FEATURE ARTICLE:

Associated gas as a driver of greater economic value and emissions reduction

Associated gas is natural gas produced together with crude oil from the same reservoir. The volume produced relative to crude oil varies depending on field geology, reservoir pressure and production maturity. Historically, it was often regarded as a by-product of oil production and, where capture and utilisation infrastructure was limited, was frequently flared. Today, it is increasingly recognised as a valuable resource that can support domestic energy supply and other productive uses. Efforts to reduce routine gas flaring and methane emissions are further strengthening incentives to capture, process and commercialise these volumes. Effective management of associated gas is therefore becoming increasingly important for maximising the value of hydrocarbon resources while reducing their environmental footprint.

Once produced, associated gas can be directed to several uses and disposition routes. Gross associated gas production can be broadly allocated among (i) marketed gas, (ii) gas used for on-site operations, (iii) gas reinjected or used for Enhanced Oil Recovery (EOR), (iv) gas flared, and (v) gas vented or released through leaks and other fugitive emissions. The balance among these pathways depends on gathering, processing and transportation infrastructure, the economics of gas utilisation, reservoir management requirements and regulatory conditions.

Global marketed associated gas production has increased significantly over the past decades, reflecting the expansion of global oil production and the growing capture and utilisation of gas produced alongside crude oil. Marketed production rose from 75 bcm in 1950 to 344 bcm in 1980 and 413 bcm in 2000, before reaching 590 bcm in 2025 (Figure i). This sustained growth highlights the increasing contribution of associated gas to overall natural gas supply, with marketed associated gas accounting for 14% of total global gas production in 2025. Unlike non-associated gas, produced from dedicated gas reservoirs and more directly influenced by market conditions, associated gas production is primarily driven by oil production. When oil prices are favourable and crude oil output expands, associated gas volumes can increase regardless of gas prices or demand. Conversely, when oil production declines, associated gas output generally falls in tandem, potentially creating supply gaps met by non-associated gas or other sources.

From a regional perspective, marketed associated gas production is highly concentrated in North America, which accounts for more than half of global marketed associated gas output. The Middle East and Eurasia follow at 12% and 11%, respectively (Figure ii).

Figure i: Global marketed associated gas production

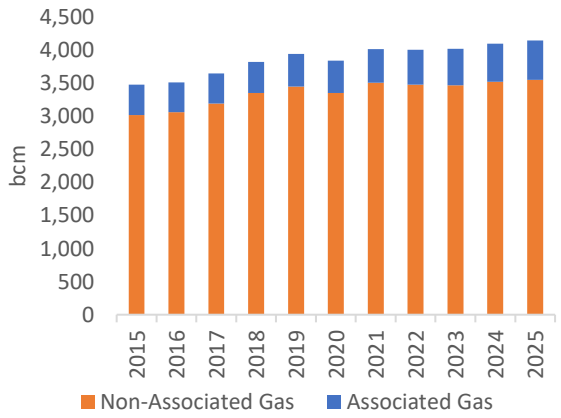
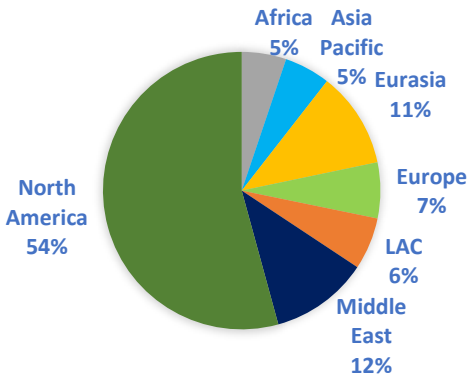


Figure ii: Regional distribution of marketed associated gas production in 2025



Source: GECF Secretariat based on data from Rystad Energy

In North America, the US dominates, accounting for 48% of global marketed associated gas production and leading by a significant margin, as the shale revolution triggered a rapid expansion of oil production from the country's shale and tight oil plays. Strong growth in US oil production, which doubled from 640 Mt in 2010 to 1,280 Mt in 2025, has translated into a substantial increase in marketed associated gas supply, rising from 90 bcm to 280 bcm over the same period and reaching 26% of total US gas output. Extensive gathering, processing, and pipeline infrastructure has enabled a large share of associated gas volumes to be captured and marketed, particularly in major oil-producing basins such as the Permian, Bakken, Eagle Ford, Anadarko, and Niobrara. The Permian Basin has emerged as the largest US source, accounting for nearly 60% of marketed associated gas output. The resulting supply of associated gas represents a structural source of relatively price-inelastic gas, which can exert downward pressure on Henry Hub prices during periods of weak gas demand and weaken the link between gas supply growth and gas-specific investment decisions and market signals.

