Why the steel industry needs to tackle coal mine methane

Global steelmaking will continue to use coal, even under optimistic decarbonisation scenarios. The sector must address its upstream climate impact.

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COAL TO CLEAN ENERGY POLICY

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About

This report assesses data on coal mine methane (CMM) and steelmaking from the International Energy Agency (IEA) and other organisations. The steel industry's current climate impact and how it might evolve under the IEA's medium to long-term Global Energy and Climate Model scenarios is analysed before providing recommendations to industry stakeholders.

Highlights

+27%

Estimate of how much coal mine methane adds to the steel industry's overall 20-year climate effect

2x

Some metallurgical coal from gassy mines can double a batch of steel's global warming impact

-11%

The moderate projected fall in coking coal demand by 2030 under governments' announced climate pledges

Foreword

The one year anniversary of the Global Methane Pledge has pointed to the urgent need to cut methane – a powerful greenhouse gas – and meet emissions reduction targets. It is of utmost importance that this EU-US-led effort, which gathers 150 countries committed to reducing global methane emissions by 30% by 2030, is successful. Taking bold action to curb methane emissions requires collaboration from all stakeholders – and each one needs to reflect on their role.

In this regard, the Emissions Gap Report 2022 of the United Nations Environment Programme (UNEP) stresses that there is no credible pathway to 1.5°C unless we usher in a system-wide transformation of our societies. The world is falling short of achieving Paris climate goals. If we carry on down this path, we could reach a 2.8°C hike in global temperatures.

This report by Ember reflects on the challenge to address the climate footprint of steel production. The takeaway message is key: we urgently need to account for and address the substantial climate impact of methane from metallurgical coal in steel production. This entails that steel producers incentivize their metallurgical coal suppliers to do direct measurements of their methane emissions and mitigate them.

Indeed, if we can't measure it, we can't fix it. UNEP's International Methane Emissions Observatory (IMEO) came into being to provide open, reliable and actionable data on methane emissions to those who can act to reduce 150Mt of methane emissions by 2030. IMEO fosters cooperation with the metallurgical coal industry and civil society to identify and implement solutions to mitigate methane emissions from the sector. Ultimately, this will reduce the climate impact of steel production in the near term.

I hope that this report will help the steel industry appreciate the role it must play to achieve methane emissions reductions from the metallurgical coal it uses. As IMEO is working with leading metallurgical coal companies to define global monitoring, reporting, verification, and performance standards, I invite all stakeholders from the steel and metallurgical coal sectors to join us to shape the work to deliver ambitious targets to slash methane emissions.

Manfredi Caltagirone
Head of UNEP's International Methane Emissions Observatory

Executive Summary

The steel industry needs to cut coal mine methane

This report highlights how low carbon pathways for steelmaking miss out on one of the biggest and quickest climate wins – reducing coal mine methane (CMM). Decarbonisation pathways for steelmaking put hope in commercially unproven carbon capture, utilisation and storage (CCUS) for reducing CO2 emissions at steel factories. But this approach ignores the methane (CH4) emitted during coal mining that can be realistically prevented from reaching the atmosphere.

01 CMM adds 27% to steel's global warming impact

Mines producing coking coal emitted nearly 12 million tonnes of methane in 2021, according to the IEA. This is equivalent to nearly 990 million tonnes of CO2 using the IPCC's 82.5 multiplier for methane's 20-year climate impact versus carbon dioxide. Coking coal methane adds 27% to the CO2 emissions from the steel industry and warms the planet more than the CO2 emissions of Germany or Canada.

02

The steel industry is forecast to use coal even in 2050

The latest IEA World Energy Outlook's 1.5-degree compliant Net Zero Emissions (NZE) scenario requires drops in coking coal usage of 26% by 2030 and 83% by 2050 versus today's level. If climate ambition falls short, metallurgical coal use might not fall as quickly. The IEA's assessment of governments' announced pledges forecasts a moderate 11% fall in coking coal use by 2030 and a 56% drop by 2050. How much coking coal will be used in 2030 will be critically important for the steel industry's climate goals and the Global Methane Pledge.

