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The impact of the EU Methane Regulation on Poland's hard coal mining industry

Introduction

The core business risk of mineral companies is closely tied to internationally adopted environmental regulations; this also directly affects the hard coal mining industry. In particular, this concerns the implementation of climate and energy policies aimed at decarbonizing the economies of European Union member states.

Regulations introduced in recent years extend their scope to the year 2050. The goal is to achieve climate neutrality by this date, meaning an economy with net-zero greenhouse gas emissions (European Climate Law 2021). This vision was presented in November 2018 and was reflected in the European Council's conclusions on climate change. Achieving this objective aligns with the EU countries' commitment to global climate action under the Paris

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Agreement (Paris Agreement 2015). A key mechanism supporting this goal is the new EU Strategy to 2050, which aims to implement the European Green Deal program. To meet this target, a decision was made to intensify the reduction of greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This target was adopted in June 2021 by the European Council, in agreement with the European Parliament, as the European Climate Law – Regulation (EU) 2021/1119 (European Climate Law 2021).

The plan to achieve climate goals also includes measures to reduce the emissions intensity of the gas industry, including addressing methane emissions related to the energy sector. In October 2020, the European Commission adopted the EU Strategy to reduce methane emissions, outlining measures to decrease methane releases both within the EU and globally (European Parliament 2021).

The strategy for reducing methane emissions includes a range of specific guidelines and actions focused on monitoring, verifying, and reporting CH_4 emissions, enabling the implementation of instruments to mitigate these emissions (Jamrozik 2025). A key component of this strategy is the Regulation of the European Parliament and of the Council on reducing methane emissions in the energy sector, adopted by the Council of the European Union in May 2024, and amending Regulation (EU) 2019/924 (the "Methane Regulation") (European Parliament and Council of the European Union 2024).

1. Methane emissions in the EU – monitoring, reporting, and analysis of emission volumes

The release of pollutants into air, water, and soil, as well as the transfer of pollutants present in wastewater and waste beyond the point of origin by industrial companies in Europe, have been monitored since 2006. The key regulatory document in this regard is Regulation (EC) No 166/2006, which establishes the European Pollutant Release and Transfer Register (E-PRTR). The creation of the European PRTR aims to provide the public with access to environmental information and facilitate participation in environmental decision-making, as outlined in the Aarhus Convention, effective from October 30, 2001 (UNECE 1998).

The publicly accessible European PRTR contains data on pollutant releases to air, water, and soil, as well as the transfer of pollutants in wastewater and waste beyond their point of origin. The register includes information on 91 pollutants listed in Annex II to Regulation (EC) No 166/2006, including greenhouse gases, heavy metals, pesticides, and chlorinated organic compounds. In Poland, this is implemented through the National Pollutant Release and Transfer Register, established under Article 236a of the Environmental Protection Law of April 27, 2007. Operators of installations are required to submit information necessary for the National PRTR to the regional environmental protection inspector by March 31 of the year following the reporting period. The National PRTR is managed by the Chief Inspector of Environmental Protection, who annually submits a report to the European Commission containing data on releases and transfers (Republic of Poland 2007).

Releases must be reported if they exceed a certain threshold and result from one of the 65 activities listed in Annex I to Regulation (EC) No 166/2006. Most of these activities are regulated by Directive 2010/75/EU on industrial emissions and include, in particular, facilities in sectors such as energy production, metal production and processing, mineral industries, chemical industries, waste and wastewater management, paper and wood production and processing, intensive livestock farming or breeding, animal and plant product processing in the food sector, and other activities, such as textile production and tanning. The register also includes, where available, data on pollutant releases from diffuse sources to air and water.

In 2019, Regulation (EC) No 166/2006 was amended by Regulation (EU) No 1010/2019 to align and simplify reporting requirements in EU environmental legislation. The amending regulation, among other things, granted the European Commission the authority to adopt implementing acts specifying the type, format, and frequency of data submission for reporting purposes under Regulation (EC) No 166/2006. Through Commission Implementing Decision (EU) 2019/1741, changes were introduced to the European PRTR, standardizing the reporting process and shortening the timelines for collecting and publishing emission data, e.g., methane emissions (European Parliament and Council of the European Union 2006).

