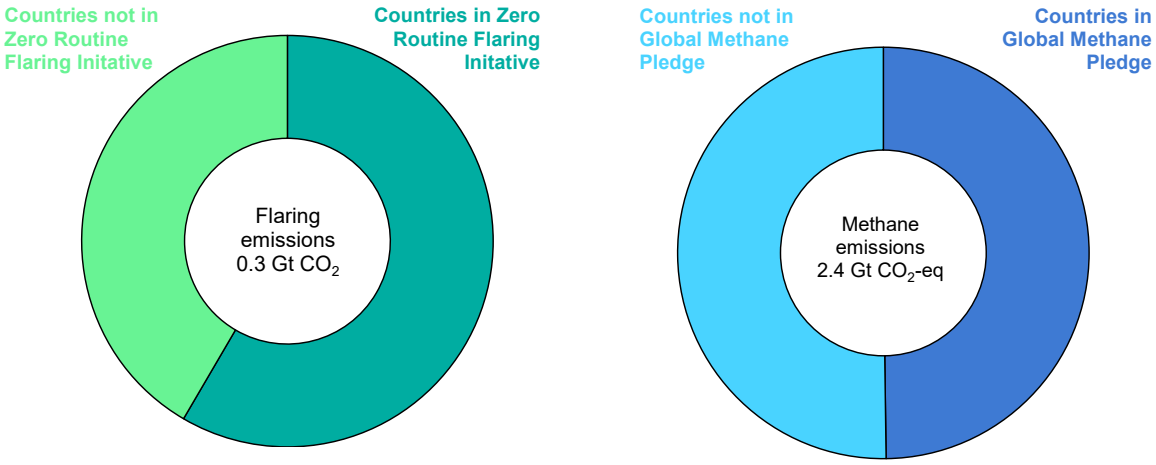
The ways to prevent flaring and methane emissions from oil and gas operations are known and cost-effective. These measures include installing emissions control devices, conducting regular leak detection and repair campaigns, and replacing components and devices that emit methane in their normal operations. If there are no connections to gas markets, companies can re-inject waste gases into oil and gas reservoirs, or use them for local electricity generation.

In total, we estimate that action to reduce methane leaks, venting and flaring could quickly bring nearly 210 bcm to global gas markets.

Substantially reducing gas flaring and methane emissions would avoid around 0.1°C of warming

Gas wasted in flaring, venting and methane leaks from oil and gas operations led to around 2.7 billion tonnes of CO_2 equivalent (Gt CO_2-eq) emissions in 2021.[2] We estimate that rapid action to deploy all available abatement technologies over the next decade would cut around 0.07 °C in 2050 and 0.12 °C in 2100 from the global temperature rise.[3] This is the same effect on the global temperature rise by mid-century as immediately eliminating the GHG emissions from all of the world's cars, trucks, buses and two- and three-wheelers.

Shares of emissions from oil and gas operations covered by international initiatives to tackle flaring and methane emissions, 2021



Note: Shares of emissions reflect countries participating in the Zero Routine Flaring by 2030 and Global Methane Pledge.

Emissions from flaring, venting and methane leaks have remained stubbornly high despite a number of commitments to address them, underscoring the need for ambitious mitigation efforts. Through the Zero Routine Flaring by 2030 Initiative, launched in 2015, governments and companies pledge to end routine flaring no later than 2030. The Global Methane Pledge, launched at the 26th UN Climate Change Conference of the Parties (COP26), includes over 110 countries that

[2] One tonne of methane is considered to be equivalent to 30 tonnes of CO_2 based on the 100-year global warming potential (GWP) (IPCC, 2021). Emissions are around 6.5 Gt CO_2-eq, if one tonne of methane is considered to be equivalent to 82 tonnes of CO_2 (based on the 20-year GWP).

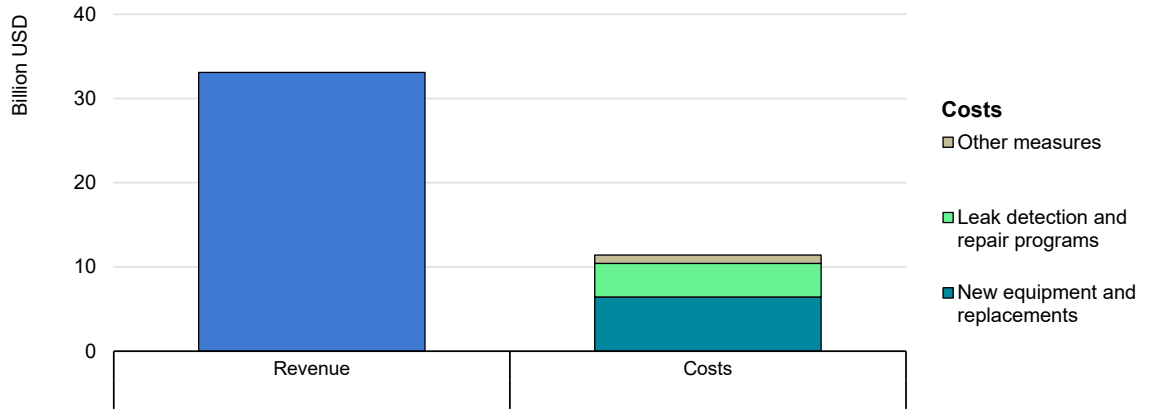
[3] Temperature differences are estimated using the Model for the Assessment of Greenhouse Gas Induced Climate Change ("MAGICC"). They are based on flaring and methane emissions from oil and gas operations in the Stated Policies Scenario in a case with no change in emissions intensities from current levels and a case with all available abatement measures deployed by 2030. See Annex for further information.