03

Underground mines can quickly and cheaply reduce methane emissions

Highly polluting coal seams must remain unmined as some metallurgical coal is so gassy it can double a batch of steel's warming effect. For the underground mines which continue operating, methane mitigation technologies are readily available. According to the UNEP, global CMM can be reduced by 28-57% at mostly low cost.

This report concludes with recommendations for steel industry stakeholders:

- Ensure CMM is included in calculations of the climate effect of steel which is produced using blast furnaces and that avoided CMM is considered as a benefit of steel which is produced using little or no coal.
- Metallurgical coal mining companies should formulate an industry standard to implement emissions reductions targets and employ best practice monitoring, reporting and verification to evaluate progress.
- Steel companies should only buy coal from companies that have a net-zero compatible plan to reduce coal mine methane.

“Steel companies need to get real about the climate damage caused by metallurgical coal mining. This means starting to account for methane leaks, working with coal companies to close the gassiest mines, and demanding quick and deep cuts to emissions at operating mines. Getting to grips with coal mine methane is one of the cheapest and easiest ways to tackle the climate crisis.”

Conal Campbell

Coal Mine Methane Analyst, Ember

Chapter 1 - Why steel CMM matters

Net zero steel pathways need to address coal mine methane

Coking coal use in steel production is set to persist, even in the most ambitious decarbonisation scenarios. This is due to the fact that low-emissions production technologies are unlikely to satisfy the projected rise in demand for steel of more than a third by 2050. This means that CMM emissions associated with steel production need to be urgently addressed.

Global steel production has increased more than threefold since 1970, including more than doubling since the turn of the millennium. The steel sector is currently the largest industrial consumer of coal, which provides around 74% of its energy input up from 65% in the year 2000. Steelmaking accounts for 7% of the global energy system's carbon emissions but the sector's methane emissions associated with coking coal mining remain unaccounted.

This paper reveals the extent of methane emissions from metallurgical coal mining, before CO2 is released at steel factories. For a detailed description of coal mine methane, please read Ember's article Why the world must act on coal mine methane.

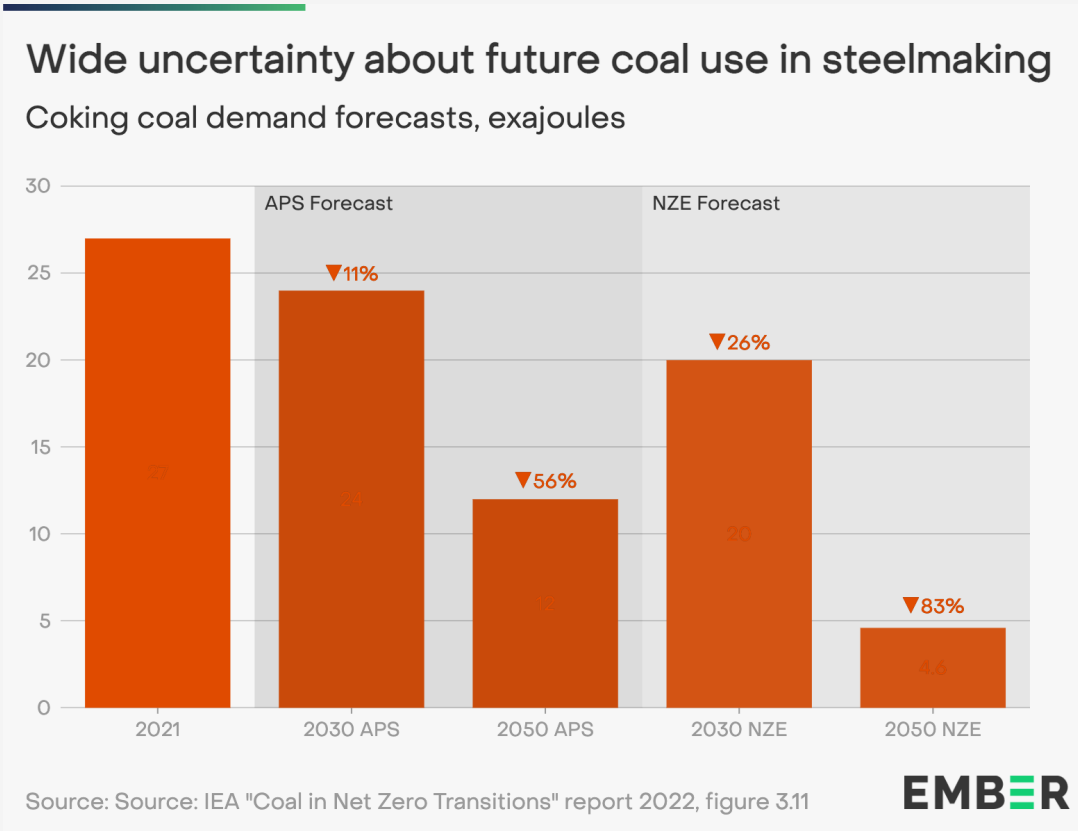
Coal Mine Methane: large and rising climate damage

