Major loopholes for coal mines in EU methane regulation

Two major loopholes in the EU methane regulation would allow coal mines to release additional methane emissions equivalent to Belgium and Czechia's annual CO2 emissions combined. Ember's recommendations could help Europe to realise one of the most cost effective ways to achieve its climate ambitions.

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About

In this analysis we look at which countries are emitting the most methane from coal mines, and what impact the EU methane regulation would have on emissions reductions, with a particular focus on Polish mines.

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Executive Summary

EU methane regulation negotiations risk increasing coal mine emissions

Coal mines are the largest single source of energy sector methane emissions in the EU, and yet the current methane regulation proposes to mitigate less than half of emissions.

European Union coal mines emitted 950 thousand tonnes of methane in 2020, more than the bloc's oil & gas emissions combined. Greenhouse gas reporting indicates two thirds of this (576 thousand tonnes) were emitted by Polish coal mines, although the IEA estimates the country's emissions are 24% higher.

The originally proposed regulation covered mitigation at active and abandoned underground mine operations which together represent 76% of EU coal mine methane (CMM) emissions. However recent amendments have increased the venting thresholds for thermal coal, whilst action on coking coal is expected to be delayed for at least five more years. Our analysis shows the latest revisions to the regulation will only cut methane emissions from coal mines by around 47%, well below its stated climate goal of a 58% reduction.

Maintaining strong action on coal mines in the EU methane regulation is one of the easiest and most cost effective ways for the EU to realise its climate ambitions.

01 Replace Poland's gassiest thermal coal with less harmful reserves

Seven coal mines emit all of Poland's reported emissions for thermal hard coal, whilst producing less than half of it. As mines close within Poland and across the EU, prioritising these for retirement and replacing residual production with Poland's "low-methane" coal would cut the EU's annual CMM emissions by 25%, equivalent to Spain's annual CO2 emissions from the energy sector.

02 Capture 3 million tonnes of methane by regulating coking coal

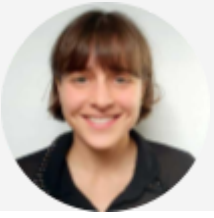
The methane regulation omits a venting threshold for coking coal used in steelmaking, missing the opportunity to prevent 3 million tonnes of methane by 2050 (a 50% reduction in coking coal emissions). Methane captured from these operations can be used for electricity generation, as will soon be done by Poland's largest coking coal company, JSW.

03 Romania's abandoned mines could be a major energy source

If Romania were to capture and utilise just half of its current abandoned mine methane (AMM) emissions, we estimate it could generate around 0.5 TWh of electricity as well as potential for local use of waste heat. This is equivalent to 75 million euros of electricity and enough waste heat to heat almost 19,000 hospital beds per year.

The European Union led 150 nations to sign the Global Methane Pledge but now risks shying away from taking action at home. Reducing coal mine methane emissions is realistic, affordable and doesn't cost jobs. Let's safeguard the EU's original sensible proposal on coal mine methane and encourage other global producers to take on one of the easiest wins in tackling the climate crisis.