The issue of methane emissions from industrial sectors is evident across the European Union (Figure 1) (EEA 2025). Although CH_4 emissions in the European Union decreased by 37,6% from 1990 to 2022 (Crippa et al. 2023), in recent years, due to the EU's dynamic environmental policy, actions to reduce emissions of this gas have been intensified. The primary emitters include Poland, Spain, and Portugal. The case of Poland is particularly special, because the country's total emissions constitute nearly 50% of the total methane emissions in the EU countries, with approximately 95% of them stemming from the coal, oil, and gas industry. This is largely because Poland is the only significant hard coal producer in the EU, making it particularly affected by regulations arising from implemented legislation. Notably, the current regulation imposes limits and associated penalties only on methane emissions related to hard coal production, while emissions from lignite, natural gas, and oil industries are subject only to monitoring and reporting requirements.

Reducing methane emissions through internal regulations is also a matter of interest in countries outside the European Union. International commitments on this matter were discussed at the COP29 summit in Baku in 2024 (UNFCCC Report 2025). That same year, China introduced stricter regulations on methane emissions from coal mines, mandating the capture of gas from mines with methane concentrations of 8% or higher and emission rates exceeding 10 m^3 per minute. These rules are scheduled to take effect on January 1, 2027 (Wang et al. 2025). The United States adopted regulations in 2022 requiring companies to pay fees for excessive methane emissions, though these rules may be suspended starting in 2025 (Ramseur 2022). Other major coal-producing countries, such as India and Indonesia, are also making efforts to reduce methane emissions; however, current frameworks do not impose binding quantitative targets or penalties for mine owners. Australia has been intensifying initiatives to utilize methane from coal seams for electricity generation (Alarcon

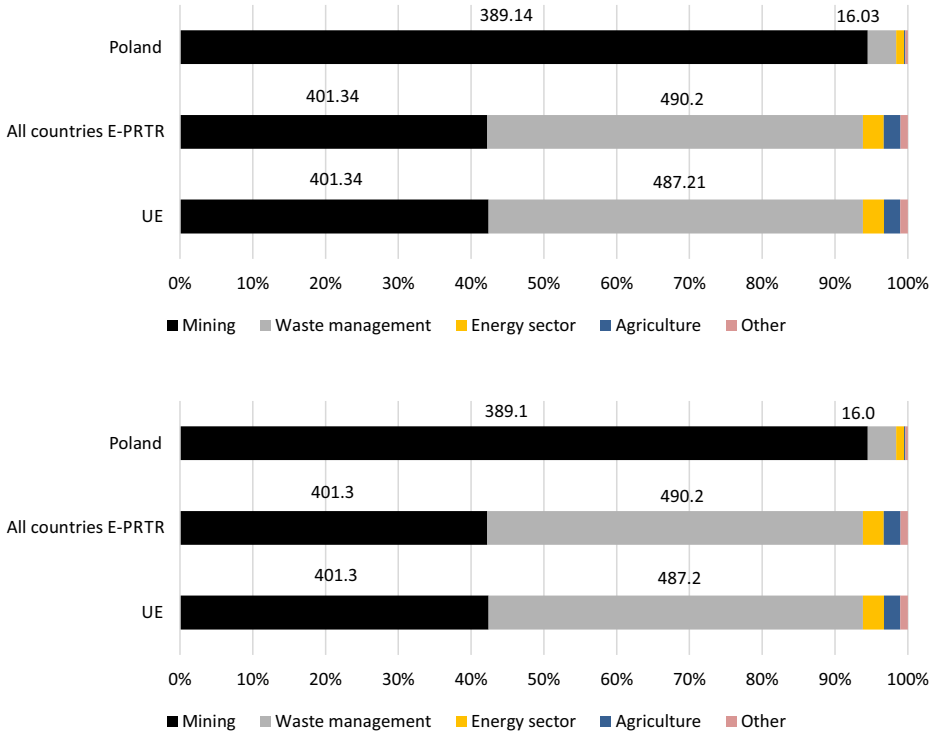

Fig. 1. Methane emissions by sector, 2023 (kt)

