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Methane abatement in India's coking coal push: Opportunities and costs

As India expands domestic coking coal production, integrating methane abatement into mine planning can reduce emissions at relatively low cost

- *India's push to expand domestic coking coal production could significantly increase methane emissions unless abatement is integrated into mine planning. As production moves to deeper, underground coking coal reserves, methane intensity is expected to rise, creating a growing and largely overlooked climate risk.*
- *Coking coal methane emissions are concentrated: Seven mines account for 81% of emissions from the 30 operating mines tracked, almost all of them in Jharkhand. Targeting methane mitigation in this small number and embedding methane management into Mission Coking Coal could deliver rapid and cost-effective emissions reductions while avoiding long-term emissions lock-in.*
- *Around 87% of India's abatable coking coal mine methane emissions can be mitigated for less than USD20/tonne of carbon dioxide equivalent (tCO_2e). This is in line with global estimates from the International Energy Agency (IEA), demonstrating that costs should not be a barrier to methane mitigation.*
- *India should also prioritise lowering coking coal demand in steel through methods such as Electric Arc Furnace (EAF), scrap utilisation, and green hydrogen. Additionally, utilisation of coal mine methane (CMM) and coal bed methane (CBM) in the steel value chain itself can help lower coking coal demand and meet steel decarbonisation targets.*

Introduction

India's coking coal production is projected to increase significantly to meet the growing demand from its expanding steel sector. This increase in production, particularly from underground mining, is expected to raise methane emissions due to the higher methane intensity of coking coal and the deeper, more gas-rich reserves being accessed. To mitigate this, stronger policy support for methane abatement technologies is crucial. Supported by existing cost-effective technologies, India can drive action on this through policy mandates, operational guidelines, and pilot projects.

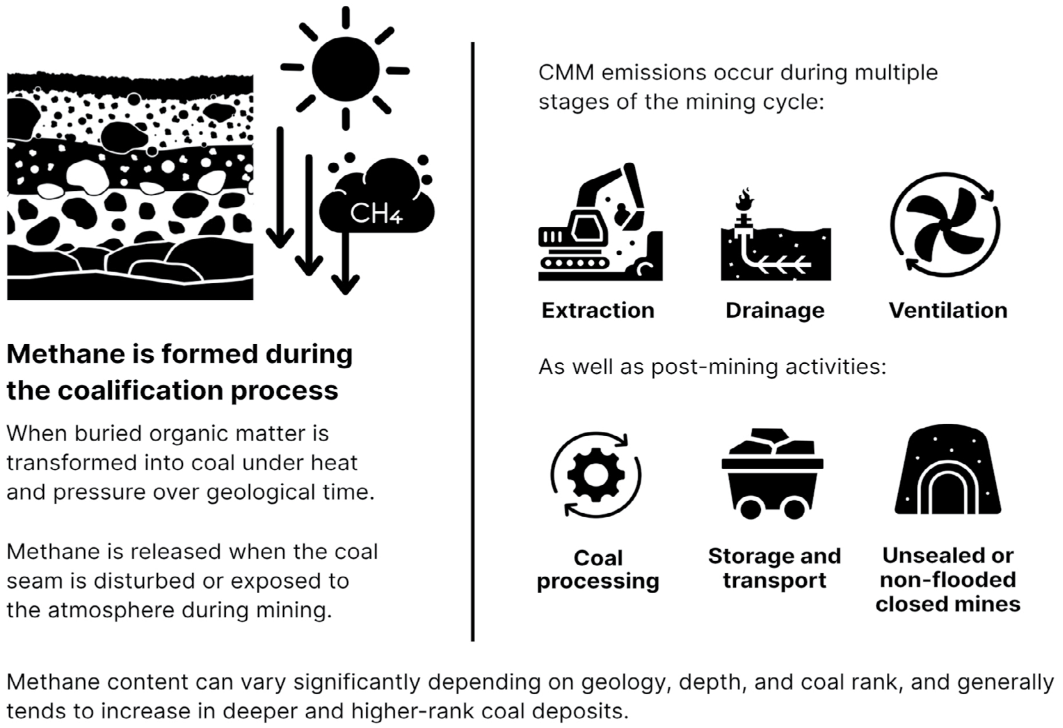
Why methane?

Methane is emerging as a critical but under-addressed component of India's climate challenge. While policy attention has majorly focused on carbon dioxide (CO_2) emissions, methane is also a significant contributor to the climate challenge and requires targeted mitigation measures. According to the Global Methane Pledge, "Methane has been responsible for 30% of total warming since the Industrial Revolution and is the second largest contributor to global warming after CO_2. Without action, global anthropogenic methane emissions are projected to rise by up to 13% between 2020 and 2030."

Methane is especially important for near-term climate action because it is a short-lived but highly potent greenhouse gas. The Intergovernmental Panel on Climate Change (IPCC) estimates that methane has a global warming potential (GWP) of 84–87 over 20 years (GWP20) and 27–30 over 100 years (GWP100). This means that even relatively small methane leaks can have a significantly high warming impact. The IPCC also notes that global methane emissions must be reduced by 30–60% below 2020 levels by 2030 to be consistent with least cost-pathways of limiting global warming to 1.5°C this century.

The energy sector, including oil, natural gas, coal, and bioenergy, is a major source of methane emissions. It accounted for over 40% of the total human-driven methane emissions of 375 million tonnes (Mt) in 2024. Other human-attributed methane-emitting sectors are agriculture and waste. Abatement of energy sector-related methane emissions is important from environmental and economic perspectives. It is considered the easiest to tackle among all human-attributed methane emissions as cost-effective technologies and operational processes can help manage and abate energy-sector methane emissions to a large extent.