commit to a collective goal of reducing global methane emissions from human activity by at least 30% compared with 2020 levels by 2030.

With 2022's high gas prices, abatement would generate global revenues of USD 90 billion

At today's elevated natural gas prices, almost all of the options to reduce flaring and methane emissions from oil and gas operations could be implemented at no net cost because the abatement measures cost less to deploy than the market value of the gas that would be captured. If all the gas flared in routine operations during 2021 was brought to markets today, its revenues would amount to about USD 60 billion. Capturing methane emissions could bring over USD 30 billion.

Annual costs and potential revenue from reducing methane emissions



Note: Revenues are based on well-head prices, derived from average natural gas import prices in 2022 within each country. For exporting countries, the relevant well-head price is taken as the import price in their largest export market net-backed to the emissions source. For the net-back, allowance is made for transport costs (including liquefaction and shipping or pipeline transport), fees and taxes. Revenue takes into account that flaring reductions would also reduce methane that is emitted due to incomplete combustion in flares.

There is growing interest in pursuing these opportunities. Canada has been supporting investments in methane abatement through the Methane Technology Implementation Program (which offers a 50 % rebate for purchasing emissions reduction equipment). The World Bank also recently published a report on Financing Solutions to Reduce Natural Gas Flaring and Methane Emissions, aiming to guide the evaluation of flaring and methane reduction projects, identify investment barriers, and share success factors.

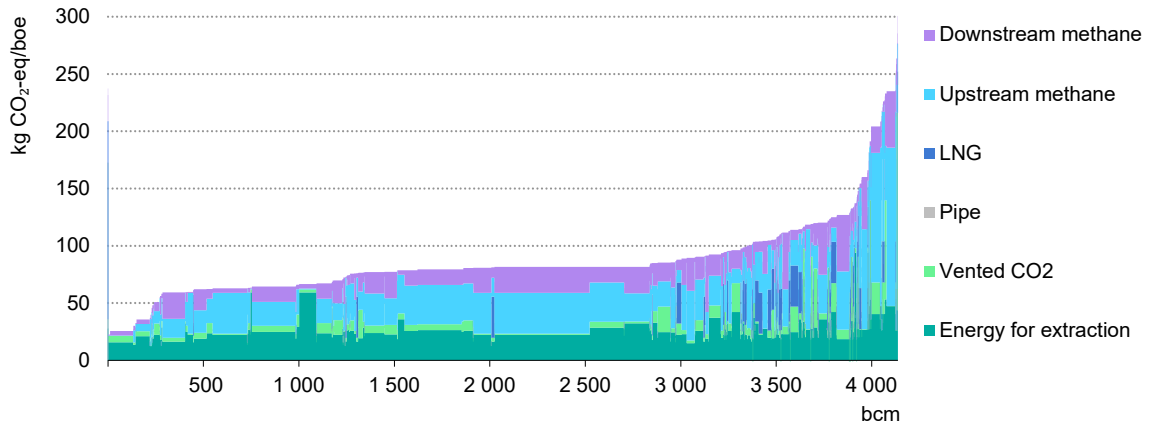
A number of organisations are working on accelerating methane abatement and flaring reduction, including the International Methane Emissions Observatory, the Climate and Clean Air Coalition, the World Bank's Global Gas Flaring Reduction Partnership and the Global Methane Hub. Financing and technical support is also coming from institutions like the European Bank for Reconstruction and Development (see, for example, the Methane Emissions Reduction Programme in Gas Supply Chains in Egypt).

Policies are key to stop non-emergency flaring and curtail methane emissions

Not enough is being done, and barriers to further action include a lack of awareness of emissions sources and abatement opportunities; misaligned incentives that make other investment options more attractive, and the lack of infrastructure to bring captured gas to markets.

These challenges can be addressed with tried and tested policies and technologies, including leak detection and repair requirements, equipment mandates and bans on non-emergency flaring and venting. Adopting these policies globally would reduce methane emissions from oil and gas emissions by half and put an end to non-emergency flaring.