Dr Sabina Assan
Methane analyst, Ember



Background

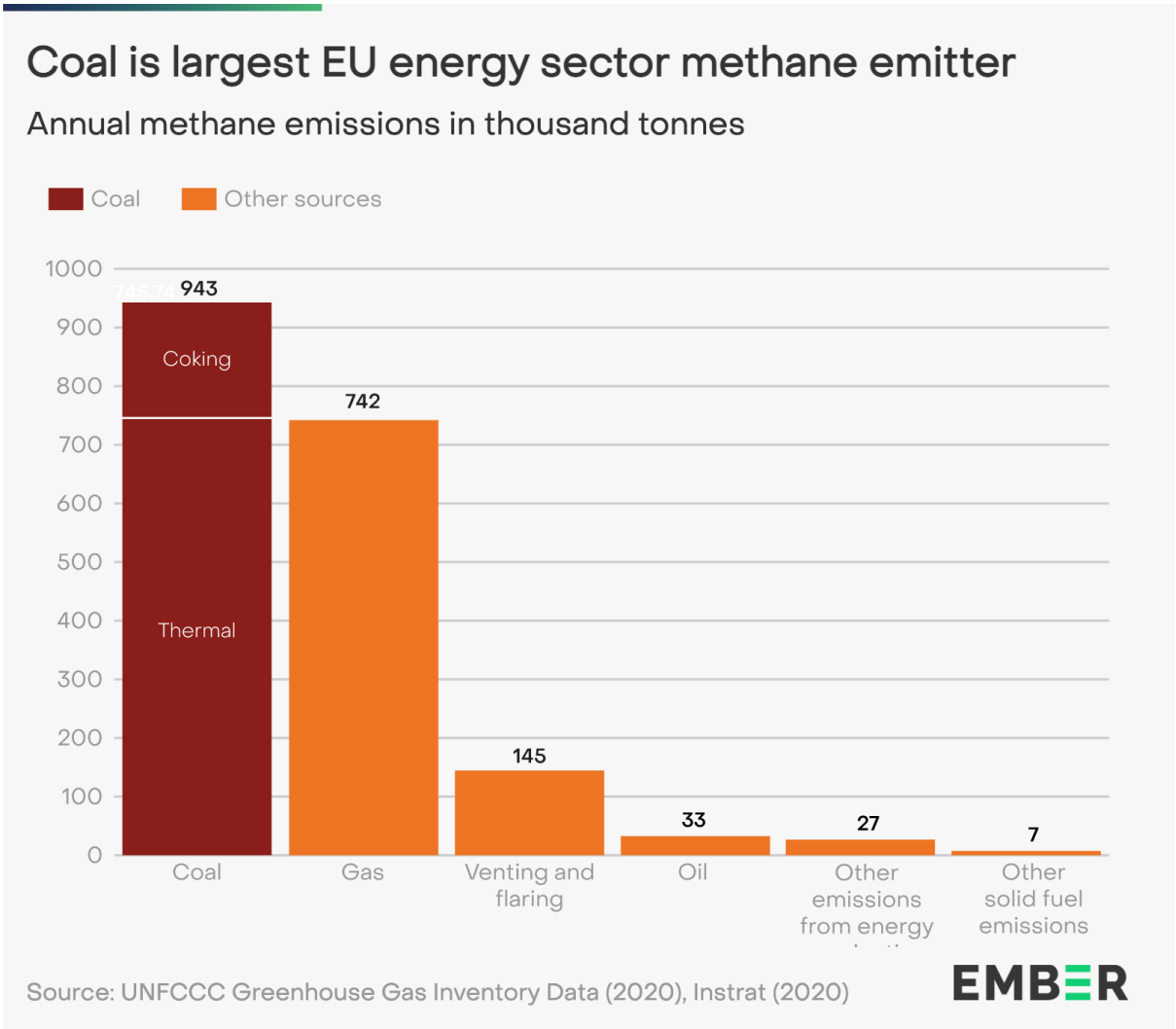
Coal Mine Methane from the EU

Methane (CH4) is one of the most potent greenhouse gases and coal mines are the largest source of energy sector methane emissions in the EU. EU coal mine methane (CMM) emissions are dominated by Poland's gassy underground mines, with the country responsible for almost two thirds of the EU's CMM emissions.

Coal is the largest source of energy sector methane in the EU

According to the greenhouse gas data reported to the UNFCCC, coal mines in the EU emitted 943 thousand tonnes of methane in 2020, making the coal industry the single largest methane emitter in the energy sector.

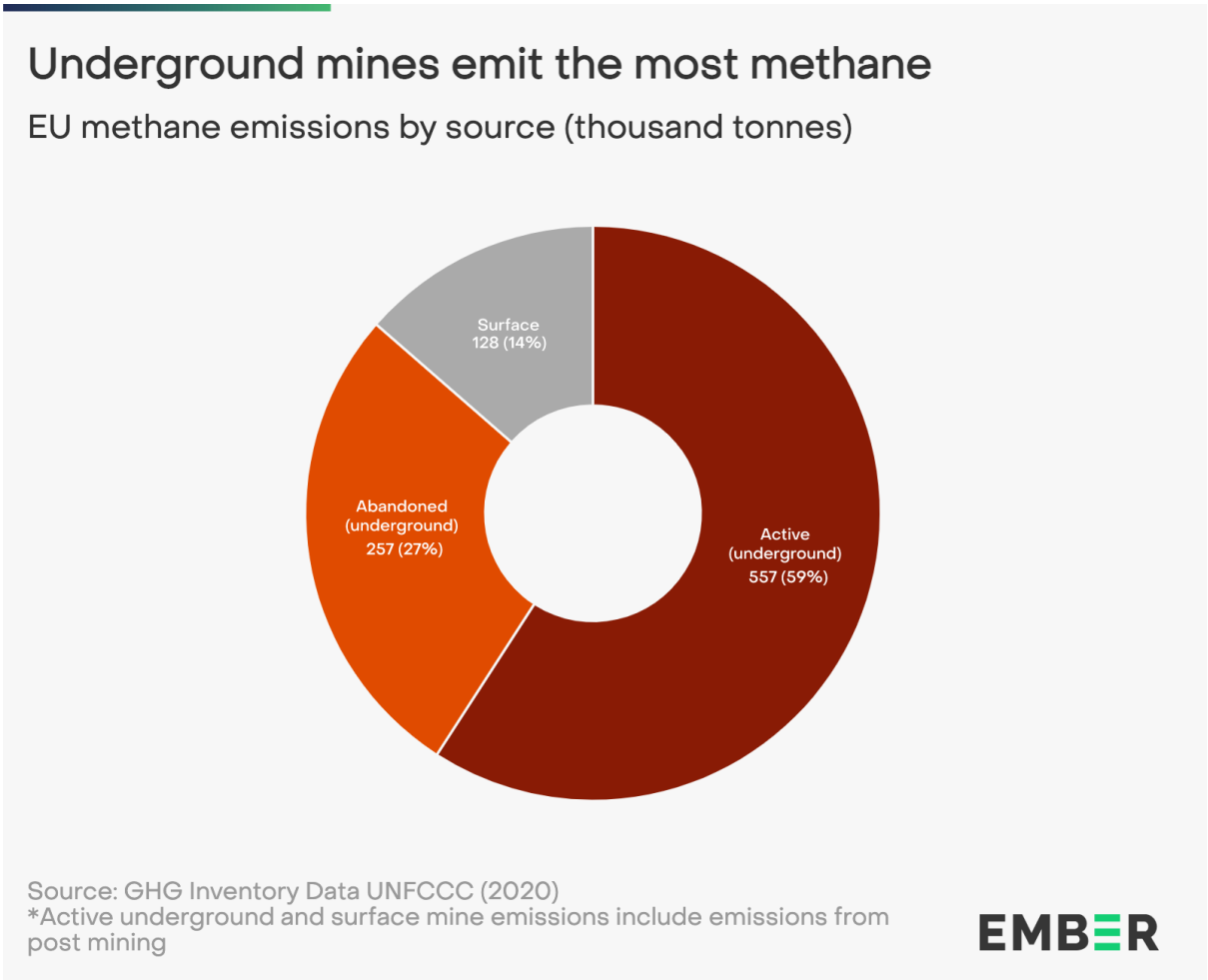
Using methane's 20 year global warming potential, this is equivalent to 78 million tonnes of additional CO2-e, more than Austria's total annual CO2 emissions.