Rys. 1. Emisje metanu w podziale na sektory, 2023 r. (kt)

Vigil et al. 2025). Only Russia – despite being one of the world's largest emitters of methane and a leading coal producer – has not taken concrete actions to limit methane emissions, despite the fuel and energy sector being the primary source of these emissions.

2. The "Methane Regulation" – impact on hard coal mining

The "Methane Regulation" addresses methane emissions in the oil, natural gas, and coal sectors (European Parliament and Council of the European Union 2024). Chapter 4 outlines the obligations of operators and Member States regarding the measurement and reporting of methane emission data in the coal sector, as well as requirements for emission reduction.

Obligations related to monitoring and reporting emissions are detailed in Article 20 of the Regulation. Article 22 specifies provisions concerning methane releases in active underground coal mines.

In the original version of the Regulation, planned for implementation, these provisions were as follows:

1. Venting and flaring of methane from drainage stations shall be prohibited from [January 1, 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 the safety of operations or personnel. In such a situation, as part of the reporting obligations set out in Article 23, drainage station EN 42 EN operators shall demonstrate to the competent authorities the necessity to opt for venting instead of flaring.

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 January 1, 2027.

On December 15, 2023, additional amendments to the Regulation were voted on, with the final text as follows:

1) Flaring with a destruction and removal efficiency by design level below 99% and venting of methane from drainage systems shall be prohibited from January 1, 2025, except in the case of an emergency or a malfunction, or where unavoidable and strictly necessary for maintenance, and except of venting in accordance with paragraph 2. In such cases, drainage station operators shall vent only if flaring is not technically feasible or risks endangering the 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 of venting instead of flaring.

2) Venting of methane through ventilation shafts in coal mines emitting more than 5 tonnes of methane per kilotonne of coal mined, other than coking coal mines, shall be prohibited from 1 January 2027, except in the case of an emergency.

Venting of methane through ventilation shafts in coal mines emitting more than 3 tonnes of methane per kilotonne of coal mined, other than coking coal mines, shall be prohibited from January 1, 2031, except in the case of an emergency.

Those thresholds shall apply per year, per mine, and per operator if one entity operates several coal mines.

4) … Member States may use a system of incentives to reduce methane emissions based on fees, charges or penalties, as referred to in Article 33, in order to ensure that operators of existing coal mines comply with the obligations, set out in paragraphs 1 and 2 of this Article.

Point 1 of Article 22 is supplemented by point 6 of Article 15, which states:

6) … flaring shall be allowed only where either re-injection, utilisation on-site, storage for later use, or dispatch of methane to a market are not feasible for reasons other than economic considerations. In such a situation, as part of the reporting obligations set out in Article 16, operators shall demonstrate to the competent authorities the necessity to use flaring instead of either re-injection, utilisation on-site, storage for later use, or dispatch of methane to a market.

Chapter 6, Article 30, provides information on penalties; however, detailed provisions regarding their amounts, applicable in cases of non-compliance with the Regulation, are to be determined by individual Member States within three months of the Regulation's entry into force. Consequently, the publication of rules for calculating and determining penalty amounts should therefore occur by August 5, 2025. As of August 31, 2025, no Member State has released the relevant implementing legislation.

The specified provisions pertain to methane emissions from underground coal mines. According to Article 22, paragraph 2, the provisions do not cover coking coal mines, defined as mines where at least 50% of the volume of production over the last three years was coking coal. Nonetheless, the Regulation stipulates that, in order to establish a framework for the gradual reduction of methane emissions in coking coal mines, the European Commission may be empowered to adopt delegated acts in accordance with Article 290 of the Treaty on the Functioning of the European Union (TFEU). Such acts would supplement the Regulation by introducing future restrictions on methane emissions from ventilation shafts in coking coal mines in the following years.