Indirect CO_2 and methane emissions from global gas supply, 2021



Note: kg CO_2-eq/boe = kilogrammes of CO_2 equivalent per barrel of oil equivalent. Energy for extraction includes emissions from processing to remove impurities before transport. Upstream methane includes emissions from production, gathering and processing; downstream methane includes emissions from shipping (if applicable), transmission and distribution. One tonne of methane is considered to be equivalent to 30 tonnes of CO_2 based on the 100-year global warming potential (IPCC, 2021).

The IEA's Regulatory Roadmap and Toolkit collects examples of regulatory experiences around the world to support policy makers looking to develop policies and regulations on methane emissions. It discusses additional policies available that could result in the full adoption of all abatement options and lead to a more than 70% reduction in methane emissions from oil and gas operations. These include emissions pricing, financing instruments, and performance standards that would need to be supported by robust measurement-based monitoring regimes. An increasing number of companies have joined the Oil and Gas Methane Partnership 2.0, which provides a key framework for companies reporting on methane emissions.

Policies can also drive down other emissions from the natural gas supply chain. For example, we estimate that the process of liquefying natural gas for transport

(as LNG) resulted in around 140 million tonnes of CO_2 in 2021. A large portion of these emissions could be avoided by sourcing low-emissions power and electrifying operations or equipping them with carbon capture and storage.

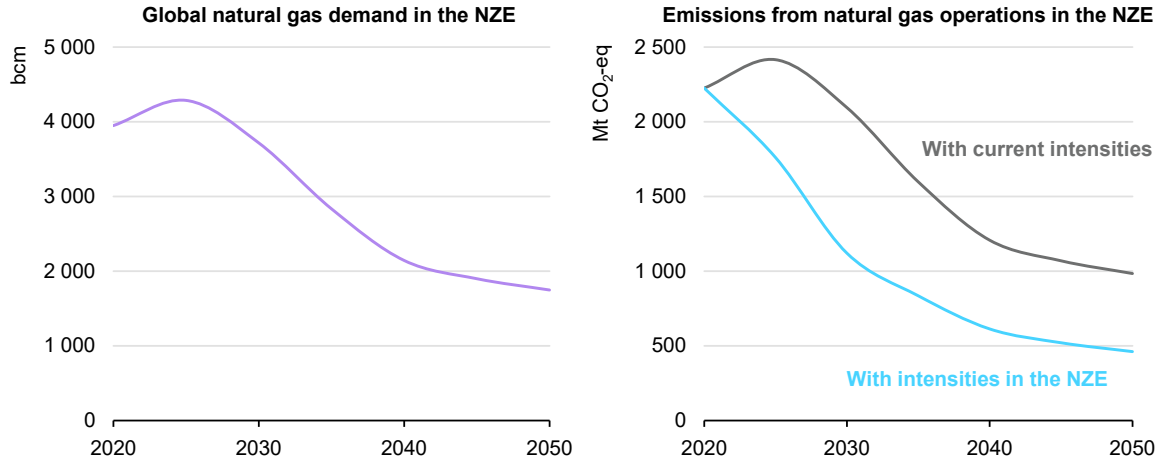
Improvements in emissions intensities are an integral part of a net zero pathway

Limiting the global temperature rise to 1.5 °C can only be accomplished by reducing the consumption of fossil fuels. These reductions need to be accompanied by an even faster decline in the greenhouse gas emissions associated with the extraction and processing of fossil fuels.

In the Net Zero Emissions by 2050 (NZE) scenario, flaring is reduced by over 90% between 2020 and 2030, and methane emissions from fossil fuel operations fall by 75%. About one-third of the drop in methane emissions to 2030 results from an overall reduction in fossil fuel consumption. The remaining two-thirds stems from the rapid deployment of mitigation measures and technologies, leading to the elimination of all non-emergency flaring and all technically avoidable methane emissions by 2030.

In this scenario, there is a near-50% reduction in the GHG emissions intensity of natural gas operations by 2030. This is a necessary condition for natural gas to play a supporting role in a pathway to net zero, where it can displace more polluting fuels such as coal in the immediate future or support low-carbon hydrogen production (when paired with carbon capture, utilisation and storage).