Underground coal mines emit the most, but are the easiest to mitigate

Hard coal, although mined in lower volumes, is far more methane intensive than lignite coal. Hard coal can be used for electricity generation (thermal coal), or in steelmaking (metallurgical/coking coal). By analysing Eurostat and UNFCCC GHG inventory data, we estimate the average methane intensity from EU mined lignite coal is 1.6 tonnes of methane per thousand tonnes of coal, whereas the corresponding figure for EU mined hard coal is 9.5 tonnes.

According to the UNFCCC, underground mines (typically hard coal) in the EU emit more methane than surface mines (typically lignite).



Mining activities from active **underground** EU coal mines emitted 557 thousand tonnes of methane in 2020, which is **59%** of total EU CMM emissions.

If not closed properly, these underground mines can also continue emitting methane long after mining operations cease. Abandoned and **closed underground** mines emitted 258 thousand tonnes of methane in 2020 (**27%** of EU CMM emissions).

The remainder of emissions in 2020 (127 thousand tonnes of methane; **14%** of EU CMM emissions) were emitted from mining and post mining activities from **surface** mines.

Mitigation is easiest from underground mines. The IEA estimates readily available technologies can currently mitigate 20% of emissions from surface mines and 70% for

underground mines, often profitably. They estimate that 126 Kt of methane emissions every year from active mines in the EU is usable, with 110 Kt at a profit.

This profitable methane would be enough to generate 0.6 TWh of electricity, similar to the total household electricity consumption in large Polish cities, such as Wroclaw (using Poland's average household consumption of electricity per capita in 2020).

Poland responsible for almost two thirds of EU coal mine methane

According to Eurostat, in 2021 Poland mined 96% of the EU's hard coal output (55 million tonnes) and was the second largest miner of lignite coal (52 million tonnes). The country is consequently the EU's largest CMM emitter, releasing 576 thousand tonnes (61% of Europe's CMM) in 2020.

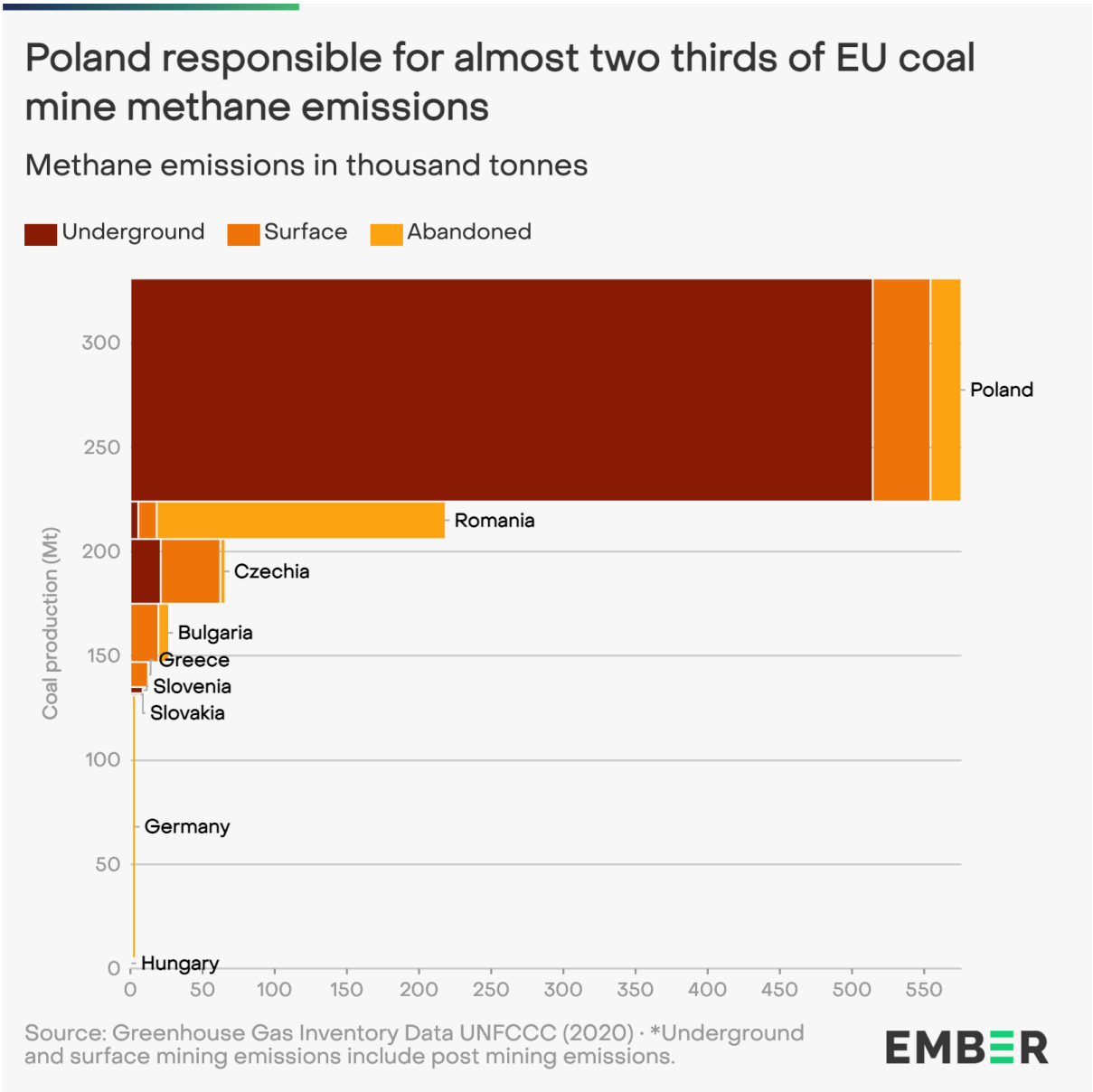
The majority of Poland's reported emissions (87%) are from the country's 12 high-methane underground hard coal mines. Data collected by Instrat shows that in 2020, 232 thousand tonnes were emitted from seven thermal coal mines, of which Polska Grupa Górnicza (PGG) is responsible for ~80%. Around 197 thousand tonnes of methane were emitted from five coking coal mines, all of which are operated by JSW.