Figure 1: Coal mine methane (CMM) during mining and post-mining activities



Within the sector, oil and gas operations account for 56% of methane emissions, followed by 29%, or an estimated 39Mt, from coal production. Within the industry, methane emissions from coal mines are referred to as coal mine methane (CMM). They offer a key abatement opportunity as existing technologies available can substantially reduce emissions. For India, this becomes more relevant as the country plans on adding to its existing coal mining operations, under various government targets.

CMM mitigation and abatement are particularly relevant for coking coal, which has a higher emission intensity than other coal types as it is often extracted from deeper, more methane-rich deposits. Emissions at these sites are also often the most cost-effective to reduce because of their high methane levels and economies of scale. This is particularly true for India, given the many proposed coking coal mines and the government's incentives for underground mining.

According to the International Energy Agency's (IEA) Global Methane Tracker 2026, India's coking coal mining resulted in around 234.7 kilotonnes (kt) of methane in 2025 with a methane intensity of 5.1kg CH_4 per tonne of coal equivalent (tCH_4/t coal), 50% higher than for steam coal, at 3.4kg.

Given its higher emissions intensity and expected increase in demand by the steel sector, methane abatement and mitigation will be essential for coking coal in India.

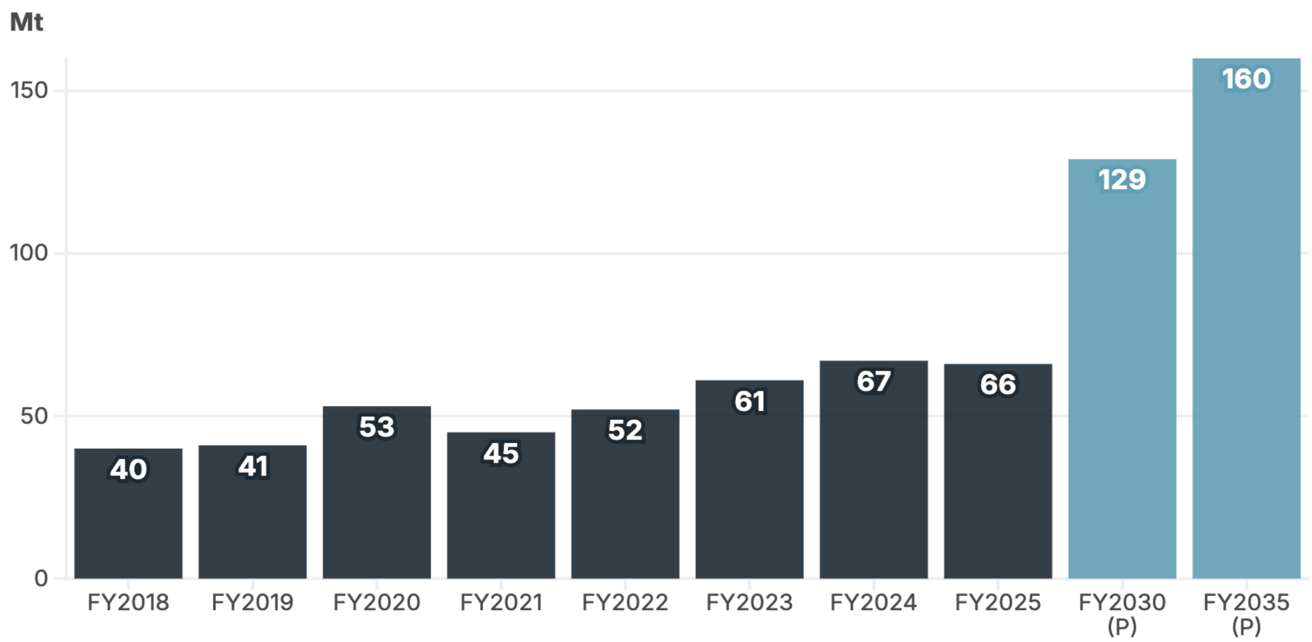
India's coking coal mining and emissions overview

A. Domestic coking coal production set to increase

Coking coal is a crucial raw material for steelmaking. The high ash component of India's domestic coking coal renders it unsuitable for use by the steel sector, making it dependent on imports. In financial year (FY) 2024–2025, India produced 66Mt coking coal, but also imported 58Mt, primarily for steel sector usage. Of the 66Mt, only 5.9Mt was washed and used for steelmaking. The remaining lower-grade coal and washery by-products were used in power generation (approximately 42Mt) and industrial applications such as foundries, chemicals, merchant coke production, and cement.

With India's plans to expand steel capacity to 300Mt per annum (Mtpa) by 2030, up from current 200Mtpa, demand for higher-quality coking coal is also expected to increase rapidly.

Figure 2: India's coking coal production: Historical trend and future projections



Source: Ministry of Coal, Crisil Intelligence.
Note: (P) represents projections from Crisil Intelligence estimates.

To counter the ongoing high import-dependence of the steel sector and to ensure adequate availability of domestic coking coal for the proposed expansion, the government initiated Mission Coking Coal in 2021. The Mission targets more than double the domestic coking coal output, taking it to 140Mt by FY2029–2030. Crisil Intelligence projects production to increase to even 160Mt by FY2034–2035. In January 2026, the government also notified coking coal as a "Critical and Strategic Mineral" under the Mines and Minerals Act, 1957. This is done to accelerate exploration and mining, including of deeper deposits, improve ease of doing business, and to attract greater private investment in beneficiation and mining technologies.

B. Methane emissions set to rise with underground mining

An increase in production of coking coal is also likely to raise CMM emissions, especially in the medium to long term when more underground mines are expected to become operational. This creates a need for stronger policy support for incorporation of methane abatement and mitigation technologies at this juncture so that methane emissions from expanded production can be controlled.