The IEA's latest Methane Tracker estimates that annual methane emissions from coal mines are 43.6 million tonnes (Mt), surpassing methane emissions from both oil (42.9 Mt) and fossil gas (39.6 Mt). Multiplied by methane's global warming potential (GWP) of 82.5 times more than CO2 over 20 years, this equals over 3.5 billion tonnes of CO2 equivalent, a sum larger than the European Union's CO2 emissions.

There is major uncertainty about the amount of CMM emitted for two main reasons. Firstly, national reporting typically relies on unrealistically benign "emission factors" rather than on-site monitoring. Secondly, information is sometimes outdated. For example, China is by far the largest CMM emitting country but has not reported its emissions to the UNFCCC since 2014.

Methane emissions from mines providing coking coal to the steel industry account for at least 27% of total CMM emissions. These emissions are set to remain a significant source of global warming as the steel industry is expected to continue to use coking coal in both the IEA's announced pledges (APS) and net zero emissions (NZE) scenarios for 2030 and 2050.

Figure 1



How much does coal mine methane add to the steel industry's climate effect?

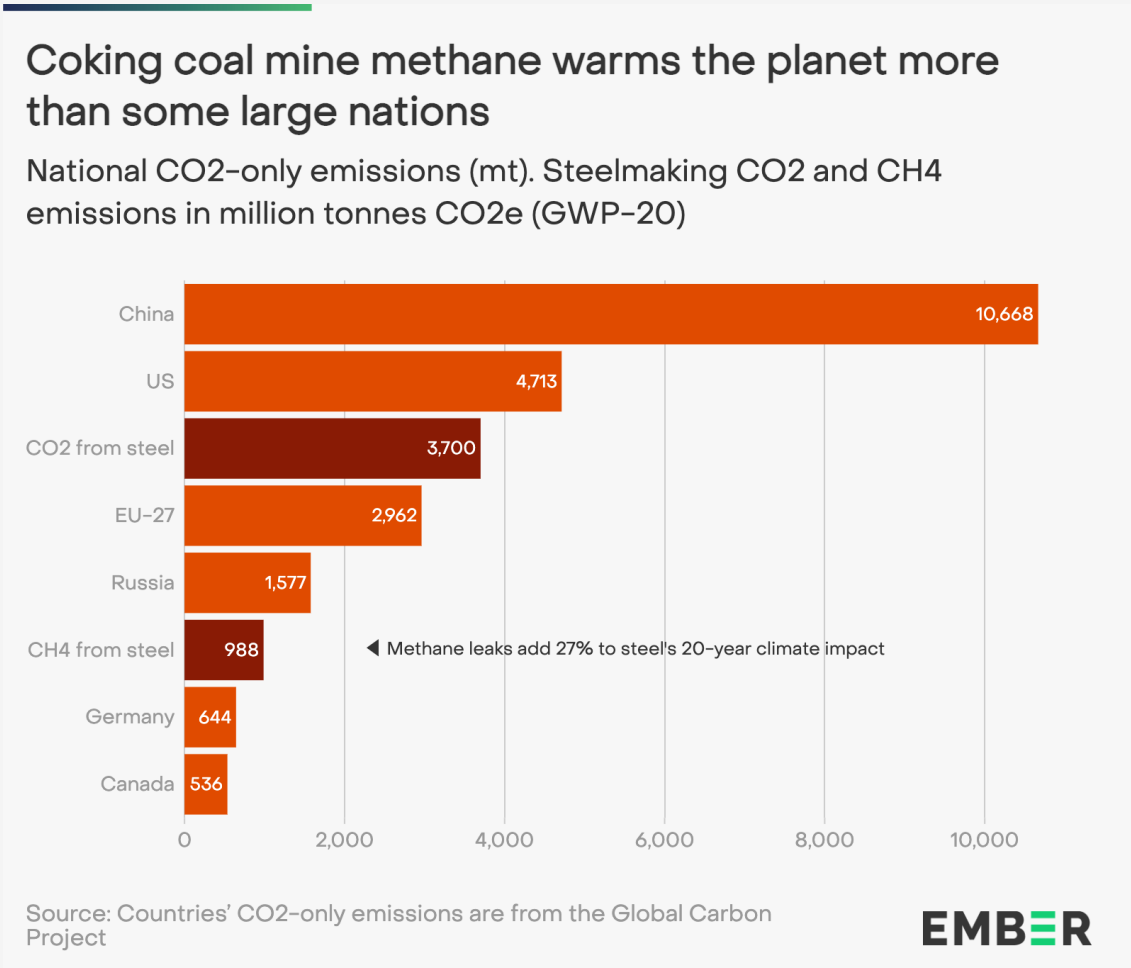
Methane isn't generally considered by steelmakers as the emissions occur at the coal mine rather than the steel factory. Our calculations show this omission leads to at least 27% of the steel industry's 20-year climate impact being ignored.

The IEA estimates that mining of coking coal (which is the primary metallurgical coal) emitted 11.98 million tonnes (Mt) of methane in 2021, equivalent to 988 Mt of CO2-equivalent annually using the IPCC's 20-year global warming potential (GWP) of 82.5 times more than CO2. This is more than the total CO2 emissions of Germany (644 Mt) or Canada (536 Mt). The IEA calculates that more methane is released by coking coal mining than from the world's gas pipelines and LNG facilities combined (10.98 Mt).

The steel industry's direct and indirect CO2 emissions were estimated by the IEA (Box 2.4) at 3,700 Mt in 2019. These CO2 emissions come from all types of steelmaking, whereas coking coal mine methane emissions are predominantly from blast furnace steelmaking which made up 70% of global steel

production in 2019. Considering coking coal methane emissions of 988 Mt of CO2-equivalent, this means that the methane emitted during mining of coking coal for blast furnace steel production adds an estimated 27% to the steel industry's 20-year climate impact.