We found the methane intensity of Poland's hard coal to be the second highest in Europe, with an average 9.4 tonnes methane per thousand tonnes of coal.

Poland's CMM likely even higher

The IEA estimates that Polish coal mines emitted 715 thousand tonnes of methane in 2022, 24% higher than what the country reported to UNFCCC in 2020.

As measurements are limited for all sources of coal mine methane, there is a high risk that methane emissions from both active and closed mines are being underreported which challenges the integrity of the EU's methane accounts and climate targets.



Romania and Czechia are also significant CMM emitters

Romania is the EU's second largest CMM emitter. Its abandoned and closed coal mines released 200 thousand tonnes of methane in 2021, representing 85% of the EU's abandoned mine methane (AMM) emissions.

Czechia is the only other European producer of hard coal, reportedly mining 2 million tonnes in 2021 which emitted 21 thousand tonnes of methane. The country however emits most of its CMM emissions from surface mines (mining lignite coal), which amounted to 41 thousand tonnes of methane emissions in 2021.

EU Methane Regulation

Scope and gaps in the regulation

The EU Methane regulation covers mitigation at active and abandoned underground mine operations which together represent 76% of EU CMM emissions. The latest revision would cut CMM by 47%, falling short of the EU's 58% target and leaking an extra 2.2 million tonnes of methane by 2050, more than Belgium and Czechia's annual CO2 emissions combined.

Three quarters of EU CMM could be covered by the regulation

The EU Methane regulation states that energy sector methane emissions need to fall by 58% by the end of this decade. The legislation has the potential to address emissions from two major sources which together accounted for 76% of the EU's CMM emissions in 2020; *Article 22* targets methane from active underground mines, and *Article 26* from abandoned and closed underground mines. The EU regulation seeks to cap the amount of methane that coal mines are allowed to release, or 'vent', instead of capturing and either destroying or utilising the gas.

Article 22 - Regulating emissions from active, underground mines

Article 22 of the legislation seeks to mitigate methane emissions from two sources at active mines. The first targets high concentration emissions from drainage stations by prohibiting releasing ('venting') and incomplete burning ('flaring') of this source at both coking and thermal mines.

The second targets emissions of low concentration, but high volume methane emitted through the ventilation air system. The initial proposal of the Regulation prohibits releasing ('venting') more than 0.5 tonnes of methane per thousand tonnes of coal produced for thermal coal mines, but sets no restrictions for coking coal.

Article 26 - Regulating emissions from abandoned and closed underground mines

Article 26 aims to prohibit releasing ('venting') and incomplete burning ('flaring') methane from abandoned and closed mines, encouraging these sources to either be shuttered responsibly to avoid methane emissions, for example by flooding the mine, or for the methane to be captured and utilised.

CMM not in scope of the EU regulation

Mitigation measures for post mining activities at underground mines (methane emitted during coal processing, storage and transportation) and for methane leaked by surface mines were not included in the Regulation. They are assumed to be smaller sources of CMM emissions in the EU, for which mitigation is technically more difficult.

Improving measurements

It is widely accepted that CMM emissions may be underestimated and are not always well understood. The Regulation aims to improve measurement, reporting and verification (MRV) of emissions so that other provisions of the regulation can be accurately enforced.

Latest revision tackles less than half of CMM emissions

Both the European Parliament and the European Council provided amendments to the initial proposal of the regulation throughout 2022 and into 2023, with a trend towards weakening its provisions, in particular, venting thresholds.
We analysed how the amendments on venting thresholds could impact EU CMM emissions.

Weakening of venting thresholds for thermal coal

The initial proposal of the EU methane regulation proposed a venting threshold of 0.5 tonnes CH4 per kilotonne of coal for thermal coal mines. This scenario would avoid 4.9 million tonnes of methane emissions by 2050, reducing CMM emissions by 25% compared to a business as usual scenario (see methodology for more detail).