According to the IEA Global Methane Tracker 2026, methane emissions from coking coal mines in India are estimated to be around 234.7kt against the 1,792.73kt from steam coal mining. While this seems a small contribution in absolute terms, coking coal mining is substantially more methane-intensive. On output-adjusted basis, it emits around 5.1kg tCH_4/t coal, compared to 3.4kg for steam coal. This is also reflected at the mine level. An assessment of 30 operating coking coal mines shows that while the 30 mines account for about 3% of India's total coal production, they contribute to 12% of total coal mining based CMM in the country.

Even globally, coking coal share in overall coal production as per IEA 2022 data was only 12% while it contributed to around 25% of overall CMM (around 10Mt). This higher intensity is driven by geological and operational factors and by the limited methane measurement options available for surface mines. Coking coal deposits are typically deeper and more gas-rich, leading to higher methane concentrations. In addition, underground mines require continuous degasification and ventilation systems, resulting in higher operational methane emissions. Surface mines, on the other hand, release methane over a large surface area during coal extraction.

India's current coking coal production remains overwhelmingly surface-based with 97% production coming from surface mining. However, there are plans to start refocusing on underground mining to achieve balanced production from both types of mines and access higher quantity and quality reserves. The 2021 Inter-Ministerial Committee (IMC) report on augmenting domestic coking coal highlighted that underground mining could produce higher-quality coal and recommended tax and financial incentives to support it. In addition, government is also looking at policy and auction-linked fiscal incentives such as lower revenue share (2% from earlier 4%), waiver of upfront payments, and lower performance security to promote underground mining. Coal companies are also adopting mass production technologies, Mine Developer and Operator (MDO) models, and reopening abandoned underground mines to further scale up underground mining.

Coking coal reserves in the country are increasingly available in deeper mines now. As shown in Table 1, only around 35% of these reserves in India fall within the 0–300 metres(m) range suitable for open cast mining. Reserves deeper than 300m constitute 41% and need underground mining. The remaining 25% are in the Jharia coal field (with a total of 23 underground mines and nine surface mines) where limited data makes it difficult to distinguish reserves up to 300m, resulting in a broader 0–600m classification.

Table 1: Depth-wise share of coking coal reserves in India (Mt)

Depth of coal reserve (m)	Proved (Mt)	Indicated (Mt)	Inferred (Mt)	Total (Mt)	Share of total reserves
0–300 (excluding Jharia coal field)	9,092	3,893	36	13,021	35%
0–600 (only Jharia coal field)	9,154	87	-	9,241	25%
300–600	2,629	5,046	737	8,411	22%
600–1200	2,603	2,761	1,335	6,699	18%

Source: Ministry of Coal, Coal Directory FY2024–2025, IEEFA.

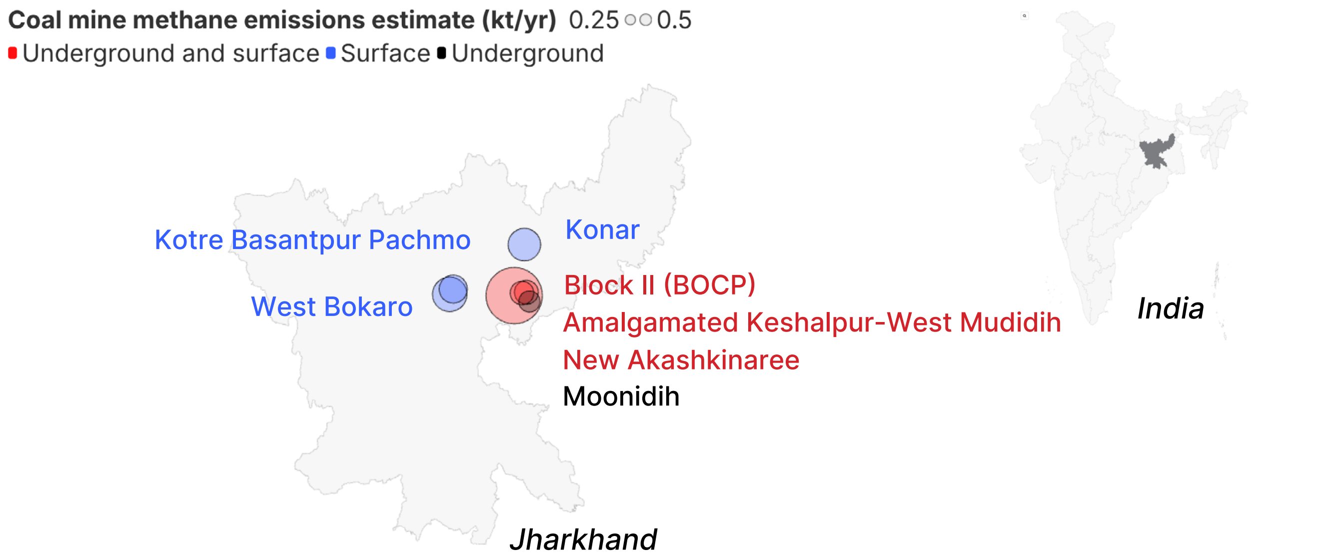
More underground mining, as expected in the next few years, also means higher methane emissions. CMM from global coking and non-coking coal production was 39Mt in 2025, with underground mining contributing to 70% of these overall methane emissions. Underground coal mining is even more methane-intensive for coking coal. Of the 10Mt global coking coal mining emissions, underground mines emit 8.6Mt or 85% of all coking coal-related methane emissions while surface mines are responsible for the remaining 15%.

The amount of methane released depends on various geological and operational factors, mostly mine depth, coal type, and mining method. In general, underground mines are considerably more methane-intensive than surface mines because deeper coal seams tend to contain higher concentrations of methane under geological pressure. This suggests that methane emissions may not rise in line with production alone: even a gradual increase in coking coal production could lead to a sharper rise in methane emissions as future supply increasingly comes from deeper and more methane-rich reserves.

