COAL MINE METHANE

An Overview for Investors

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Environmental Defense Fund | BUSINESS

COAL MINE METHANE: SUMMARY

Coal mining emits methane, a major climate pollutant. Methane accounts for about a third of the warming experienced today. Coal mining is believed to emit ~42 Mt of methane annually, half as much as the oil & gas industry. Although coal mine methane (CMM) is well understood as a mining safety hazard, it has received less attention as a driver of climate change.

Most CMM is vented into the atmosphere. Underground mines drain gas and/or dilute and vent methane through ventilation shafts. Surface and abandoned mines also emit methane. However, CMM emission estimates remain uncertain in most countries, and more research is needed to improve measurement.

On average, CMM looks relatively inexpensive to abate — more expensive than oil & gas, but cheaper than agriculture or waste. This makes it a low-cost abatement option in the near-term as coal is phased out globally.

Metallurgical coal is a focal point for CMM mitigation. Compared to thermal coal, met coal mining is more methane intensive, is likely to be slower to phase out, and has a more integrated supply chain. As met coal emissions add significantly to the steel industry's footprint, CMM abatement should be an integral part of the transition to green steel.

Attention to CMM is increasing. While oil and gas has been the focal point for global action as the fastest and most cost-effective mitigation opportunity, evolving initiatives are likely to put a greater spotlight on coal.

The financial sector should engage with coal mining and steel companies on CMM. So far, most mining and steel companies lack incentives to reduce methane emissions and have limited to no disclosures or commitments around CMM. We suggest ways for investors to encourage action on this issue.

How investors should engage mining companies on CMM

General

- → Measure, quantify, report, and verify methane emissions from coal production at each site, rather than using emission factors.
- → Report details of methane abatement efforts, including capital expenditures.
- → Consider carbon markets as a source of financing for CMM abatement activities.
- → Support national and subnational policies that encourage CMM abatement.

Pre-Mining

- → When planning mining operations, prioritize lower-methane intensity seams.
- → Maximize drainage of methane prior to commencement of mining operations.

During/Post-Mining

- → Capture and use drained methane, where possible. Otherwise flare with high efficiency. Do not vent.
- → Eliminate ventilation air methane with methane destruction technologies such as regenerative thermal oxidizers (RTOs).
- → When phasing down mining operations, close higher methane intensity seams sooner.
- → Manage mine closures to minimize emissions and impacts on local communities.

How investors should engage steel companies on CMM

General

- → Incorporate primary data on coal-related methane emissions into GHG intensity calculations for steel products.
  - → Data should be based on empirical measurements rather than emission factors.
- → Adopt GHG reduction targets and transition plans that include CMM-specific measures.
- → Engage with reporting frameworks and emerging global initiatives to:
  - → Improve standards for monitoring, reporting, and verification (MRV) of CMM emissions at coal mines.
  - → More thoroughly incorporate CMM into steel companies' reporting requirements.
- → Develop "low-methane steel" products and engage with customers to promote these products.
- → Support national and subnational policies that encourage CMM abatement.

Supply Chain Engagement

- → Ask coal suppliers to measure CMM and provide the methane intensities of supplied met coal.
- → Encourage coal mine suppliers to reduce CMM emissions and offer financial support for doing so.
- → Signal a willingness to pay a premium for lower-methane coal.

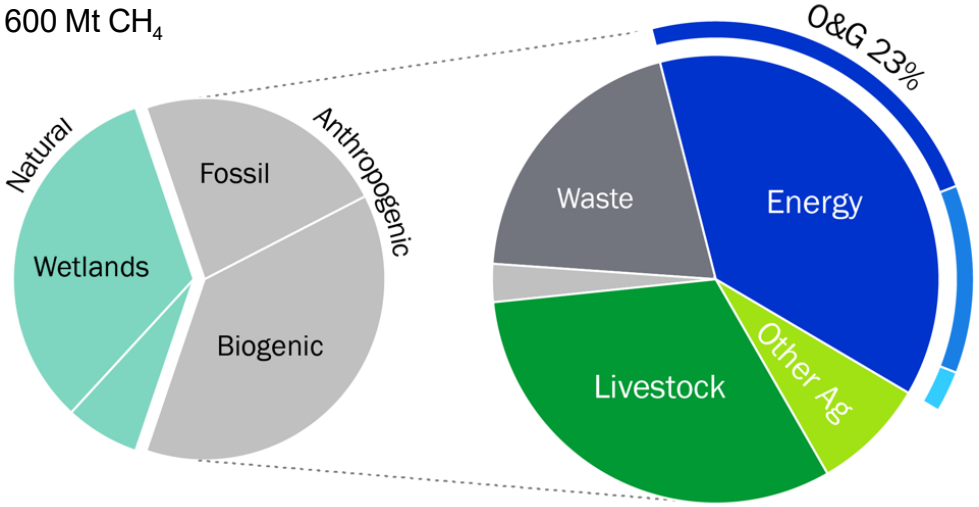

THE COAL MINE
METHANE
CHALLENGE

Coal mine methane: a 3.5 Gt CO_2e problem

Coal mine methane (CMM) is the second largest industrial source of methane emissions after oil and gas, but it has not attracted the amount of attention it deserves.

Global Methane Emissions

600 Mt CH_4



Coal 12%

42 Mt CH_4

*equal to**

1.2 Gt CO_2e — Over 100 years

or

3.5 Gt CO_2e — Over 20 years

(Equivalent to the emissions of 730 mil cars)

** Converting methane to CO_2 equivalent emissions poses challenges due to the different chemical properties of methane compared with CO_2, bringing different warming impacts and lifespans in the atmosphere.*

Source: U.S. EPA (2019a), IEA (2024a).

How is coal methane formed and released?

Methane is trapped within coal during the coal formation process, and its presence varies considerably depending on geology: methane content tends to increase with the depth and rank of coal. It is then emitted when the coal seam is exposed to the atmosphere.

The Coalification Process

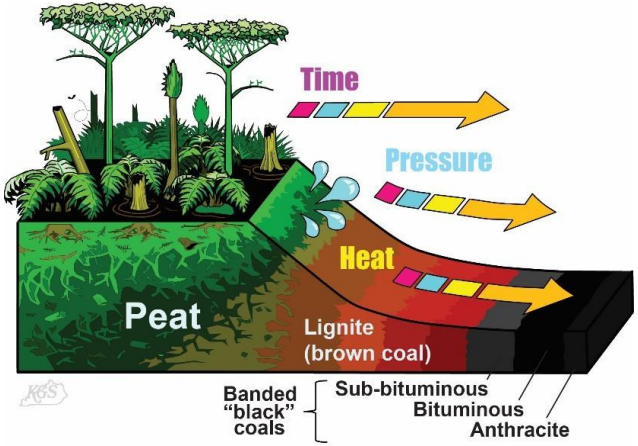
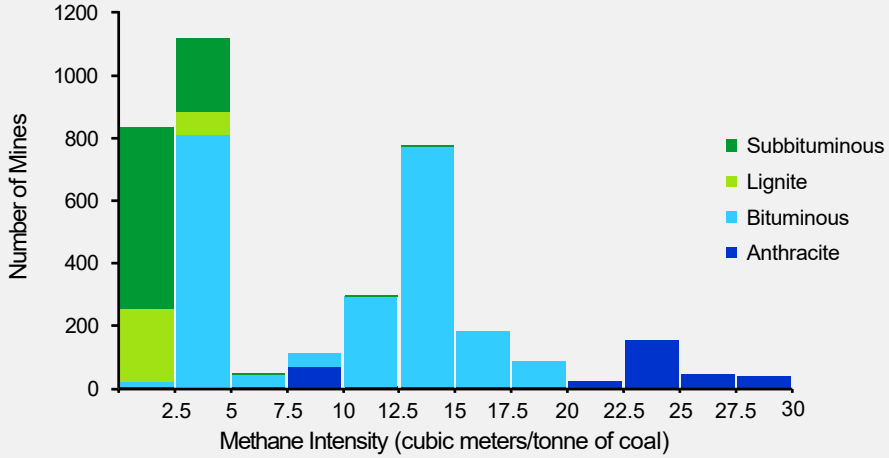


Image credit: Greb (2009).