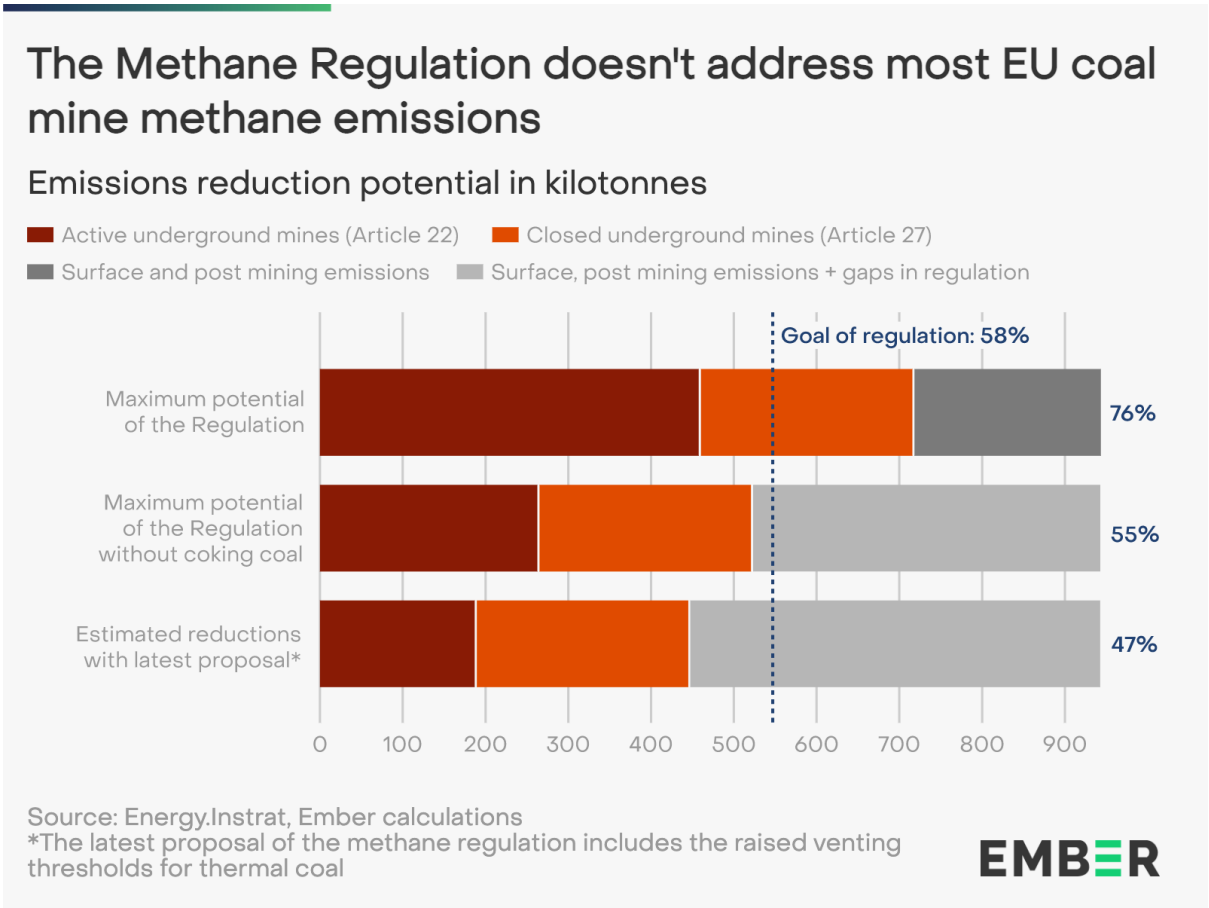
The latest revision to the regulation increased the venting threshold from 0.5 to 5 tonnes of CH4 per kilotonne of coal until 2031, after which the threshold will be lowered to 3 tonnes. This would emit 900 thousand more tonnes of methane by 2050 than the initial proposal.

Omission of venting threshold for coking coal

A major weakness of the Regulation is that the timeline to define a venting threshold for methane-intensive coking coal has been delayed from 3 to 5 years. Polish coking coal mines release around 200 thousand tonnes of methane per year, just under half of the emissions from active underground mines in the EU. Without imposing a venting threshold on coking coal mines the scope of the Regulation to reduce EU CMM emissions is capped at 55%.

Total impact of current loopholes

Our analysis found that the latest revision of the Regulation emits an extra 2.2 million tonnes of methane by 2050 when compared to its 58% reduction goal. Using methane's 20 year global warming potential, this is equivalent to 180 million tonnes of additional CO2-e, more than Belgium and Czechia's annual CO2 emissions combined.



Recommendations

Looking ahead

It is realistic for the EU methane regulation to deliver on its goal of 58% reductions this decade, by tightening venting thresholds for both thermal and coking coal mines, closing Poland's seven gassiest mines and mitigating or capturing methane from Romania's closed mines.

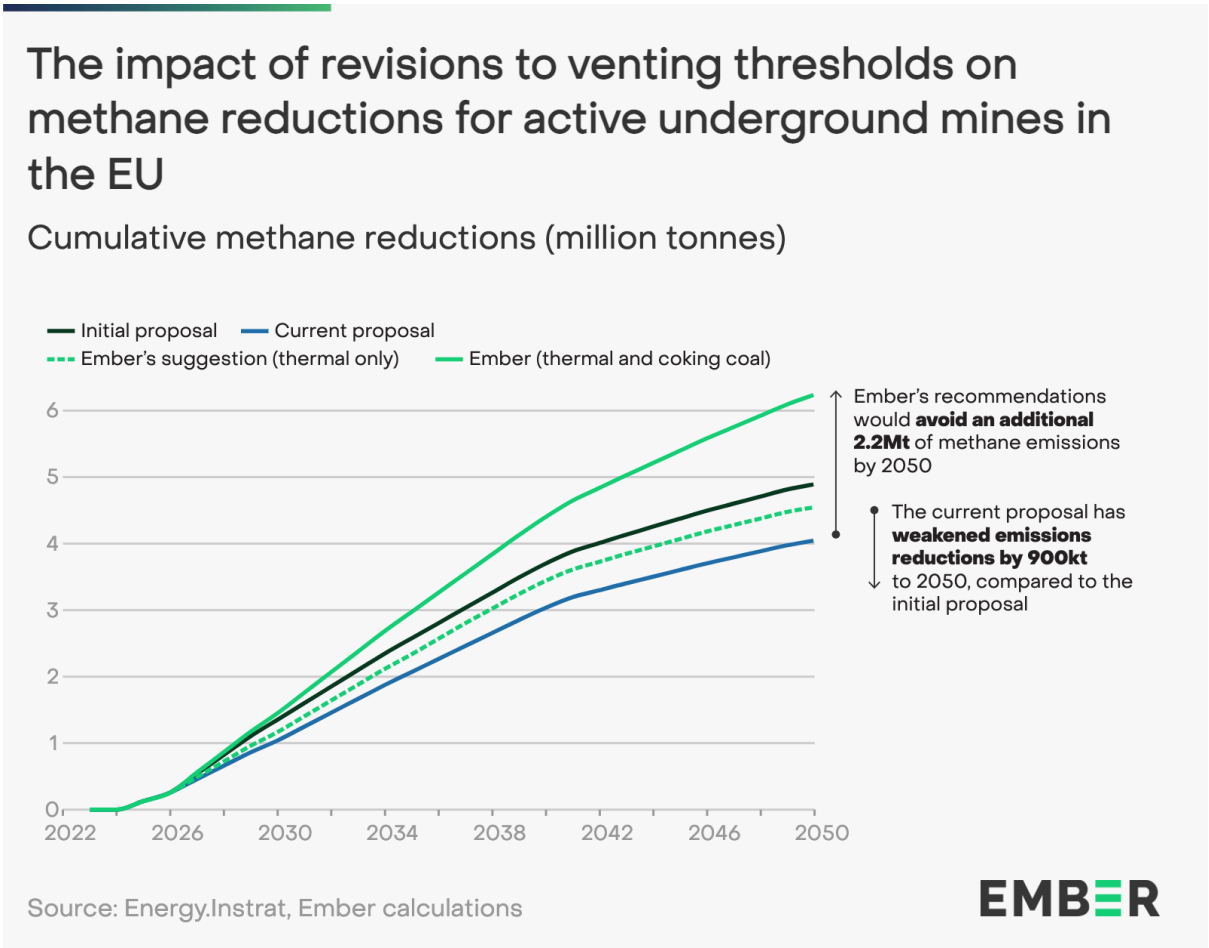
Tightening venting thresholds can put EU back on track for climate targets