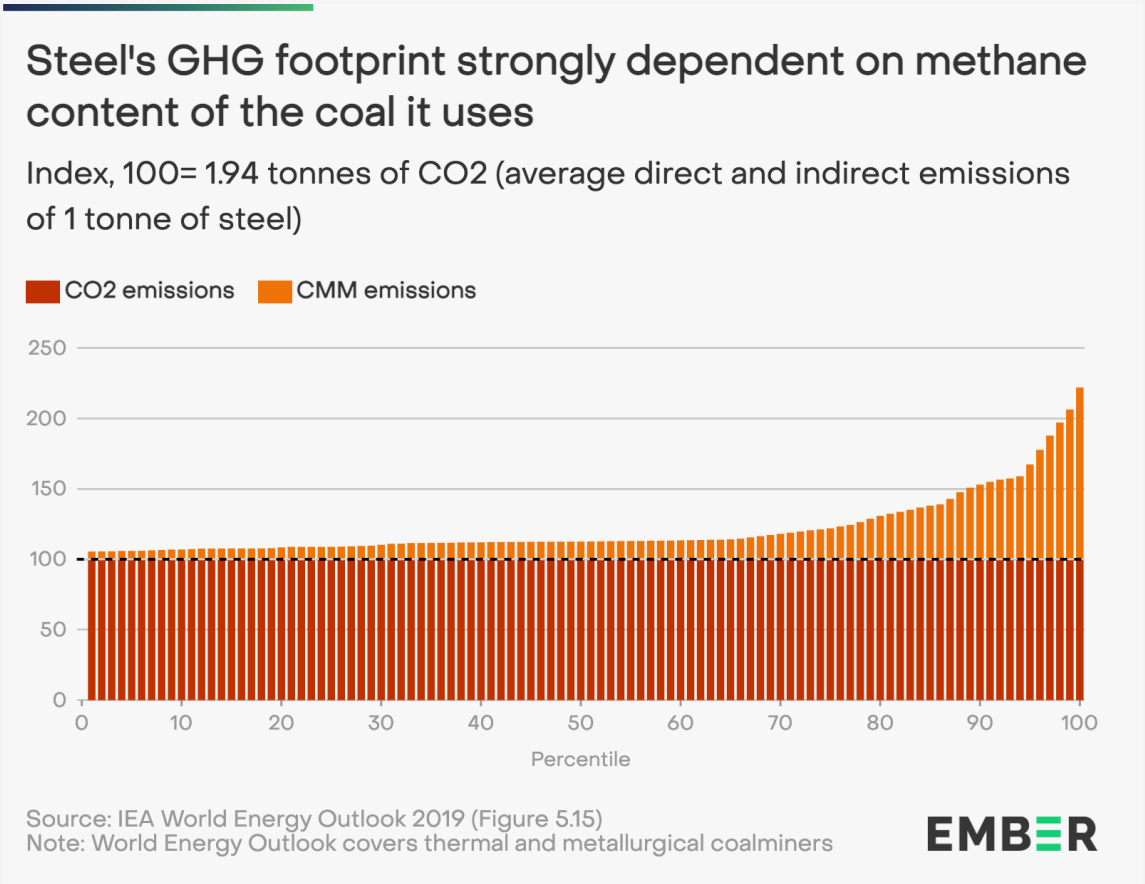
Figure 2



Steel's climate effect is determined by coal gassiness and production method

Some types of coal emit much more methane than others during the mining process. As a rule of thumb, underground mines are gassier than surface mines and metallurgical coal has more methane content than thermal coal. The gassiest coal can double a batch of steel's global warming effect, as seen below based on standard blast furnace CO2 emissions intensity and viewing the full range of coal mine methane emissions.

Figure 3



Alternatives to coal for steel production

Producing steel without using coal can drastically reduce methane emissions. Switching to fossil gas is possible for some existing infrastructure but would replace one methane emitting fuel with another. Hydrogen-based steelmaking has picked up significant momentum. Several newly announced projects in Europe and North America aim to be ready to produce hydrogen-based steel at commercial scale in the 2026–30 period. However, hydrogen is not an energy source and needs to be produced from renewable power that is not displacing fossil fuel retirement. Hydrogen is also a heavy (indirect) greenhouse gas and must be demonstrated to have near-zero emissions. Moreover, currently announced projects and policy plans using "innovative technologies" such as hydrogen are projected to capture only 1% of primary production by 2030, emphasising the importance of addressing metallurgical coal mine methane.