Distribution of methane intensities at various mines, by rank

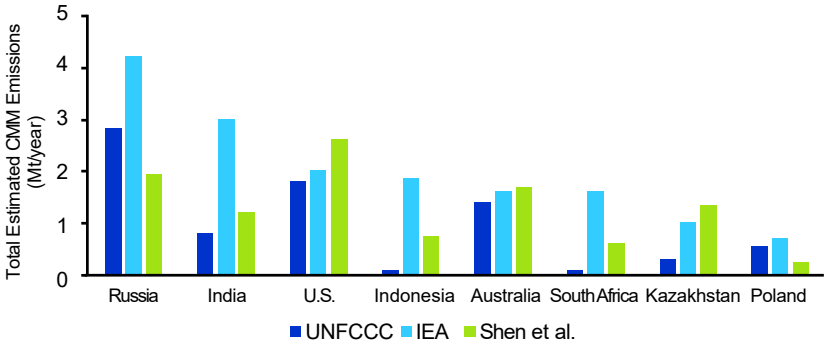


Source: Global Energy Monitor (2024). For an expanded version, see Appendix 1.

Measurement and reporting remain sources of uncertainty

Due to a lack of direct measurement and data reporting, most CMM estimates are based on bottom-up inventories using the IPCC's tiering system, with default emissions factors (EFs) established in the 1996 IPCC Guidelines (see Appendix 2). These vary widely from actual conditions, which can lead to large differences between official statistics and independent estimates.

Variation among estimates for selected countries:



Source: Ember (2023a), IEA (2024a), Shen et al. (2023), UNFCCC (2023).

CMM emissions are typically estimated using one of two approaches:

Top-down

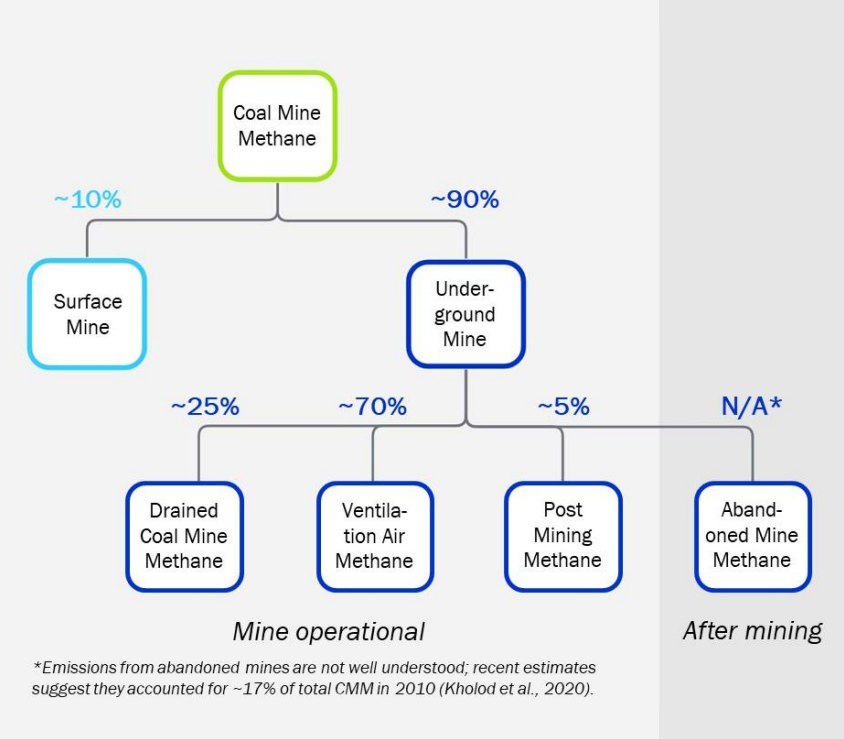
Tower, airborne, or satellite sensing of atmospheric methane concentrations are used to generate large-scale estimates.

Bottom-up

Sampled/continuous measurements are generalized into **emissions factors** (emissions per tonne of coal) for different types of deposits.

Image credit: European Space Agency, Pixabay.