To align with the EU's methane reduction goal of 58% this decade, *Article 22* needs to be strengthened to achieve at least a 30% reduction in methane leaks from active mines.

Our analysis found this is achievable. The venting thresholds on thermal mines should be no more than 3 tonnes methane/kilotonne of coal mined from 2027. This must be reduced to 1 tonnes methane/kilotonne of coal mined by 2030, ensuring no high-methane emitting underground thermal coal mines are active within the EU past this date.

For coking coal mines, we suggest the regulation should enforce a venting threshold of maximum 5 tonnes methane/kilotonne of coal from 2027.

Such a scenario would avoid at least 6.2 million tonnes of methane by 2050, reducing total CMM emissions by 31% versus the business as usual scenario.



Replace Poland's high-methane thermal coal

Whether a venting threshold of 0.5, 3, or 5 tonnes of methane per kilotonne of coal is legislated, it is likely that approximately three to seven of Poland's most gassy mines will struggle to meet venting requirements even with mitigation measures. For example, PGG who own five of the seven high-methane thermal coal mines claim they would have to close two thirds of their mines if the 0.5 tonnes methane per kilotonne coal venting threshold is legislated.

The seven high-methane thermal coal mines that are impacted by the legislation emitted all of Poland's reported methane emission for hard thermal coal (232 thousand tonnes) whilst only producing ~17Mt, or 40% of output. This is 25% of the EU's entire annual CMM emissions, for only 5% of the EU's total coal output.

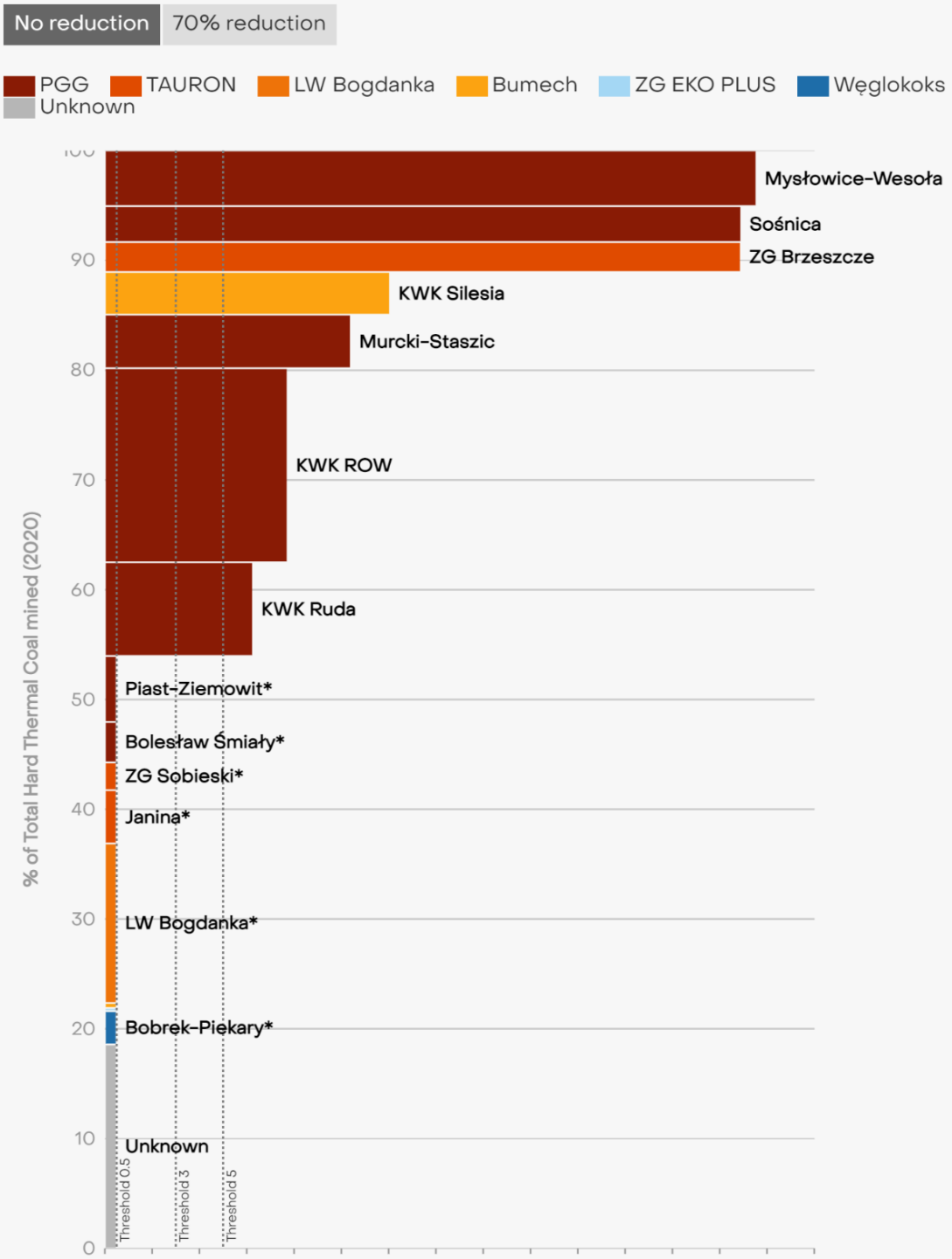
Low-methane mines on the other hand produced ~21 million tonnes of hard thermal coal the same year, with significantly less methane emissions (these mines don't report emissions, they are assumed to have a methane intensity below 1 tonne per kilotonne coal).