C. Assessment of top-emitting coking coal mines in India

An analysis of India's mine-level coking coal data of 30 operating mines (based on Global Energy Monitor (GEM) and ClimateTRACE databases) shows that higher methane emissions are concentrated in a relatively small number of mines. Of these, seven high-emitting mines account for 138.3kt, or 81%, of the combined 170kt emissions from all 30.

Figure 3: Geographical concentration of methane-emitting coal mines in India (top 7)



Source: IEEFA analysis, GEM coal tracker

Of these 30 mines, 28 are located in Jharkhand, making the methane risk and its abatement potential geographically clustered and targeted to specific regions.

Table 2: Methane emissions from high-emitting coking coal mines in India (Operational)

Mine name	Owners	Prod-uction (Mtpa)	Mine type	Mine depth (m)	State	CMM emiss-ions esti-mate (kt)	Emission intensity (tCH4/t coal)*
Block II Open Cast Project (BOCP)	Bharat Coking Coal Ltd. (BCCL)	5.35	Under-ground and Surface	250	Jharkhand	56.2	0.011
West Bokaro	Coal India; Tata Steel	7	Surface	50	Jharkhand	21.1	0.003
Konar⁺	Central Coalfields Ltd.	5.35	Surface	60	Jharkhand	18.8	0.004
Kotre Basantpur Pachmo^	Central Coalfields Ltd.	4	Surface	60	Jharkhand	14.1	0.004
Amalgamated Keshalpur-West Mudidih (AKWMC)	BCCL	2.71	Under-ground and Surface	60	Jharkhand	10.2	0.004
New Akashkinaree	BCCL	1.44	Under-ground and Surface	130	Jharkhand	9.9	0.007
Moonidih	BCCL	0.49	Under-ground	650	Jharkhand	8	0.017
Total		26.34				138.3	

Source: IEEFA analysis based on Ministry of Coal, ClimateTRACE, and GEM, May 2026 data.
**Note: Emission intensity (in tCH_4/t coal) measures methane emitted per tonne of coal and is independent of total production. It is calculated using data available in GEM data for methane gas content (m^3/t), emission factor coefficient, and 7.16×10^{-4} as converting factor to change methane in volume to mass.*
⁺Note: Konar coal mine is both a coking coal and a thermal coal mine.
^Note: Data for Kotre Basantpur Pachmo Coal Mine has been taken from the proposed mines section of GEM, May 2026 data as it has become operational as per government sources.

D. Emissions from proposed mines will increase methane risk

Along with emissions from operating mines, it is also critical to understand the emission potential of proposed mines. This analysis considers coking coal mines allocated through government auctions as listed in National Institute of Advanced Studies (NIAS) report Enhancing Domestic Coking Coal Availability to Reduce the Import of Coking Coal (2024). The mines in the table below are the allocations made under Coal Mines (Special Provisions) Act (CMSP) Tranches 12–15 and Mines and Minerals (Development and Regulation) Act (MMDR) Tranches 2–5 to private companies. These are expected to become operational in FY2027–2031.

Some mines, such as Basantpur and Choritand Tiliaya, are excluded due to data limitations. Additionally, the coking coal mines from the most recent auction, MMDR9, including Babupara East, Duni Central, Lalgarh South, Lamatola, and South of Damuda (most of them in Jharkhand) were excluded because their Peak Rated Capacity (PRC) has not been determined yet.

Table 3: Methane emissions for proposed coking coal mines with high estimated emissions

Mine name	Owners	Capa-city (Mtpa)	Mine type	Mine depth (m)	State	Year–mine opera-tional	CMM emiss-ions esti-mate (kt)	Emiss-ion inten-sity (tCH_4/t coal)
Rabodih OCP	Twenty First Century Mining Private Ltd.	2.5	Surface	50	Jharkhand	2026	1.6	0.001
Jitpur*	Terri Mining Private Ltd.	2	Surface	60	Jharkhand	2030	7	0.004
Parbatpur Central	JSW Steel Ltd.	1.24	Under-ground and Surface	60	Jharkhand	2026	3.4	0.004
Beheraband North Extension*	Auro Coal Private Ltd.	1	Surface	60	Madhya Pradesh	2028	2	0.004
Lalgarh North	Adhunik Power and Natural	1	Surface	60	Jharkhand	2030	3.2	0.004
Jogeshwar & Khas Jogeswar	South West Pinnacle	0.6	Surface	60	Jharkhand	2027	2.1	0.004
Sitanala	JSW Steel Ltd.	0.3	Under-ground	300	Jharkhand	2026	3.5	0.012
Total		8.64					22.8	

Source: IEEFA analysis based on NIAS and GEM, May 2026 data.
Note: Methane emissions data for Jitpur and Beheraband North Extension was taken from GEM 2025 database.*

As new mines are long-term investments, deeper, methane-heavy mines developed today could lock in higher emissions for many years, especially if abatement measures are not built in from the start.