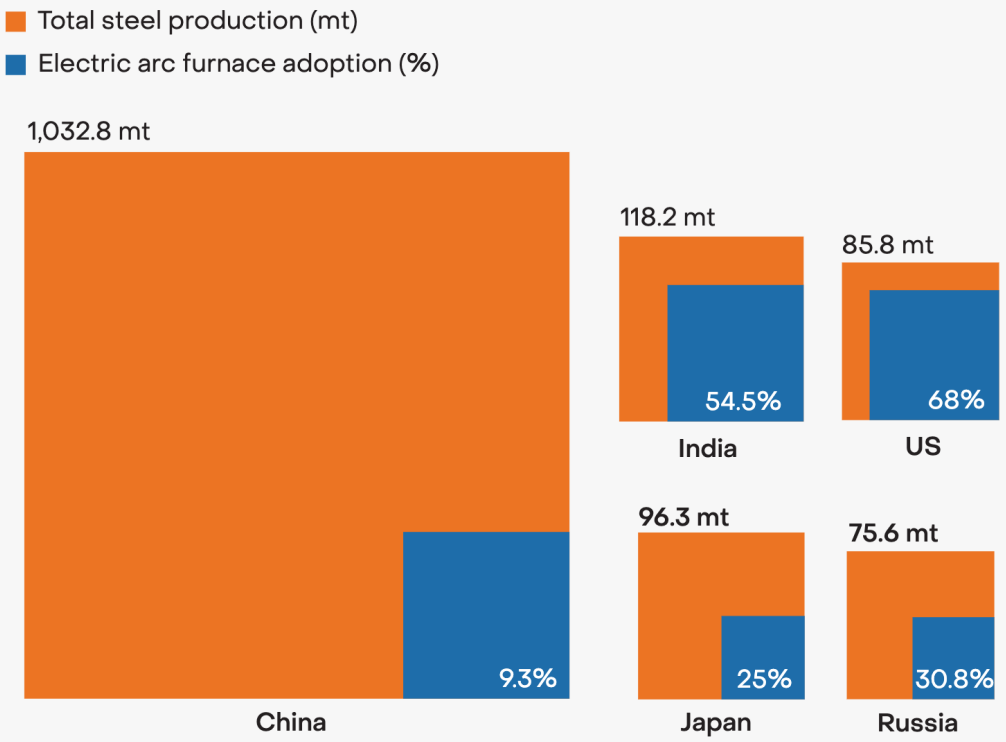
The existing at-scale, low-coal steelmaking process is via electric arc furnaces (EAFs), which use scrap metal and an average of 12 kg of coal per ton of produced steel compared to 770 kg of coking coal via the blast furnace process.

Chinese adoption of EAF technology will be crucial for global coal mine methane emissions. During the country's building boom from the year 2000 until 2020, China's level of EAF steel production almost halved as the country lacked scrap steel. In "advanced economies" the same period saw a 16% increase in EAF production driven by cost and sustainability considerations.

Figure 4

China's low take up of electric arc furnace steelmaking is keeping coal mine methane emissions elevated

Top five steelmakers' outputs (mt) and EAF adoption (%)



EAF steelmaking uses ~64x less coal than blast furnaces, thus sharply reducing methane leaks

Source: World Steel in Figures 2022 and World Steel Statistical Yearbook 2019

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How to reduce steelmaking CMM emissions

More than 150 countries have signed the Global Methane Pledge promising to reduce methane emissions by at least 30% from 2020 levels by 2030, which could eliminate over 0.2˚C of warming by 2050. We identify two main approaches that can sharply reduce coking coal mine methane emissions:

Keep methane intensive coal in the ground

Gassy coal deposits cause disproportionate damage to the climate, as described in Figure 3 above. The gassiest coal seams should be identified and left untouched. This requires that mines implement best practice monitoring, reporting and verification (MRV) which would reveal the highest methane areas.

Reduce methane leaks at operating mines

Working underground mines are responsible for 90% of global CMM emissions of which about 60–80% is emitted in very dilute form (typically less than 1% CH4) through the mine ventilation air methane (VAM). Underground mines' methane emissions can be sharply reduced. Some CMM can be captured and utilised for heating or electricity production for the mine itself or to supply to nearby grids. Alternatively, VAM can be destroyed by oxidation or flaring. Further information

on CMM best practices can be found in publications from the United Nations Economic Commission for Europe (UNECE) and United States Environmental Protection Agency (EPA).