National data from eight low-methane hard coal mines indicate they have 1,660 million tonnes of coal reserves, enough to replace the current levels of Polish demand for at least the next 26 years. In reality there is likely to be a much lower demand for coal. Research by the Jagiellonian Institute estimates that Poland's current thermal hard coal demand will consistently decrease from the current 53 Mt in 2023 to 43-30 Mt by 2030 and 23-12 Mt by 2040 (depending on scenario). Already mines are closing as demand both within Poland and across the EU declines for coal-fired electricity.

We recommend that all high-methane thermal coal mines should be prioritised for retirement ahead of other mines, and residual production replaced with Poland's "low-methane" coal deposits.

Seven coal mines emit almost all of Poland's thermal coal methane emissions

Methane intensity of hard thermal coal mines in Poland (T methane / kT coal)



Source: Instrat (2020), Ember calculations
* Assumed low-methane mines have a methane intensity of 0.5 T methane/ kT coal

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Apply a venting threshold for coking coal

To achieve the required emissions reductions, coking coal mines must also reduce their emissions.

Ember suggests a maximum venting threshold of 5 tonnes methane per kilotonne of coal as it would require the mines to reduce their ventilation air methane emissions by on average 50% and is the minimum to keep EU climate targets within reach. This would avoid 3 million tonnes of methane emissions by 2050.

For example, simple improvements to the existing drainage and some additional investment in existing gas infrastructure can reduce emissions by around 40-80%. Poland's major coking coal company, JSW, has already received funding for their methane reduction programme, which plans to increase the capture of methane emissions by the drainage system above 50% and use this to produce electricity and heat.

The Global Methane Assessment found that these technologies are some of the cheapest methane mitigation options in any sector. According to their estimates, methane from coal mines can be mitigated at an average cost of €177 per tonne (less than €10 per tonne of CO2-e).

Improved methane control also reduces the risk of explosions in underground mines – a critical element of ensuring workers' health as inadequate drainage still leads to serious incidents and deaths today.

Tackle emissions from closed coal mines

European abandoned and closed mines emitted 257 thousand tonnes of methane in 2020, almost all of which is avoidable with mitigation measures such as mine flooding, or methane capturing and flaring/utilisation. If AMM mitigation is thoroughly implemented, the EU's total CMM emissions could be cut by ~25%.

Abandoned mine methane can also be a significant energy resource. The most common options for commercial methane utilisation are power generation (including CHP) and sale to natural gas pipelines. To extract gas from an abandoned mine, it must be sealed after which the gas can be collected with methane concentrations ranging from 15% to 90%. The quantity of AMM depends on geological conditions, and not all abandoned mines are suitable for AMM projects.

If Romania were to capture and utilise just half of its current AMM emissions, we estimate it could generate around 0.5 TWh of electricity as well as potential for local use of waste heat. This is equivalent to 75 million euros of electricity (using the January 2023 electricity price in Romania at a spot price of 136 euro per MWh) and enough waste heat to heat almost 19,000 hospital beds per year.

Ensure close monitoring of implementation

Once the Regulation is agreed there will still be several potential loopholes which can be abused. Member States have the power to designate the "competent authorities responsible for monitoring and enforcing the application of this Regulation" (*Article 4.1*), creating scope for national authorities to be sympathetic to local coal companies. This risk is heightened by worrying provisions such as the period between inspections being as much as five years (*Article 6.3*) and Member States themselves laying down the rules on applicable penalties (*Article 30.1*). In this context, the Commission and Member States are expected to form a network (*Preamble (10)*) which will be important for working on the practicalities of applying the Regulation.

Supporting Materials

Technical Information

Methane

When measured over a 20 year horizon, fossil methane has a global warming potential (GWP) 82.5 times more than CO2 despite its atmospheric lifetime of just 12 years compared to centuries for CO2. This makes rapidly reducing methane a prime target to slow climate change in order to stand a chance of limiting temperature rises to 1.5 degrees. Methane mitigation was highlighted by the IPCC as a vital step for short and long term gains on regulating surface temperature.

Coal Production

In 2021, EU countries mined 332 million tonnes of coal. An estimated 83% of which was lignite coal, whilst the remainder, 57 million tonnes, was hard coal. Lignite is predominantly used for electricity generation, and often mined from surface mines found in Germany, Poland, Czechia and Bulgaria. In 2021, coking coal represented 25% of the EU's hard coal production (14 million tonnes).

Poland

According to Eurostat, in 2021 Poland mined 96% of the EU's hard coal output (55 million tonnes) and was the second largest miner of lignite coal after Germany, mining 52 million tonnes that year. The country released 576 thousand tonnes (61% of Europe's CMM) in 2020. The majority of Poland's emissions (87%) are emitted from 12 deep underground hard coal mines, listed below. More information including reported methane emissions can be found on the Instrat website.