Sources of CMM: underground VAM is largest source

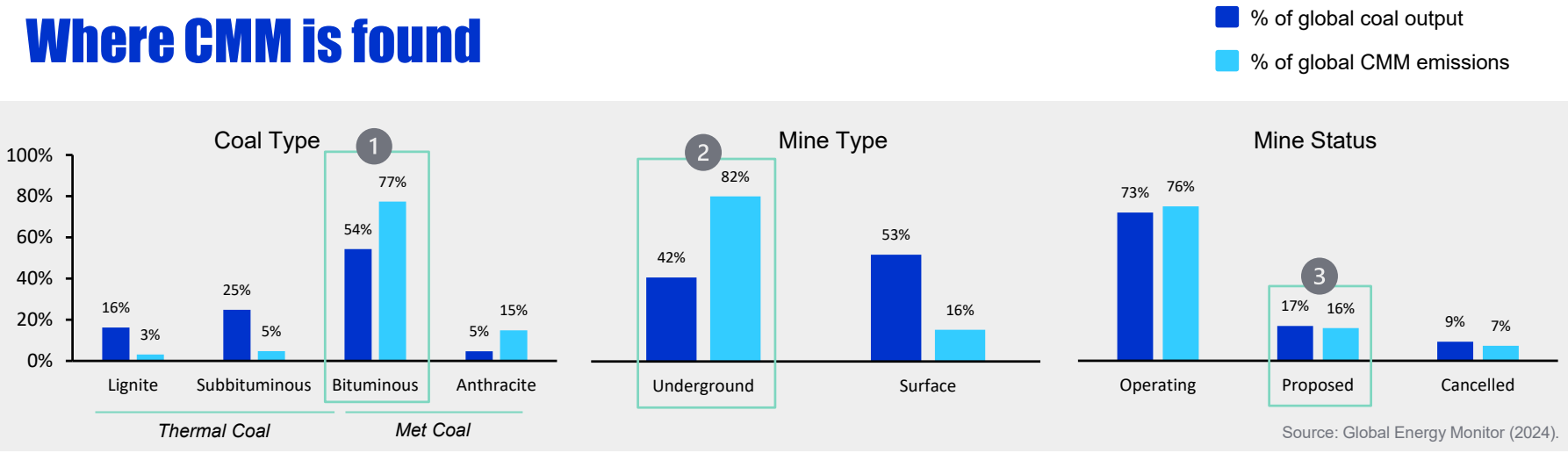


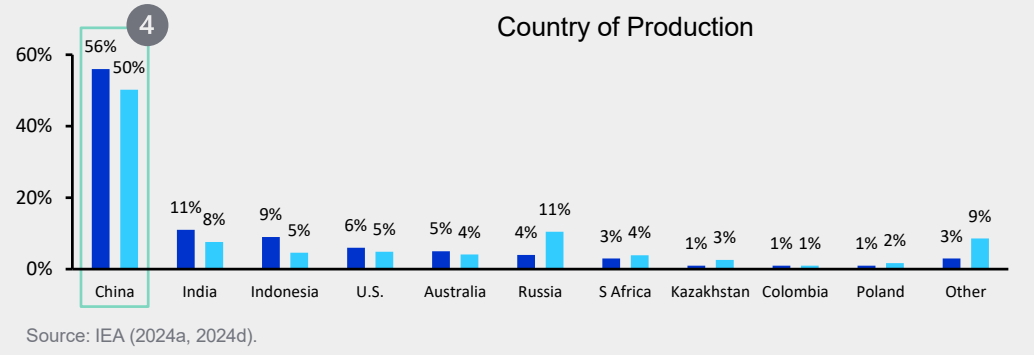
Adapted from Ember (2022).

- Underground mines are believed to represent approximately 90% of CMM emissions:
  - **Drained gas** represents ~25% of underground CMM. It is relatively high in concentration (>25% CH_4) and can often be utilized for power generation or taken away by pipeline. Much of the time, it is flared or vented.
  - **Ventilation air methane (VAM)** represents ~70% of underground CMM. It is low in concentration (<1% CH_4) and can be destroyed using regenerative thermal oxidizers (RTOs). Only a few RTOs are in operation today due to a lack of incentives.
- CMM is also emitted from surface and abandoned mines, as well as during transportation & processing after the coal has been mined. However, direct measurements are needed to better understand these emissions.

Source: Global Energy Monitor (2022), IEA (2024b), UNECE (2016), U.S. EPA (2019b).

Where CMM is found

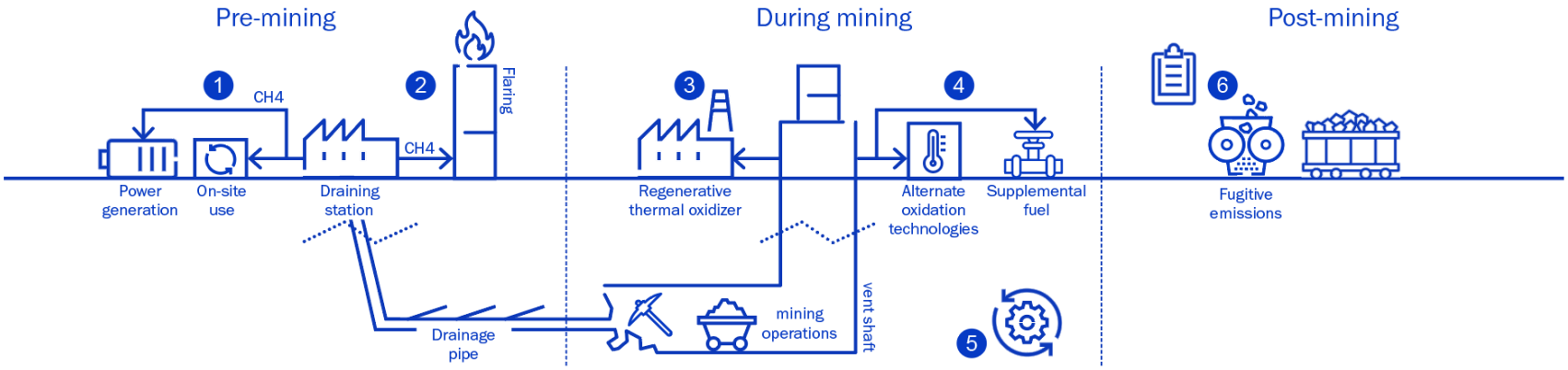




These estimates are subject to considerable uncertainty, as they are based on emissions factors. Key takeaways:

1. Met coal is considerably more methane intensive than thermal coal.
2. Underground mines contain far more methane than surface mines.
3. Proposed mines account for a meaningful portion of emissions.
4. China generates a large estimated share of CMM.

Understanding CMM abatement technologies



1 Drained gas utilization

Gas extracted from drainage boreholes can be injected into pipelines, used to generate electricity, or used on-site. This may also occur during and/or post-mining.

2 Flare

When there are no feasible alternative uses, drained gas can be flared, as it should not be vented. Flares should be high efficiency.

3 VAM oxidation

Between CH_4 concentrations of 0.25% and 1.25%, regenerative thermal oxidizers can destroy VAM. For details, see Appendix 4.

4 On-site recovery & use

Catalytic oxidizers operate at lower temperatures than RTOs. VAM can also be used as a supplemental fuel, combined with other feedstocks.

5 Efficiency improvements

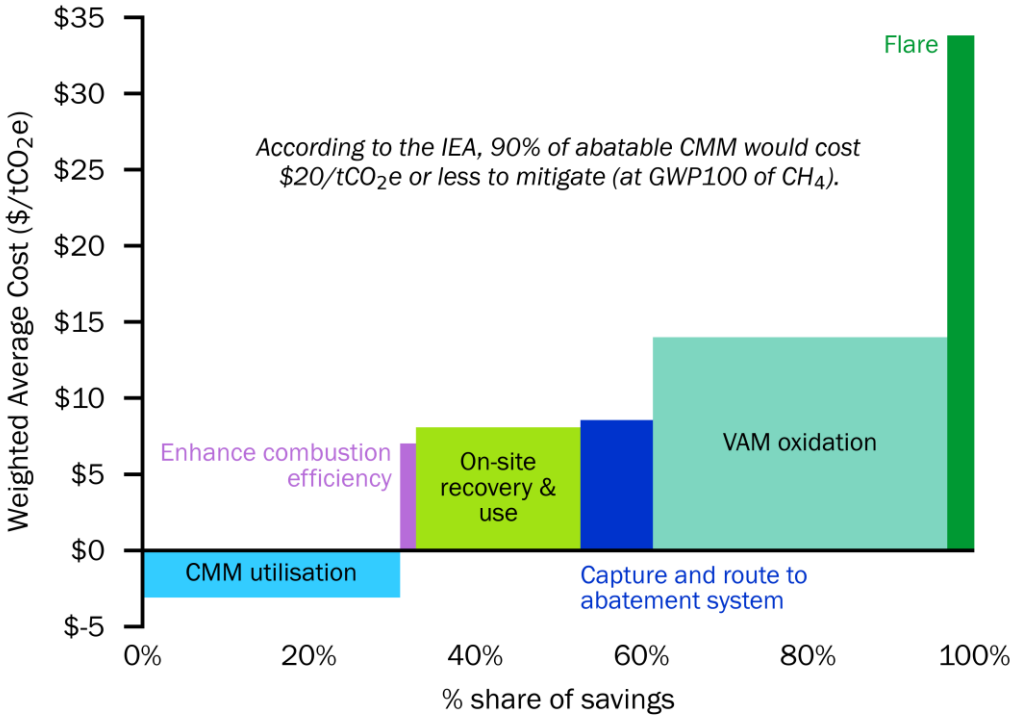
Measures can be taken to improve combustion and oxidation efficiencies as well as minimize losses from equipment.