Given that the 2021 Global Methane Assessment reports readily available targeted measures could reduce coal sector CH4 emissions by 12–25 Mt/yr, this represents 28–57% of global CMM emissions according to the latest data (43.6 Mt/year) from the IEA Methane Tracker. From 55% to 98% of these coal sector measures could be implemented at negative or low cost.

Chapter 4 – Recommendations

How steel industry stakeholders can reduce coal mine methane

Cutting CMM emissions will be crucial for steelmaking's climate impact under forecasts for both 2030 and 2050. We outline steps that can be taken to reduce methane emissions by metallurgical coal mining companies, steelmakers, NGOs, national policymakers, and investors.

Recommendations for **metallurgical coal mining companies:**

- Look to the Oil and Gas Methane Partnership 2nd Framework (OGMP 2.0) as an example that could provide an effective framework for monitoring, reporting and verification of methane emissions. Through participation in the OGMP and associated reporting, oil and gas companies have been provided with a credible mechanism to address their methane emissions and to demonstrate reduced environmental harm.
- Implement methane mitigation plans at active and closed mines. Coal from gassy seams that cannot be sufficiently mitigated and emits more methane than average should be avoided as it causes disproportionate global warming.

Recommendations for **steelmakers**:

- Support coal-powered production phaseout as soon as possible. The IEA notes that for coal●dependent heavy industries such as steelmaking, the year 2050 is just one investment cycle away. Around 60% of steel production facilities globally will undergo investment decisions this decade. The timeframes of needed decisions to reduce coal usage vary by region: 90% of European steel facilities are over 20 years old, while the average age of Chinese steel facilities is only 16 years.
- Engage with other stakeholders to create a framework that would outline targets and improve monitoring, reporting and verification (MRV) for the metallurgical coal industry. Adopting such a standard into steelmakers' procurement processes could quickly cut purchases of high methane coal.

Recommendations for **NGOs** and organisations assessing clean steel pathways:

- Include CMM emissions in assessing the climate impact of both abated and unabated coal use in decarbonisation pathways. Carbon capture, utilisation and storage (CCUS) at coal-fired power plants is an unproven abatement technology at commercial scale. Potential CCUS investments need to be assessed including properly accounting for the methane released from potentially prolonging metallurgical coal mining.●
- Consider avoided CMM as a benefit of increasing adoption of electric arc furnace and green hydrogen powered steelmaking.

Recommendations to **national policymakers** working on steel transition:

- Apply the 20-year global warming potential (GWP) to better consider the near-term influence of methane on climate change. National policies typically use the IPCC's 100-year GWP of methane being 29.8 times more damaging than carbon dioxide. GWP has been noted as misrepresenting the physics of global warming and having "no place in describing the effects of climate change mitigation strategies beyond a 20-year horizon". ●
- Include methane in carbon border adjustment mechanisms so that countries do not outsource their emissions. For example, this would mean that Japanese and Korean steelmakers should be accountable for their proportion of the methane emissions from Australian coal mines. Europe will need to consider methane from the coal which replaces Russian supply following the embargo after the invasion of Ukraine.

Recommendations to **investors** and investor groups:

- Recognise full lifecycle emissions in corporate assessments of steelmakers. The Science Based Targets initiative (SBTi) and other groups are making progress on including CMM in the steel industry's lifecycle greenhouse gas assessments. This needs to become standard among investment industry environmental, social and corporate governance (ESG) ratings.
- Support steel companies in developing regions to meet the high upfront capital costs of low-emissions technologies. The debt-equity ratio of a sample of listed steel producers in emerging market and developing economies (other than China) shows an average gearing ratio of nearly 200%, constraining their ability to finance low-emissions projects.

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