E. Emission intensity and the role of mine characteristics

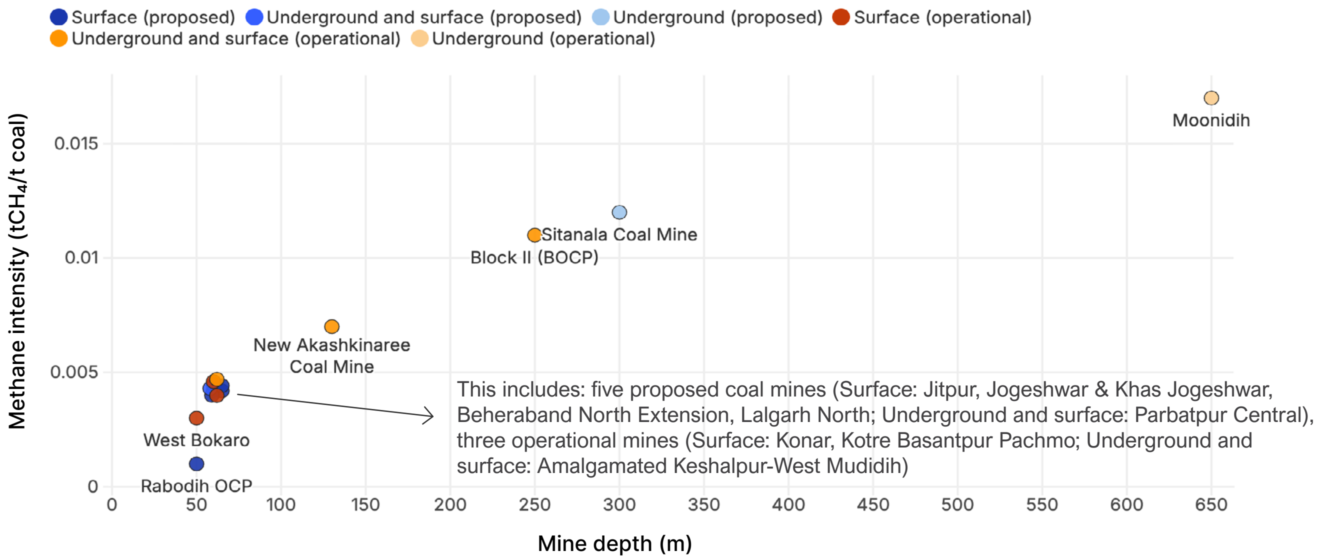
The mine-level data also further emphasises that methane risk is shaped not only by coal production, but also by geological and operational factors such as mine depth, methane gas content, and mining method.

As shown in Figure 4, there is a clear positive relationship between mine depth and methane emission intensity:

- Surface mines at depths of 50–60m show low emission intensities (0.001–0.004 tCH_4/t coal)
- Underground mines at 250–300m show significantly higher intensities (0.011–0.012 tCH_4/t coal)
- The deepest mine, Moonidih (650 metres), shows the highest emission intensity (0.017 tCH_4/t coal)

This indicates that future methane emissions will not only increase in line with coking coal production, but also that a gradual increase in production from deeper, methane-rich reserves could result in a disproportionately higher methane emission.

Figure 4: Emission intensity vs. depth, proposed mines and operating mines



Source: IEEFA analysis based on NIAS, ClimateTRACE, and GEM, May 2026 data.

Coal mining methane abatement

A. Established abatement measures

Methane abatement in coal mining refers to capturing, using, or destroying methane before it is released into the atmosphere. The IEA estimates that more than half of global CMM emissions can be reduced using existing technologies, often at low or even negative cost where the gas can be used within the mining facilities. The UN Environment Programme (UNEP) forecasts that for the projected 43Mt of global coal mine methane emissions in 2030, 25Mt (60%) is readily abatable at a low cost using existing measures and technologies.

CMM emissions arise from a mix of vented emissions (intentional releases for safety or operational reasons), incomplete combustion (methane slip from flares, engines, or oxidation systems), and fugitive emissions (unintentional leaks).

The IEA groups CMM abatement measures based on where emissions originate in the mining process, including degasification systems, ventilation systems, and other CMM sources:

1. **Degasification systems:** Degasification wells and drainage boreholes can capture methane in coal reservoirs. They target high-concentration methane extracted through drainage systems, especially if planned at the start of a mining project. The captured gas can be utilised or flared depending on its concentration and mine characteristics.

    - **CMM utilisation:** Methane is extracted from coal seams using pre- or post-drainage systems before or during mining. Where gas concentration is high enough, it can be used to generate power or heat for the mining operations, creating a revenue stream that can result in low or negative abatement costs.

    - **Flaring:** Methane is combusted where utilisation is not feasible, converting it into CO_2 and reducing its climate impact. It is typically used as a fall-back option and does not generate revenue. It is applied to mines with annual emissions of less than 1kt or as an emergency measure for safety purposes.

2. **Ventilation systems:** Underground mines use ventilation systems to move fresh air through the mine to lower methane concentration as a safety measure. While the ventilation exhausts have highly diluted methane emissions, they are still the largest source of CMM due to the high flow rates. Ventilation air methane (VAM) can be blended to use as an energy source or oxidised to destroy the fugitive methane to lower environmental impact.

    - **VAM oxidation:** Thermal or catalytic oxidation technologies are used for very low methane concentrations (0.25%–1.25%). This enables VAM destruction and reduces climate impact. This approach is typically applied in mines with a methane intensity below 10 kgCH_4/t of coal or total annual CMM emissions below 10kt.

    - **On-site recovery and use:** This measure applies to mines where methane concentrations and total emissions are above the thresholds established for VAM oxidation. Oxidation technologies allow for heat recovery and utilisation on site and VAM can also be used as a supplementary fuel for combustion of boilers and turbines.

3. **Other CMM sources:** These measures address remaining emissions across the mine system such as those in post-mining activities or through incomplete combustion.

    - **Efficiency improvements:** These focus on reducing methane losses during existing abatement processes such as flare or VAM and ensure proper combustion and minimise leaks or inefficiencies in equipment.