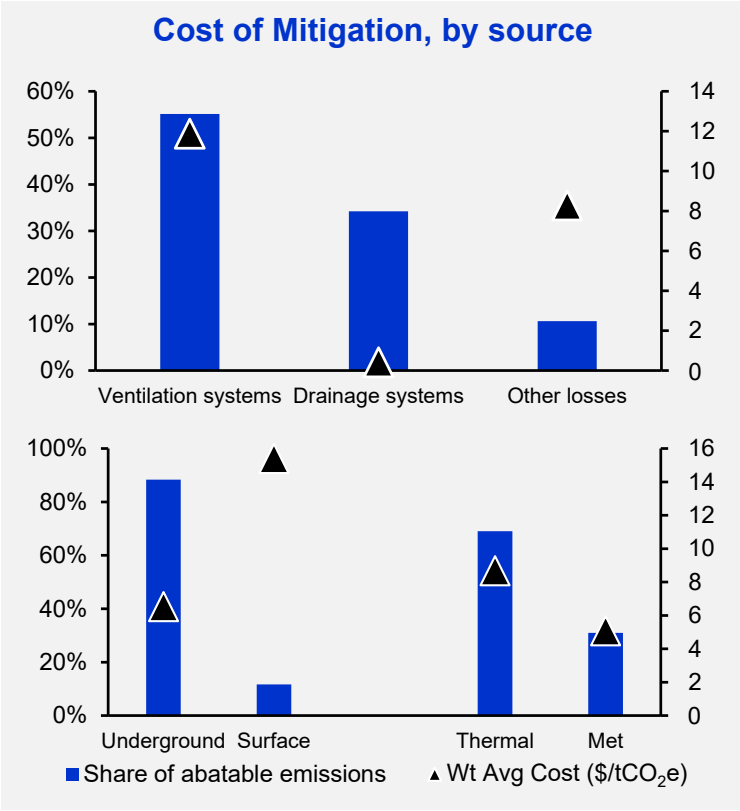
6 Capture and route

Fugitive emissions — such as from outcrops or post-mining activities — are monitored, captured, sealed, and/or routed to abatement systems.

Abatement technologies and definitions from IEA (2024b) and U.S. EPA (2019b). For more details, see Appendices 3 and 4.

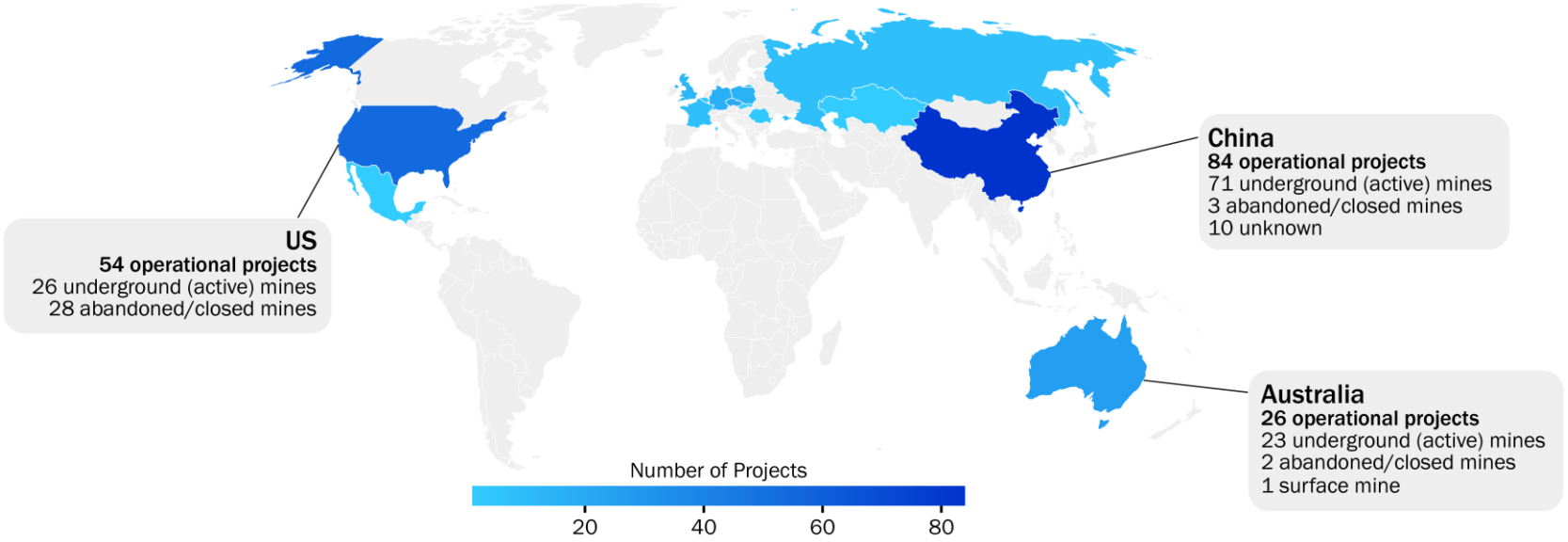
Estimating the cost of CMM abatement





Source: IEA (2024a). Converted using the IEA's GWP100 of 30. Note: The IEA model considers flaring only when there are no feasible alternatives, leading to low assumed utilization rates and high estimated costs.

Operational CMM abatement projects, as of 2024



The Global Methane Initiative (GMI) database, updated in July 2024, identifies 254 operational CMM abatement projects:

→ China has the most (84), followed by the U.S. (54) & Australia (26).

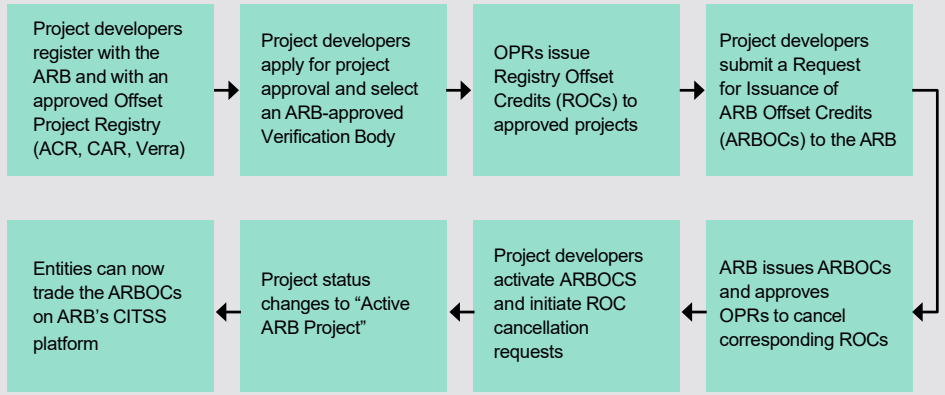
→ The majority (235) are drained gas, with just 19 known VAM abatement projects.