In the Middle East, strategic midstream investments are transforming associated gas from a historical by-product of crude oil production into an increasingly important domestic energy resource. Today, marketed associated gas production amounts to nearly 10% of total regional gas output. Saudi Arabia leads the region in associated gas output, capturing 35 bcm in 2025, with the Ghawar oil field serving as its largest source. Its Master Gas System, one of the world's most extensive gas gathering and processing networks, was purpose-built to capture associated gas from major oil fields, including Ghawar, Safaniya, and Abqaiq, transforming what was historically a flared by-product into a backbone of the Kingdom's industrial energy supply. Significant volumes are also generated by other major regional oil producers, including Iran, where associated gas production is concentrated in Khuzestan Province and various offshore fields, as well as Iraq, the UAE, and Kuwait. While Iraq has historically faced challenges in capturing and processing associated gas due to infrastructure constraints and high flaring levels, ongoing investments in gas gathering and processing are increasingly allowing the country to convert these volumes into a valuable domestic energy resource.

In Eurasia, Russia is the dominant source of marketed associated gas, reflecting the scale of its oil production and extensive hydrocarbon resource base. Production is concentrated in major oil-producing regions, including Western Siberia, where extensive oil and gas infrastructure supports the gathering, processing and utilisation of associated gas. Kazakhstan and Azerbaijan also contribute significant volumes, driven by major oil-producing projects such as Tengiz and Kashagan in Kazakhstan and the Azeri-Chirag-Gunashli complex in Azerbaijan. The region's substantial oil production and gas infrastructure provide opportunities to capture and utilise associated gas for domestic energy supply, industrial applications and other productive uses, thereby increasing the value derived from oil production and supporting regional gas supply.

Beyond marketed volumes, associated gas can also be used on-site or reinjected into reservoirs, including for Enhanced Oil Recovery (EOR). Gas used for on-site operations can fuel power generation, compressors, heating and other production activities, reducing reliance on external energy supplies. This is particularly relevant in large and remote oil-producing fields, where production operations require energy inputs. Reinjection and EOR provide another important utilisation pathway, allowing gas to maintain reservoir pressure and increase oil recovery while reducing the need for flaring. These practices are particularly important in countries with mature oil fields and advanced reservoir-management systems. Where gas markets or utilisation infrastructure are limited, reinjection can also provide an alternative to flaring.

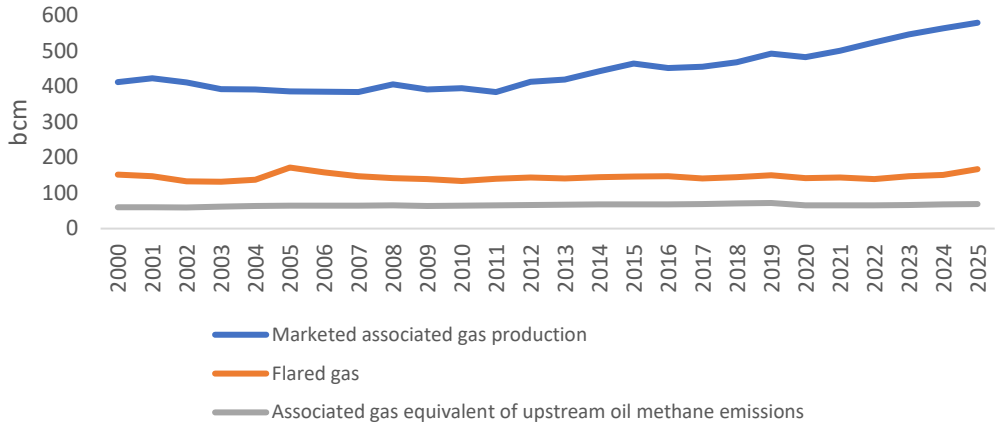
Where associated gas cannot be marketed, used on-site or reinjected, it may be flared or vented, contributing to greenhouse gas emissions and other environmental impacts. Gas flaring remains a major environmental challenge for the petroleum industry, particularly in regions where associated gas capture and utilisation infrastructure remains insufficient. According to the World Bank, global flaring volumes increased to 167 bcm in 2025, with oil production accounting for the vast majority of this volume. This was the highest level recorded since 2019 and corresponded to an estimated 429 million tonnes of CO_2 equivalent (CO_2e) emissions. Flaring converts the energy contained in associated gas into heat and CO_2, while incomplete combustion can release methane and other pollutants. It also produces black carbon, or soot, which can affect atmospheric conditions and, when deposited on snow and ice, increase heat absorption and accelerate surface melting. Beyond these direct emissions, persistent flaring can contribute to local air pollution and atmospheric impacts, particularly in areas with intensive oil production and prolonged flaring activity.