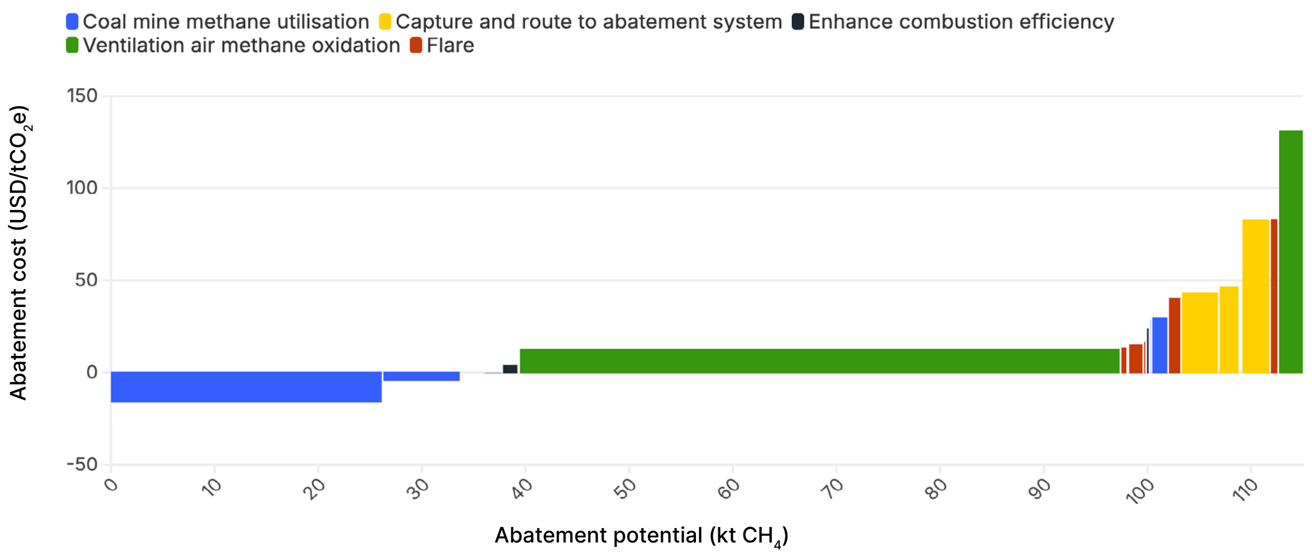
    - **Capture and route:** This method is crucial for reducing fugitive emissions that escape from coal mines by monitoring potential sources of emissions. This includes capturing or sealing fugitive sources and directing them to drainage or VAM abatement systems.

B. Methane abatement cost for Indian coking coal mines

While a range of methane abatement technologies are available, understanding how they compare in terms of economic viability and abatement potential is critical to identifying the most practical pathways for reducing methane emissions in India's coal sector.

To analyse costs in the Indian context, this briefing note uses data from the IEA Methane Tracker which provides estimates of methane savings (abatement potential) and costs by technology for the coal sector and interpolate it to the coking coal sector. Using this data, a marginal abatement cost curve (MACC) has been constructed which helps compare different technologies based on their cost and emissions abatement potential specifically for the Indian coking coal mining sector. This MACC can be a valuable decision-making tool for coal mining companies to cut their methane emissions with lowest-effort and highest-impact abatement technologies.

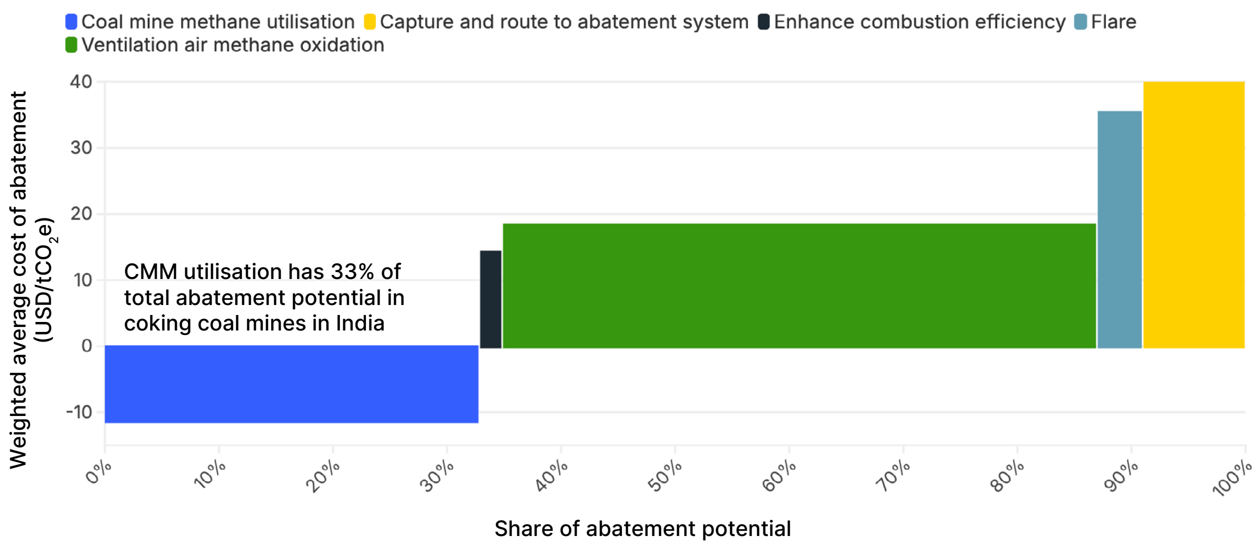
Figure 5: Marginal abatement cost curve (MACC) for methane emissions from coking coal in India



Source: IEEFA analysis based on IEA Global Methane Tracker 2026.
Note: IEA global methane tracker provides 24 potential abatement estimates for coking coal in India, which have been used for the graph above.

A technology-level average abatement cost curve has also been created using the same India-specific coking coal data from the IEA Global Methane Tracker. This allows stakeholders to identify technology options that are lowest-cost or most revenue-generating, and which require policy support in India. Notably, [according to IEA, 90% of abatable global CMM would cost less than USD20/tCO$_2$e to mitigate] (at GWP100 of methane). Even for India's coking coal mines, 87% of abatable CMM would cost less than USD20/tCO$_2$e.

Figure 6: Technology-level average abatement cost curve for coking coal mining methane emissions in India



Source: IEEFA analysis based on IEA Global Methane Tracker 2026.