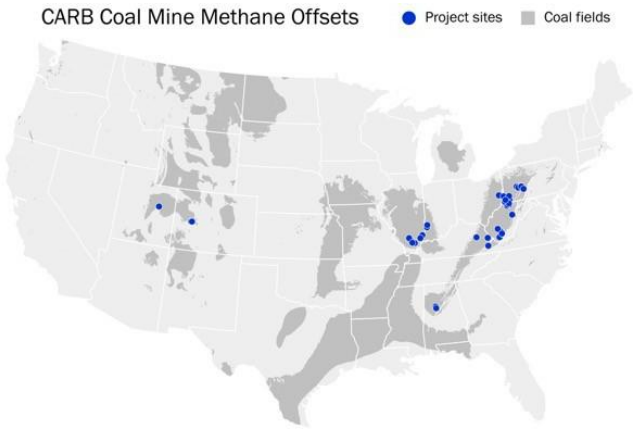
Source: Global Methane Initiative (2024).The GMI database may not include all CMM abatement projects globally.

Carbon markets can provide financing to abate CMM

California's Cap-and-Trade Regulation allows entities to fulfill 4% of their compliance obligations using offsets generated from approved Compliance Offset Protocols (3 for CMM). Projects can take place at underground, surface, or abandoned mines, but **must capture and destroy methane that would otherwise be vented** and "represent an end-use management option other than natural gas pipeline injection." Other mechanisms for generating carbon credits from CMM abatement include the Australian Carbon Credit Unit Scheme and the voluntary carbon market.

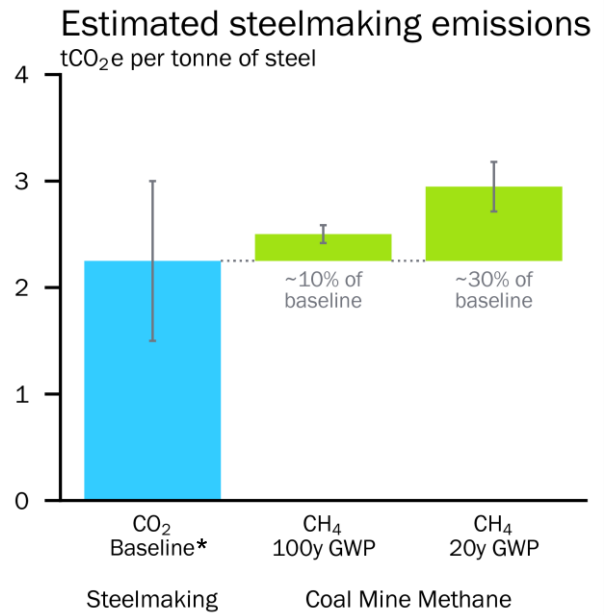
California Air Resources Board (CARB) Registration Process

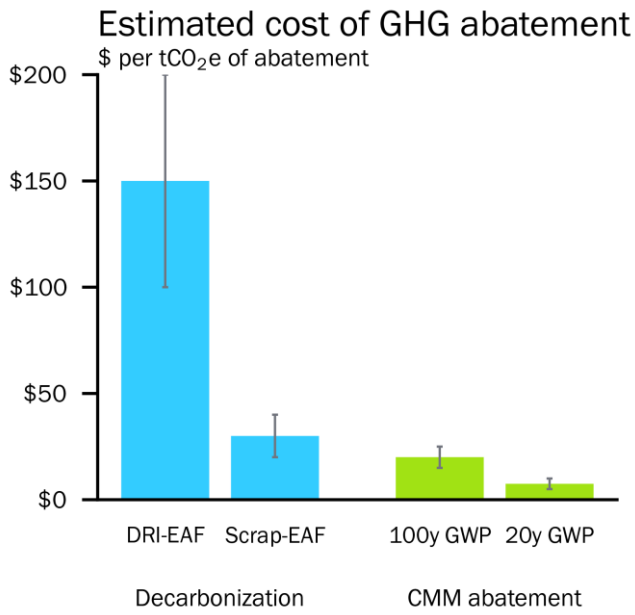




Source: American Carbon Registry (2024), California Air Resources Board (2024). For more information on carbon credits, see EDF's Carbon Credits 101 for Investors primer.

CMM adds significantly to steel's footprint: abatement should be an integral part of transitioning to green steel



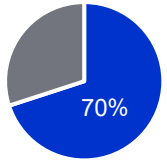


Source: BloombergNEF (2023), CRU (2020), Fan and Friedmann (2021), Hasanbeigi (2022), IEA (2024b), IEEFA (2022), Kasprzak et al. (in preparation), MPP (2022), SMA (2022), WEF (2023).

***Baseline**

Blast furnace - basic oxygen furnace (BF-BOF):
Coke from metallurgical coal is used to reduce iron ore into crude iron in a blast furnace. Crude iron is then converted into steel in a basic-oxygen furnace.

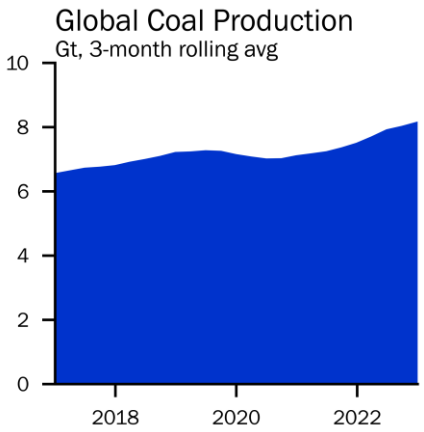
Share of global steel production:

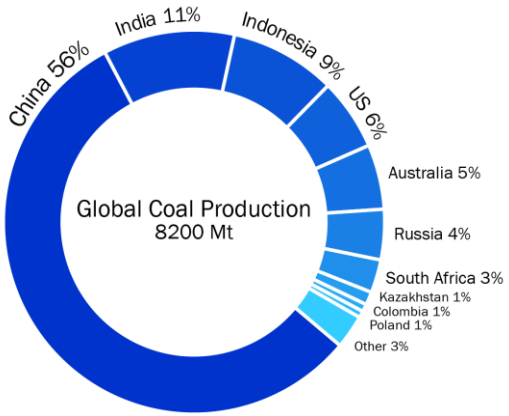


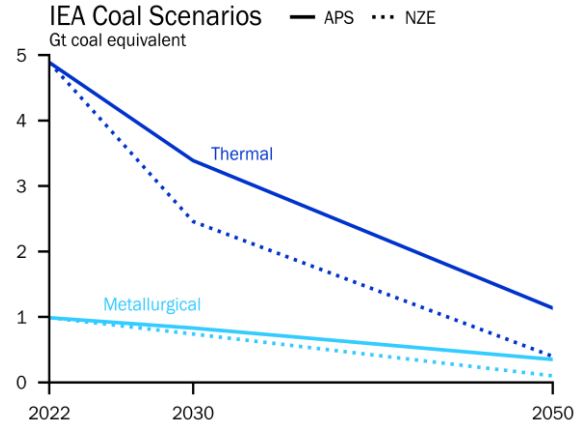
Scrap-EAF: Electric Arc Furnace, with scrap.
DRI-EAF: Direct Reduced Iron-EAF (using H_2).


GLOBAL BACKDROP,
CORPORATE ACTION,
AND POLICY

The global coal market: driven by Asia, slow to transition







→ **Production has surged in response to market disruptions** caused by the Covid-19 pandemic and the invasion of Ukraine, with China, India, and Indonesia together comprising ~75% of global production volume.

→ **The IEA's energy transition scenarios expect global coal demand to decline** by ~18% in 2030 and by ~43% in 2050. **Metcoal demand is projected to decline more slowly**, by ~10% in 2030 and by ~30% in 2050.

Source: IEA (2022, 2024d).

What are mining and steel companies saying about CMM?