Natural gas demand and emissions in the Net Zero Emissions by 2050 Scenario



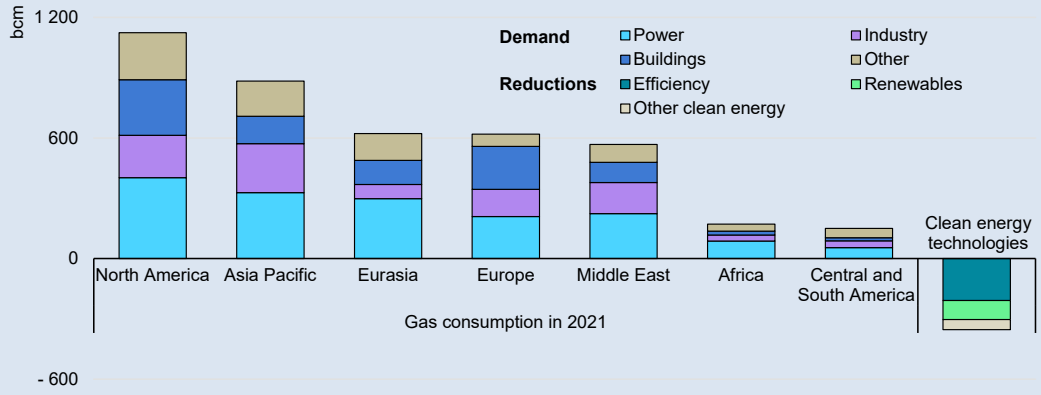
Note: Emissions from natural gas operations uses natural gas consumption in the NZE scenario. “With current intensities” assumes no change in current practices; “With intensities in the NZE” uses the change in intensities in the NZE.

Speeding up clean energy development can quickly lower gas demand

Global gas consumption today is around 4 100 bcm, about 40% of which is consumed in the power sector, 25% in industry and 20% in buildings. We estimate that rapidly deploying an array of clean energy technologies globally could free up around 350 bcm of natural gas by 2025. Efficiency gains would contribute around 210 bcm to the total, the deployment of renewables would contribute about 100 bcm, and the remainder would come from an increase in the use of bioenergy and direct use of heat, hydrogen and geothermal.

Producer economies in the Middle East and North Africa have the potential to reduce around 70 bcm of natural gas consumption through the rapid deployment of clean energy technologies, thereby freeing this gas for export. Currently, oil and gas account for almost 95% of electricity generation in this region. Over 150 bcm of natural gas – around one-fifth of the region's total gas consumption – is used each year in low-efficiency gas-fired power plants. By expanding renewable deployment and other clean energy technologies, the region stands to gain gas export revenues while boosting local economies and clean energy supply chains.

Current gas demand for selected regions and deploying clean energy technologies



Note: Other includes gas used in transport and other uses (e.g. energy transformation, losses). Deploying clean energy technologies shows potential avoided gas demand by boosting the deployment of efficiency measures, renewables, and other clean energy technologies to 2025.

Abatement measures can quickly help Europe reduce its reliance on Russian gas

Curtailing flaring and methane emissions would save over 45 bcm of natural gas in countries that currently export to the European Union. Many of these measures could be implemented quickly, especially by replacing leaky equipment or by minimising accidental leaks with frequent leak detection and repair programmes. If all other LNG exporters, including Egypt, Australia, and Malaysia were to do the same, they could provide an additional 8 bcm to global gas markets without needing to construct any new LNG liquefaction terminals.

The European Commission has announced measures to mitigate flaring and methane emissions. The EU framework to decarbonise gas markets, promote hydrogen and reduce methane emissions includes a regulation that bans venting and flaring, introduces measurement, reporting, and verification standards, and a leak detection and repair requirement. It also addresses methane emissions from gas imports by creating transparency tools to support more stringent measures in the future. More recently, the EU external energy engagement strategy aims to ensure that additional gas supplies are coupled with targeted actions to tackle methane leaks and to address venting and flaring. It further mentions the EU will provide technical assistance to partners to set up "You collect/we buy" schemes.

Possible gas savings from current and potential exporters to the European Union from reducing flaring and methane emissions (bcm)

	Reducing flaring	Reducing methane	Total	Difference between 2022 export capacity and 2021 exports	Additional gas available
Current exporters to the EU					
United States	8	14	22	18	18
Algeria	7	2	10	10	10
Nigeria	6	2	8	7	7
Libya	5	2	7	7	7
Angola	2	0.4	2	2	2
United Kingdom	0.8	0.2	1	1	1
Trinidad and Tobago	0.1	0.2	0.4	5	0.4
Equatorial Guinea	0.2	0.2	0.4	0.4	0.4
Total	**29**	**21**	**50**	**50**	**46**
Other LNG exporters					
Egypt	2	1	3	7	3
Australia	0.8	0.6	1	7	1
Malaysia	2	0.5	2	7	2
Other	1	0.3	1	6	1
Total	**5**	**2**	**8**	**27**	**8**

Note: US export capacity in 2022 takes into account LNG liquefaction facilities currently under construction; Algeria 2022 export capacity takes into account midstream bottlenecks that effectively limit available pipeline and LNG capacity. Other LNG exporters include Cameroon, Brunei and Peru.

Annex

Download the full data set for further regional and country-level information on related emissions, abatement potentials, additional gas supply, costs and revenues.

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