CMM utilisation has a negative average cost (–USD11.9/tCO_2e), meaning the methane captured via degasification or drainage can generate revenue and help recover costs when it is sold or used as fuel. This alone makes up 33% of the total abatement potential in coking coal mines in India.

VAM oxidation accounts for 52% of total abatement potential and an average cost of USD18.9/tCO_2e. Therefore, implementing VAM oxidation would need a carbon price or policy push to be utilised in the price-sensitive Indian context.

Flaring and capture and route are the two most expensive options among abatement technologies with an average cost of USD35/tCO_2e, and USD45/tCO_2e respectively and an abatement potential of only 13% combined.

C. Abatement measures for top-emitting operational and proposed coking coal mines

A closer look at the top-emitting mines shows that total potential methane reduction is around 105kt CH_4 per year from just seven mines, with the majority coming from underground operations due to higher methane concentrations. VAM oxidation and on-site methane recovery and utilisation are actively being used as abatement measures in high-emitting mines. This highlights the need to prioritise abatement potential of proposed underground assets as well. While abatement measures for surface mines were not available, the capture and route option can show significant abatement potential compared to flaring.

Table 4: Abatement strategy and emissions reduction potential for high methane-emitting coking coal mines operational in India

Mine name	CMM emissions estimate (kt)	Abatement measure	Description	Total emissions reduced per year (kt CH_4)
Block II (BOCP)	56.2	On-site recovery and use	If methane concentrations are high enough, ventilated methane can be used for heat recovery and used on-site	35.7
West Bokaro*	21.1	Capture and route	Identifying and sealing leak points to reduce fugitive emissions and directing them to drainage or VAM abatement systems	21
Konar*	18.8	Capture and route	Identifying and sealing leak points to reduce fugitive emissions and directing them to drainage or VAM abatement systems	18.7
Kotre Basantpur Pachmo*	14.1	Capture and route	Identifying and sealing leak points to reduce fugitive emissions and directing them to drainage or VAM abatement systems	14
Amalgamated Keshalpur-West Mudidih (AKWMC)*	10.2	VAM oxidation	Thermal or catalytic oxidation of ventilated air methane	6.1

New Akashkinaree	9.9	VAM oxidation	Thermal or catalytic oxidation of ventilated air methane	3
Moonidih	8	VAM oxidation	Thermal or catalytic oxidation of ventilated air methane	6.5
Total emissions reduced per year (kt CH_4)				105

Source: IEEFA based on ClimateTRACE data.
**Note: No abatement strategy mentioned for the West Bokaro, Konar, Kotre Basantpur Pachmo, and AKWMC coal mine in ClimateTRACE data. Since West Bokaro, Konar, and Kotre Basantpur Pachmo are surface-level mines, it is assumed that capture and route is the most feasible abatement measure that will help reduce emissions significantly and cost less than the flare option. For AKWMC, VAM oxidation has been assumed due to its underground mining operations, where methane is primarily emitted through ventilated air. The emission reduction has been calculated using the ClimateTRACE methodology to calculate the emissions factor scaling ratio which is multiplied with mine-level emissions to calculate emission reduction.*

Similarly, deploying various abatement measures from the outset of operations for top-emitting proposed mines has a high abatement potential. The table below shows that six proposed mines in Jharkhand could together reduce methane emissions by almost 20kt CH_4 per year by deploying abatement measures such as capture and route, VAM oxidation, and flare. These measures have been selected based on mine type, depth, methane emissions intensity, and methane gas content.

Table 5: Methane abatement strategy and emissions reduction potential for proposed high-emitting coking coal mines in India

Mine name	CMM emissions estimate (kt)	Assumed abatement measure	Emission factor scaling ratio	Total emissions reduced per year (kt CH_4)
Rabodih OCP	1.6	Capture and route	0.99	1.59
Jitpur	7	Capture and route	0.99	6.97
Parbatpur Central	3.4	VAM oxidation	0.80	2.72
Beheraband North Extension	2	Capture and route	0.99	1.99
Lalgarh North	3.2	Capture and route	0.99	3.19
Jogeshwar & Khas Jogeshwar	2.1	Flare	0.89	1.88
Sitanala	3.5	VAM oxidation	0.60	2.09
Total emissions reduced per year (kt CH_4)				20

Source: IEEFA based on ClimateTRACE data.
Note: The abatement measures for the proposed mines have been calculated using the ClimateTRACE methodology. An emission factor scaling ratio is first calculated for each mitigation option as [1 – (share of emissions from the source × abatement effectiveness of the measure)]. This ratio represents the share of total mine methane emissions that can be reduced through the selected abatement measure. It is then multiplied with mine-level emissions to estimate the emissions reduction potential.

The analysis highlights substantial methane abatement opportunities across the proposed mines using a combination of capture and route, VAM oxidation, and flaring technologies. Capture and route at Rabodih OCP, Jitpur, Beheraband North Extension, and Lalgarh North could achieve methane mitigation of around 99%, together reducing approximately 13.7kt CH_4 annually. Parbatpur Central and Sitanala could reduce methane emissions through VAM oxidation by an estimated 80% (2.7kt CH_4) and 60% (2.09kt CH_4), respectively, while Jogeshwar & Khas Jogeshwar could achieve 89% methane reduction (1.8kt CH_4 annually) through flaring.

In total, the identified opportunities could reduce approximately 20kt CH_4 per year, subject to site-specific validation of methane concentrations, infrastructure requirements, and operational conditions.

Recommendations

1. Prioritise mitigation in deep and methane-intensive coking coal mines

Methane mitigation should focus on deep, underground, and methane-intensive coking coal mines that have the highest emissions intensity and abatement potential as seen in the case of China and Indonesia. As per IEA, China, with 90% of its coal coming from underground mines, has a methane abatement potential of 65% versus Indonesia's mere 25% abatement potential as 90% of its coal comes from surface mines. Moreover, emissions at underground sites are often the most cost-effective to abate due to their high methane concentrations and economies of scale. Hence, proposed and upcoming coking coal mines should integrate methane monitoring and mitigation systems at the planning stage itself.