	Company	Country	Scope 1 emissions attributed to CMM ($MtCO_2e$)	Coal Production (Mt, million tonnes)	CMM in Sustainability Report
Coal	Teck Resources	Canada	~0.8 29% of Scope 1	21.5	Fugitive CMM is one of 4 "opportunities for decarbonization" in 2022 Sustainability Report. Roadmap to Net Zero includes CMM abatement.
Diversified Mining	Anglo American	United Kingdom	4.2 ~51% of Scope 1	15.0	2022 Sustainability Report mentions that its "Steelmaking Coal business… transitioned production to new mining areas that generate lower methane concentrations."
	BHP	Australia	1.2 ~15% of Scope 1	42.8	"Improving the comprehensiveness and accuracy of methane emissions measurement" is noted; CMM poses "technical and economic challenges" to abatement.
	Glencore	Switzerland	2.6 ~16% of Scope 1	110.0	"Targeting a 15% emission reduction by 2026 and a 50% reduction by 2035 across its global mining business." No CMM-specific disclosures or targets are provided.
	JSW	Poland	5.5 ~72% of Scope 1	14.1	Identifies ventilation methane as "main source of GHG emissions following from the Groups' operations." Several methane reduction projects underway.
Steel	ArcelorMittal	Luxembourg	N/A	N/A	Included CMM in Scope 1 for previous coal mining activities but not in Scope 3 for steelmaking. "Reducing… gases such as… methane from mining and steelmaking continues to be a major priority."

Source: Company reports.

CMM is not well incorporated into GHG reporting frameworks

Greenhouse Gas Protocol

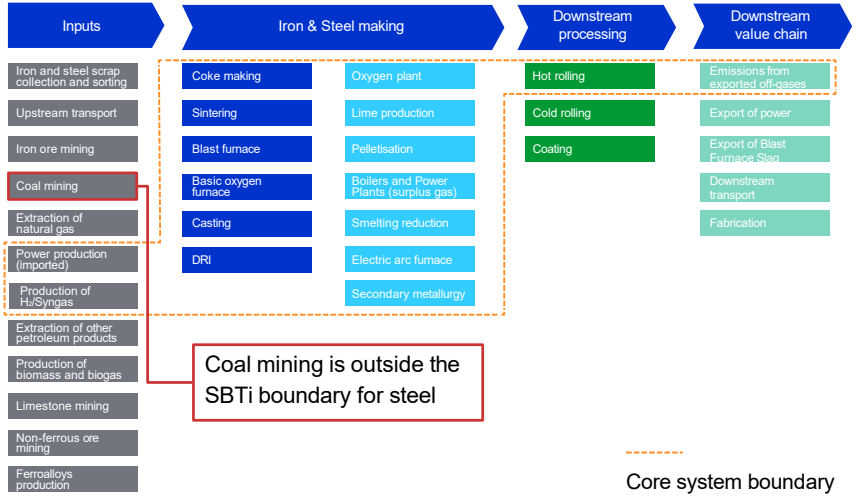
CMM is considered a Scope 1 emission source for the coal mining sector, and a Scope 3 (Category 3) emission source for other reporting companies.

IFRS S2 Climate Related Disclosures (Industry-based Guidance)

CMM emissions are included in Scope 1 reporting for coal sector companies but **not included in Scope 3 reporting for iron & steel producers.**

Science Based Targets initiative

For steel, **upstream emissions from metcoal mining are "material but lack sufficiently accurate and stable data"** to be included in the core system boundary.



Source: GHG Protocol (2004, 2011), International Financial Reporting Standards Foundation (2023), SBTi (2023).

Global efforts are underway to increase the focus on CMM

- In 2022, the **Joint Declaration from Energy Importers and Exporters on Reducing Greenhouse Gas Emissions from Fossil Fuels** was signed by the U.S., the EU, Canada, Japan, Norway, Singapore, and the UK, with specific provisions addressing CMM.
- At COP28 in 2023, the **Steel Standard Principles** contained the first global acknowledgement of methane's importance to the steel industry. It establishes common principles for emission measurements methodologies in the steel sector.
- The **Steel Methane Programme (SMP),** supported by UNEP's International Methane Emissions Observatory (IMEO), is being established to bring together industry leaders to improve methane reporting, progressing from emission factors to empirical measurements. Not yet formally announced.
  - Member companies commit to a 60-75% reduction in methane emissions, or down to 1-3 tCH_4 per kilotonne of marketed coal, by 2030. The SMP is supported by extensive science studies to help define best measurement methodologies.

Source: IEA (2024c), International Methane Emissions Observatory (2022, 2023), World Trade Organization (2024).

Types of regulations affecting CMM

Policy Type	Description	Example Policy
Monitoring & Reporting	Requires coal companies to measure and report their methane emissions.	The EU Methane Regulation (2024) "requires operators to report regularly… about quantification and measurements of methane emissions at source level, including for non-operated assets."
Target Setting	Requires emissions reductions for coal mining, ideally specifying targets and activities.	The Vietnam Action Plan for Methane Emissions Reduction (2022) limits CMM emissions to 3.5 Mt by 2025 and 2.0 Mt by 2030, specifically identifying drainage and recovery through drilling as a mitigation activity.
CMM Abatement	Encourages abatement activities, development and utilization of CMM/CBM resources.	China's "Notice on further strengthening… management of coal resource development" (2020) encourages the utilization of VAM and other gas flows with concentrations of 2-8% methane and drained gas with concentrations of ≥8%.
Financing Mechanisms	Establishes funding, subsidies, tax cuts, etc. to support abatement, utilization, or innovation.	The U.S. ARPA-E REMEDY program (2021) provides $35 million to develop methane abatement technologies for the fossil sector, specifically targeting VAM emissions from operating underground mines.
Coal Phase Down	Stimulates the reduction or elimination of coal production and/or consumption.	"Faster and Further: Canada's Methane Strategy" (2022) aims to address emissions by "phasing out unabated coal-fired electricity… and banning thermal coal exports from Canada by 2030."

Source: IEA (2024c).

Regulatory landscape in key jurisdictions

Country	General CH_4 in NDC*	General CH_4 Strategy	Coal Mine Methane Targets in Methane Strategy	Policy Types	Relevant Policies
Australia				Monitoring, financing mechanisms	Australian Carbon Credit Unit Scheme; National Greenhouse and Energy Reporting Regulations; New South Wales Coal Innovation Fund.
Canada	✓	✓	"Phasing out unabated coal-fired electricity in Canada by 2030; leading a global effort to phase-out coal-powered electricity; banning thermal coal exports from Canada by 2030."	Monitoring, target setting, phase down	Faster and Further: Canada's Methane Strategy.
China	✓	✓	Promoting regular methane emissions reporting; implementing & further improving emission standards; annual utilization of 6 billion m3 of coal mine gas by 2025.	Monitoring, CMM abatement, financing mechanisms, phase down	Emission Standard of Coalbed Methane/Coal Mine Gas; National Methane Plan; Opinions on Resolving Overcapacity in the Coal Industry and Realising Development out of Difficulties, etc.
India				CMM abatement	Policy for Early Monetisation of Coal Bed Methane Gas Marketing and Pricing Freedom
Poland		✓	Covered by the EU Methane Regulation (see Appendix 4).	Monitoring, target setting, phase down	EU Methane Strategy; Social Contract for the Mining Industry
United States	✓	✓	Additional funding for the existing Abandoned Mine Land grant program, to reduce emissions from unremediated, abandoned mines.	Monitoring, financing mechanisms	GHG Reporting Program; ARPA-E "Reducing Emissions of Methane Every Day of the Year" program; California Air Resources Board Offset Program for Mine Methane Capture Projects, etc.