Methane emissions from upstream oil operations represent a further environmental challenge, particularly where associated gas is vented or released through equipment leaks and other fugitive sources. According to the IEA, oil operations were the largest source of energy-related methane emissions in 2025, accounting for an estimated 45 Mt of methane. These emissions arise from equipment leaks, intentional venting and other releases during oil production and associated gas handling. Given methane's high warming potential, such emissions can significantly increase the climate impact of oil production, while their dispersed and often intermittent nature makes them challenging to monitor and quantify accurately.

In this context, capturing and utilising associated gas can help address both gas flaring and methane emissions by reducing the amount of gas combusted or released at oil production sites. By recovering gas that would otherwise be flared or vented, oil producers can limit CO_2, methane and other emissions associated with these practices. This is particularly relevant in major oil-producing regions where large volumes of associated gas are generated and flaring remains widespread. Effective capture and utilisation can also reduce emissions from incomplete combustion, including methane and black carbon, while improving the overall environmental performance of oil production and associated gas management.

The evolution of marketed associated gas production, flaring and upstream oil methane emissions can be assessed by comparing their respective volumes over time. Between 2000 and 2025, global marketed associated gas production increased from 413 bcm to 590 bcm, an increase of 40%. Over the same period, gas flaring increased much more slowly, from 152 bcm to 167 bcm, while the associated-gas equivalent of upstream oil methane emissions rose from around 60 bcm to 70 bcm (Figure iii). Consequently, both flaring and methane emissions declined relative to marketed associated gas production, as their growth remained well below the increase in marketed associated gas output. Gas flaring represented 28% of marketed associated gas production in 2025, compared with 37% in 2000, while the associated-gas equivalent of upstream oil methane emissions declined from 15% to 12% over the same period. These trends indicate that, although flaring and methane emissions remain significant, their volumes have grown more slowly than marketed associated gas production. This suggests improvements in associated gas management, with increasing volumes being captured and utilised rather than flared or released.

Figure iii: Global marketed associated gas production, gas flaring and associated gas equivalent of upstream oil methane emissions



Source: GECF Secretariat based on data from the World Bank, IEA, and Rystad Energy

Associated gas also represents a significant economic opportunity for oil-producing countries because it is generated alongside crude oil production and therefore does not require separate exploration and production activities. Once the necessary gathering, processing, transportation and utilisation infrastructure is in place, associated gas can provide an additional source of energy and revenue from existing oil production, while making greater use of resources already being produced. This makes associated gas particularly attractive from an economic perspective, as the main requirement is investment in the infrastructure needed to capture, process and deliver the gas to consumers, rather than the full cost of developing a separate gas resource. This relatively low incremental resource cost can make associated gas especially valuable for countries seeking to expand domestic gas supply.

The scale of this opportunity is significant. In 2025, around 237 bcm of associated gas was flared or lost through upstream oil methane emissions, a volume exceeding the annual natural gas production of Latin America and the Caribbean and of Europe individually, and approaching the level of Africa's gas production. This represents a substantial volume of potentially valuable gas that was not put to productive use and highlights the considerable economic potential of better associated gas utilisation. Recovering even a portion of these volumes could increase domestic gas availability and generate additional value from existing oil production. For many oil-producing developing countries, greater utilisation of associated gas could support power generation and industrialisation, reduce reliance on alternative fuels, and create opportunities for broader economic development.

In the meantime, the severe Middle East crisis in 2026, driven by the blockade of the Strait of Hormuz, highlighted an important vulnerability of associated gas supply: its direct dependence on crude oil production. Major disruptions to regional energy infrastructure and sharp reductions in crude oil output led to significant declines in associated gas production. Unlike non-associated gas, which can be produced independently, associated gas output is closely tied to oil production and can therefore decline rapidly when crude oil extraction is disrupted. This placed additional pressure on domestic gas supplies in countries such as Saudi Arabia, Bahrain and Kuwait, where associated gas plays an important role in power generation and industrial activity, increasing the need for alternative fuel supplies. The crisis has demonstrated that reliance on associated gas can create an additional energy security risk when disruptions to oil production simultaneously constrain domestic gas availability.