As abatement measures vary based on mine type, depth, emission intensity, and methane gas content, a targeted approach would be more cost-effective than uniform measures across all coal operations.

Recommendation: A phased mitigation roadmap, starting with the highest-emitting mines in states such as Jharkhand would be more practical than applying uniform solutions across all coking coal operations. This approach will allow India to build technical capability, infrastructure, and experience before scaling up across the sector.

2. Conduct pre-feasibility studies for methane mitigation measures

The IEA estimates that more than half of global CMM emissions could be avoided with existing technologies, although feasibility depends on mine-specific conditions. Hence, mine-level pre-feasibility studies can help assess the technical, financial, and environmental impact of the abatement measure suitable to the mines in question. To expand the use of different measures such as degasification systems, VAM, or methane capture and utilisation, pre-feasibility studies of CMM for mines must be undertaken, especially for all upcoming mines.

Such studies have previously been undertaken for mines such as Sawang (East Bokaro) supported by the Global Methane Initiative and US Environmental Protection Agency (EPA). India can also build on its existing pilots such as BCCL's Moonidih mine and feasibility studies supported by Central Mine Planning and Design Institute (CMPDI), Ministry of Coal, and the US EPA.

Recommendation: Scaling pre-feasibility studies through India's pilot projects and greater private sector participation is essential to move from demonstration of methane abatement measures to successful deployment.

3. Integrate methane abatement into Mission Coking Coal

Integrating methane into broader coal and energy policy will help ensure that efforts to enhance domestic coking coal supply do not lock in higher emissions. Instead of treating methane mitigation as a separate policy action, India should embed it into Mission Coking Coal, underground mining expansion, and mine approvals.

IEA's regulatory roadmap and toolkit highlights that if coal production is under the purview of state-owned companies, government agencies may be able to exercise greater influence over methane abatement through direct regulation. Given that Coal India Limited (CIL) and its subsidiaries are in control of a majority of coal production in the country, India is in a good position to drive methane action through policy mandates, operational guidelines, and pilot projects.

Additionally, strengthening technical capacity and international collaboration can support large-scale deployment of methane mitigation measures. India can build on its long-standing partnerships with organisations such as Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), the US EPA and the Global Methane Initiative, which have supported methane mitigation pilots, feasibility studies, and capacity-building over the past two decades.

Recommendation: India should embed methane mitigation into Mission Coking Coal, underground mining expansion, and mine approvals from an early stage, rather than treating it as a separate policy action.

4. Reduce long-term dependence on coking coal

Continued expansion of underground coking coal mining risks locking in high methane emissions for decades. Therefore, it is critical to reduce dependence on coking coal.

The steel sector remains one of the largest consumers of coking coal in India and the world.

According to Ember, coking coal mine methane adds 27% to the total climate impact of the steel industry globally. India should prioritise strategies to reduce future coking coal demand using alternative steelmaking technologies that use less coking coal. These include Electric Arc Furnace (EAF), scrap steel-based production, and domestically produced green hydrogen in Direct Reduced Iron (DRI).

The Indian government aims that by 2047, 50% of steel production would be fed by scrap metal, up from 23% at present. This will not only help in steel sector decarbonisation, but also reduce the need for coking coal mining, thus lowering CMM emissions from coking coal to a large extent. Using the scrap-based EAF method would require only 12 kg of coking coal versus 770kg of coking coal in the conventional blast furnace method.

Recommendation: India should prioritise strategies to reduce future coking coal demand through greater steel scrap utilisation, expansion of EAF capacity, and accelerated deployment of low-emission steelmaking pathways such as green hydrogen-based DRI.

5. Expand methane utilisation in industrial applications

Expanding productive uses for methane recovered from coal bed methane (CBM) and CMM can strengthen the commercial case for methane recovery and utilisation. CBM, which is extracted from unmined coal seams, is distinct from CMM, which is released during active mining operations. However, it offers a complementary opportunity to build methane utilisation markets.

Natural gas is already widely used globally as the primary reducing gas in DRI-based steelmaking. While there are no known commercial examples of using captured CMM or CBM for DRI production, they could become a potential domestic alternative in the future.

India has significant CBM potential, with 15 active CBM blocks that are being connected to the national gas grid. Organisations such as the Oil and Natural Gas Corporation (ONGC), CIL, and CMPDI have led their development. Along with power generation and industrial applications, the CMPDI has identified blast furnace injection as a promising application of CBM in the steel sector. This can reduce coking coal use in steel plants, and improve productivity and performance.

In 2022, Tata Steel became the first steel producer globally to undertake a pilot on continuous injection of CBM into a blast furnace at its Jamshedpur plant, demonstrating its potential to partially replace coking coal and reduce emissions. Wider adoption of such applications can reduce coking coal-dependence while creating productive end uses for methane.

Recommendation: Expanding productive uses for methane recovered from CBM and CMM can strengthen the commercial case for methane recovery and utilisation, especially in the steel sector where it can also improve productivity and lower imported coking coal demand.

Conclusion

As India pursues coking coal self-sufficiency, there is an opportunity to integrate methane abatement into mining operations before new high-emitting mines become operational. This would enable India to improve resource security while avoiding decades of abatable methane emissions. With proven technologies already available and most abatement achievable at relatively low cost, early action can strengthen the long-term sustainability and enable lower CMM emissions. Adopting methane mitigation measures in coking coal mining and utilising CMM and CBM in the steel value chain can not only contribute to reducing methane emissions but also help in meeting India's steel decarbonisation targets and achieving net zero by 2070.

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