Source: IEA (2024c), Olczak (2023).

*Indicates whether there are methane-specific measures within the NDC.

CMM is a component of wider considerations around coal

- In many parts of the world, the coal industry is both a major employer and a source of environmental harms in the communities where it operates. **Coal mine methane is just one of these environmental impacts**, which also include local air pollution, ecosystem degradation, and downstream GHG emissions, among others.
- As such, managing CMM does not in and of itself address critical environmental & climate justice (ECJ) and just transition (JT) considerations that are central to the sector and can at times be in tension with each other.
- Steps to address CMM should be considered within the broader coal landscape: CMM abatement measures are inequitable when used to extend the lifespan of coal assets but can be better aligned with both ECJ and JT if implemented alongside properly designed phase-out policies.
- These issues must be negotiated in collaboration with impacted communities based on a foundational commitment to agency, sustainability, and justice.

For more on the Just Energy Transition, EDF's Just Transition and Safeguards Framework provides countries and companies with guidelines for shifting from fossil fuels to renewable energy while ensuring fairness and equity.

Source: Brown and Spiegel (2019), Edwards (2019), Environmental Defense Fund (2024).

Key resources

Ember:

- → In The Dark: Underreporting of coal mine methane is a major climate risk.
- → Why the steel industry needs to tackle coal mine methane.

International Energy Agency:

- → Coal in Net Zero Transitions.
- → Global Methane Tracker 2024.

Institutional Investor Group on Climate Change (IIGCC):

- → Addressing methane emissions from fossil fuel operations.

Global Energy Monitor:

- → Global Coal Mine Tracker.

Global Methane Initiative:

- → Basics of Coal Mine Methane.

Maria Olczak, Environmental Defense Fund:

- → Policy Options for Addressing Methane Emissions from the Coal Sector.

United National Economic Commission for Europe:

- → Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines.

References

American Carbon Registry (2024). Process for Registering Compliance Offset Projects on ACR for the California State Cap-and-Trade Program.

BloombergNEF (2023). Green Steel Demand is Rising Faster Than Production Can Ramp Up.

Brown and Spiegel (2019). Coal, Climate Justice, and the Cultural Politics of Energy Transition.

California Air Resources Board (2024). ARB Offset Credit Issuance Table.

CRU (2020). The immense decarbonisation challenge facing the steel industry.

Edwards (2019). Coal and climate change.

Ember (2022). Tackling Australia's Coal Mine Methane Problem.

Ember (2023a). In The Dark: underreporting of coal mine methane is a major climate risk.

Ember (2023b). Why the steel industry needs to tackle coal mine methane.

Environmental Defense Fund (2023). Carbon Credits 101 for Investors.

Environmental Defense Fund (2024). Just Transition and Safeguards Framework.

European Commission (2023). Commission welcomes deal on first-ever EU law to curb methane emissions in the EU and globally.

European Space Agency. TROPOMI.

Fan and Friedmann (2021). Low-carbon production of iron and steel: Technology options, economic assessment, and policy.

Global Energy Monitor (2022). Bigger than Oil or Gas? Sizing Up Coal Mine Methane.

Global Energy Monitor (2024). Global Coal Mine Tracker, April 2024 release.

Global Methane Initiative (2022). Basics of Coal Mine Methane.

Global Methane Initiative (2024). International Coal Mine Methane Projects Database.

Greb (2009). Coal formation diagram: Lateral layout with coal types: Kentucky Geological Survey.

Greenhouse Gas Protocol (2004). The GHG Protocol Corporate Accounting and Reporting Standard Revised.

Greenhouse Gas Protocol (2011). The Corporate Value Chain (Scope 3) Accounting and Reporting Standard.

Hasanbeigi (2022). Steel Climate Impact: An International Benchmarking of Energy and CO2 Intensities.

Institute for Energy Economics and Financial Analysis (2022). The facts about steelmaking – Steelmakers seeking Green steel.

Institutional Investor Group on Climate Change (2024). Addressing methane emissions from fossil fuel operations.

Intergovernmental Panel on Climate Change (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

International Financial Reporting Standards Foundation (2023). IFRS S2 Climate-related Disclosures.

International Energy Agency (2022). Coal in Net Zero Transitions.

International Energy Agency (2024a). Global Methane Tracker 2024.

International Energy Agency (2024b). Global Methane Tracker Documentation 2024 Version.

International Energy Agency (2024c). Policies and Measures Database.

International Energy Agency (2024d). Quarterly Coal Statistics.

International Methane Emissions Observatory (2022). Coal Mine Methane Science Studies Road Map.

International Methane Emissions Observatory (2023). Metcoal Methane Partnership.

Kasprzak et al. (in preparation). Coal Mine Methane's Contribution to the Climate Impact of Steel Manufacturing Needs Urgent Reassessment.

Kholod et al. (2020). Global methane emissions from coal mining to continue growing even with declining coal production.

Mission Possible Partnership (2022). Making Net-Zero Steel Possible: An industry-based, 1.5ºC-aligned transition strategy.

Olczak (2023). Policy Options for Addressing Methane Emissions from the Coal Sector.

Pixabay. Coal stock photo by hangela.

Science Based Targets initiative (2023). 1.5ºC Science-Based Target-Setting in the Steel Sector: Guidance Launch Webinar.

Shen et al. (2023). National quantifications of methane emissions from fuel exploitation using high resolution inversions of satellite observations.

Steel Manufacturers Association (2022). Emissions Analysis Executive Summary.

United Nations Economic Commission for Europe (2016). Best Practice Guidance for Effective Methane Drainage and Use in Coal Mines.

United Nations Framework Convention on Climate Change (2023). Flexible Queries for Annex I Parties and Non-Annex I Parties.