Budryk	JSW	Majority Coking
Pniówek	JSW	Majority Coking
Knurów-Szczygłowice	JSW	Majority Coking
Borynia-Zofiówka	JSW	Majority Coking
Jastrzębie-Bzie	JSW	Majority Coking

KWK Row	PGG	Majority Thermal
KWK Ruda	PGG	Majority Thermal
Murcki-Staszic	PGG	Majority Thermal
Sośnica	PGG	Majority Thermal
Mysłowice-Wesoła	PGG/SRK	Majority Thermal
ZG Brzeszcze	Tauron/SRK	Majority Thermal
KWK Silesia	Bumech	Majority Thermal

Czechia
Czechia is the only other European producer of hard coal, reportedly mining 2 million tonnes in 2021 which emitted 21 thousand tonnes of methane. This makes Czechia's hard coal methane intensity the highest in the EU, at 9.7 tonnes methane per thousand tonnes of coal. The country however emits most of its CMM emissions from surface mines (mining lignite coal), which amounted to 41 thousand tonnes of methane emissions in 2021.

Other EU countries
The remainder of coal producing EU countries mine lignite coal which can have a range of methane intensities. In 2021, Germany was by far the EUs largest miner of lignite, mining 126 million tonnes. Mined at surface mines, this coal is reported to have a very low methane intensity of on average 0.009 tonnes methane per kilotonne of coal - 1000 times less than EU hard coal methane intensities.

The most methane intensive lignite coal is mined in underground mines in Slovenia and Slovakia. The average methane intensity of these coals are 3.3 and 5.9 tonnes of methane per kilotonne of coal respectively.

Methane Regulation

The European Commission (EC) presented a proposal for a Regulation on methane emissions reduction in the energy sector in December 2021, as part of the 'Fit for 55' legislative proposals that aim to implement the European Green Deal with a view to achieving climate neutrality in the Union by 2050. To be on track for the EU's climate goals, methane emissions from the energy sector should decrease by around 58% by 2030 compared to 2020.

The EU's 2030 Climate Target Plan shows that the most cost effective methane emission savings can be achieved in the energy sector, which also means cutting coal mine methane emissions. Along with requirements on measurement, reporting and verification (MRV) for

surface, underground and closed mines, the legislation proposed mitigation requirements for underground mines.

Amendments to Article 22 of the Regulation:

Initial Proposal	Paragraph 1 Venting and flaring of methane from drainage stations shall be prohibited from [1 January 2025], except in the case of an emergency, a malfunction or where unavoidable and strictly necessary for maintenance. In such cases, drainage station operators shall vent only if flaring is not technically feasible or risks endangering safety of operations or personnel. In such a situation, as part of the reporting obligations set out in Article 23, drainage station operators shall demonstrate to the competent authorities the necessity to opt for venting instead of flaring.	Paragraph 2 Venting of methane through ventilation shafts in coal mines emitting more than 0.5 tonnes of methane/kilotonne of coal mined, other than coking coal mines, shall be prohibited from 1 January 2027.
Latest Revision (Revision 6)	Flaring with a destruction and removal efficiency below 98% and venting of methane from drainage stations shall be prohibited from [1 January 2025]…..	Venting of methane through ventilation shafts in coal mines emitting more than 5 tonnes of methane/kilotonne of coal mined, other than coking coal mines, shall be prohibited from 1 January 2027. Venting of methane through ventilation shafts in coal mines emitting more than 3 tonnes of methane/kilotonne of coal mined, other than coking coal mines, shall be prohibited from 1 January 2031. These thresholds shall apply per year per mine and per operator, if one entity operates several mines.

Methodology

Global Warming Potential
Global Warming Potential (GWP) is a measure to express the effects of GHGs in CO2 equivalent terms. Given that CH4 absorbs much more energy when in the atmosphere, but has a shorter lifetime than CO2, the IPCC considers its impact over 20 years (GWP = 82.5) and over 100 years (GWP = 29.8). One of the shortcomings of this metric is that it assumes a constant value of methane's effects over time, when in reality it varies significantly. Historically, the 100-year value has been used by Governments and in major international agreements on the basis that global warming is a long term challenge.

At Ember, we propose to use the 20-year GWP. Climate change is an emergency, and the next 20 years are critical with regards to climate action. Methane's short atmospheric lifetime means emissions reductions can reduce global heating in the near term.

Business As Usual scenario
We estimate that the twelve high-methane Polish coal mines would emit approximately 9.8 million tonnes of methane by 2050 if following a business as usual (BaU) scenario, including their established closure dates. We assume the "high methane" coal mines continue mining the same tonnage of coal every year, until their respective phase out dates. We also assume that the methane intensity of coal remains the same. This means our BaU estimates likely underestimate future methane emissions, as the methane intensity of the mines in question is likely to increase with time, as the mines dig deeper.

The analysis in this report is based on officially reported data (UNFCCC, and Polish nationally reported data), and consequently our estimated reduction potentials do not take into account any underreported CMM emissions. It is likely that some reduction potentials are greater than estimated in this analysis. Emission reduction strategies will need to improve quantification of emissions to apply meaningful targets.

As far as we are aware, "low-methane" mines do not currently report any methane emissions. Within our calculations we have therefore assumed that all reported emissions are only from the "high-methane" mines. Although we do expect low methane mines to have minor emissions, for lack of data we excluded them from this analysis.

Data Sources

We used publicly available data of coal production and methane emissions collated by Instrat from 12 "high methane" mines in Poland. These mines represented all of Poland's

and 93% of EU methane emissions from mining activities at underground mines, respectively.
All other methane emission data was collated from the IEA, and UNFCCC Greenhouse Gas Reporting database.

Acknowledgements

Acknowledgements

This report greatly benefited from the support and insights of: Jan Balcerowski at Instrat.

Cover image
Headframes at Chwalowice coal mine are seen at dawn in Rybnik, Poland in 2022. The mine is among the most methane-intensive in Europe. Credit: Reuters / Alamy