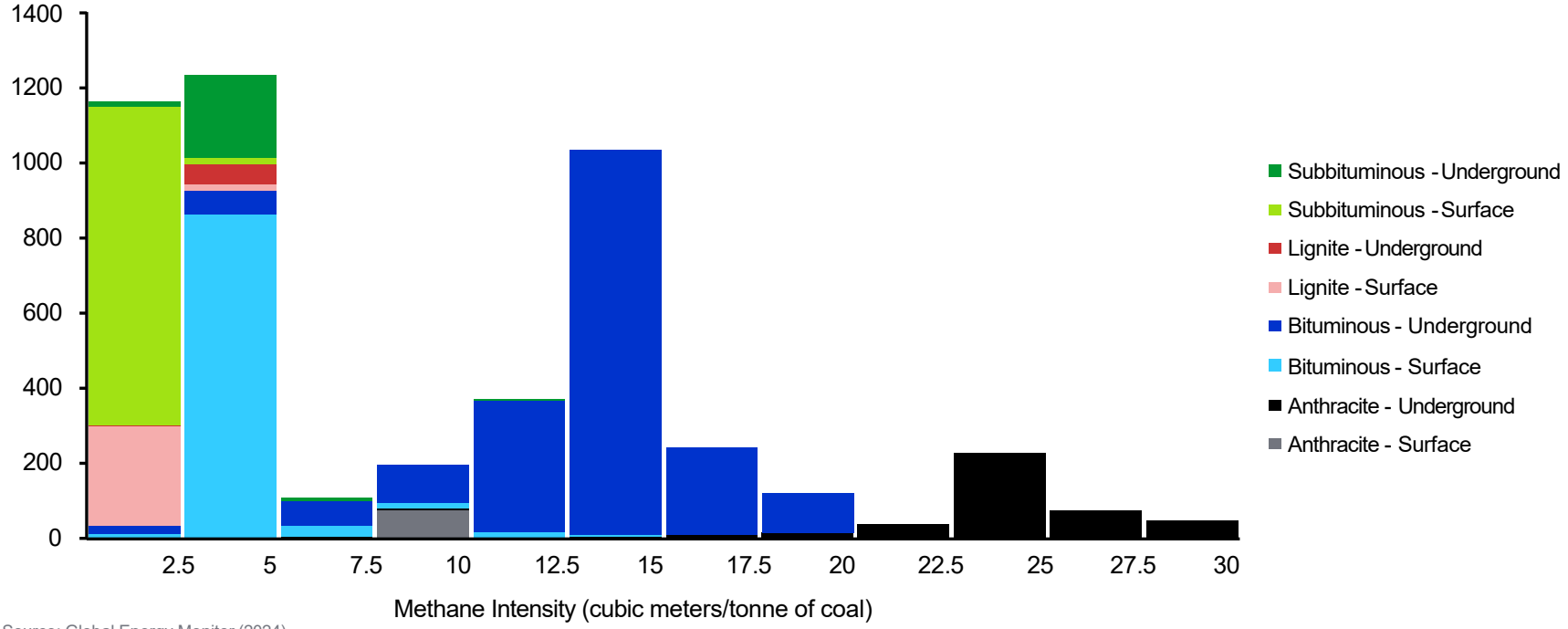
United States Environmental Protection Agency (2019a). Non-CO2 Greenhouse Gas Data Tool.

United States Environmental Protection Agency (2019b). Ventilation Air Methane (VAM) Utilization Technologies.

World Economic Forum (2023). Net-Zero Industry Tracker 2023.

World Trade Organization (2024). Steel Standards Principles.

Appendix 1: Distribution of emission factors in the GEM Global Coal Mine Tracker (expanded)



Source: Global Energy Monitor (2024).

Appendix 2: IPCC & SMP tiering systems

→ Official country statistics reported to the UNFCCC use the 3-tier system established by the IPCC, with each tier representing a different level of methodological complexity:

Tier 1	Default IPCC emission factors (EF * Activity Data = Emissions)	First-order approach; highest level of uncertainty
Tier 2	Country-specific or basin-specific emission factors	More detailed than Tier 1; lower uncertainty
Tier 3	Facility-level measurements, detailed modeling, or specific emission factors	Detailed activity data; data at highest resolution; lowest uncertainty

The default EF range is 7.4 - 19.7 kg/t for underground mines and 0.2 - 1.5 kg/t for surface mines.

→ The SMP framework uses a 5-level approach; in particular, reporting level 5 requires top-down site-level measurements to reconcile source- and site-level estimates and improve confidence in reported emissions.

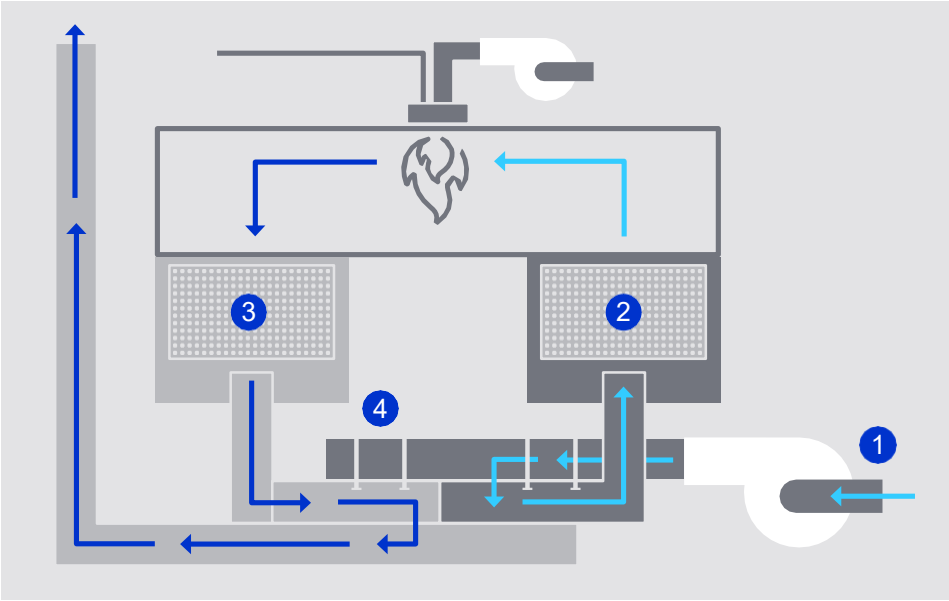
Source: Intergovernmental Panel on Climate Change (2006), International Methane Emissions Observatory (2023).

Appendix 3: IEA categorization of sources and abatement

Source	Type	Share of underground emissions	Share of surface emissions	Abatement Potential	Abatement Measure
Drainage systems	Vented	25%	0%	76%	Flare
					Drained CMM utilization
Ventilation systems	Vented	60%	15%	70%	VAM oxidation
					On-site recovery and use
Other losses	Incomplete combustion	2%	1%	60%	Efficiency improvements
Other losses	Fugitive	5%	1%	50%	Capture and route
Post-mining	Fugitive	3%	8%	20%	Capture and route
Outcrops, workings	Fugitive	5%	75%	7%	Capture and route

Source: IEA (2024b).

Appendix 4: How regenerative thermal oxidizers (RTOs) destroy VAM



1. Mine ventilation air is directed into the oxidizer by a fan and duct system.
2. The VAM encounters pre-heated heat exchange material at the oxidation temperature of methane (1000°C), converting methane into CO_2 and water.
3. The oxidation process also releases heat, which is absorbed by a second bed/column of heat exchange material.
4. The flow of incoming VAM is repeatedly reversed using valves. The reaction is thus sustained through the heat exchange process and does not require additional inputs of energy.

RTOs are a mature technology, with thermal and destruction removal efficiencies of >95%. Regenerative catalytic oxidizer (RCO) systems are in development that could operate at lower temperatures and use less energy.

Source: U.S. EPA (2019b).

Appendix 5: EU Methane Regulation (2024) overview

- Fossil fuel industries, including coal, must measure, monitor, report, verify, and reduce their methane emissions
- To reduce emissions within the EU:
  - Regular reporting, including for non-operated assets.
  - Venting and flaring bans for drainage stations, starting 2025
  - Venting limits for ventilation shafts of thermal coal mines, starting 2027 (with a ruling on metallurgical coal to follow within the next 3 years).
  - Inventories and mitigation plans for closed, inactive, plugged, and abandoned assets
- Imported emissions (details still being worked out):
  - A transparency database and performance profiles (country & company).
  - A global emissions monitoring tool and a rapid alert mechanism for super-emitting events.
  - Equal MRV standards in new import contracts for exporters, starting 2027.

Source: European Commission (2023).

THANK YOU!

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