Additionally, the Regulation imposes an obligation on the European Commission to establish and maintain a publicly accessible database to enhance transparency regarding methane emissions by February 5, 2026 at the latest. This database is to contain information on companies, importers, and quantities of oil, natural gas, and coal from Member States and third countries placed on the Union market.

Among the Regulation's key requirements for operators (i.e., mine owners) are the provisions that, effective January 1, 2025, gas flaring is prohibited and specific emission limits apply to methane released into the atmosphere through coal mine ventilation shafts. The principal compliance strategy under these provisions involves the capture and proper management of methane. Moreover, the Regulation permits operators conducting production activities across several mines to account for emissions collectively. This flexibility may be particularly beneficial in the context of coal production from mines with low methane concentrations, potentially mitigating operational risks associated with continued operations in subsequent years.

3. Possibilities for meeting methane regulation limits – the case of Poland

The provisions of the regulation concerning methane emissions in the coal sector will most significantly impact operators of hard coal mines in Poland, due to the still high level of production of this mineral. For this reason, an analysis of the possibilities for complying with the regulation's limits and the necessary actions to mitigate the risk of additional charges was conducted using the example of domestic mine operators (mining corporations) for the period 2027–2030 and from the beginning of 2031.

3.1. Methane in Polish mines – as of 2024 (coal mining, emissions)

In 2024, hard coal mining in Poland was conducted in 19 underground mines, of which 6 were large, joined coal mines. The mining takes place in both methane-bearing and non-methane-bearing beds. The highest absolute methane emissions (above 40 million m^3/year) were recorded in the mines of JSW Corp. (Budryk mine, Pniówek mine, Knurów-Szczygłowice mine, and Borynia-Zofiówka mine), PKW Corp. (Brzeszcze mine), and PGG Corp. (Mysłowice-Wesoła mine and Chwałowice mine). A second group of mines with slightly lower absolute methane emissions (above 30 million m^3/year) includes PGG mines (Sośnica and Staszic-Wujek, Murcki-Staszic). Among the mines exploiting non-methane-bearing beds are the mines of PKW (Janina, Sobieski), PGG (Piast-Ziemowit, Bolesław-Śmiały), LW Bogdanka Corp., Węglokoks KRAJ Ltd. (Bobrek), as well as private mines Siltech Ltd. and Eko-Plus Ltd. (SMA 2025).

However, the regulation limits pertain to methane releases from ventilation shafts. Therefore, in the context of meeting the regulation's requirements, the so-called ventilation air methane (VAM) capacity is significant; it represents the absolute methane emissions (coal mine methane, CMM) reduced by the volume of captured gas that has been sold to external recipients or utilized, for example, for electricity and heat production. This practice has become increasingly common among mining companies in recent years (Łukaszczyk and Nawrat 2022).

3.2. The degree of preparedness of Polish mining to meet the requirements of the Methane Regulation

The regulation will significantly impact selected mining companies. Among the companies most affected by the regulation's provisions are PGG, which conducts mining operations in 13 mines, 10 of which are methane-bearing mines; PKW, which operates 3 mines, with methane emissions to the atmosphere occurring only at the Brzeszcze mine; and Bumech, which conducts operations at the Silesia mine. The coal seams mined by Węglokoks KRAJ, LW Bogdanka, ZG Siltech, and Eko-Plus are non-methane-bearing, meaning there is no risk of penalties due to the implementation of the regulation. Currently, mines where 50% of the produced resource is coking coal are also exempt from the regulation's provisions, which consequently does not currently require JSW to comply with the regulation/s requirements.

The mine methane index (MMI) in PGG mines varies significantly. In 2024, the highest values were recorded at Sośnica mine (42.9 m^3 CH_4/Mg of coal) and Mysłowice-Wesoła mine (35.3 m^3 CH_4/Mg of coal), while the average for the entire PGG was 14.1 m^3 CH_4/ Mg of coal. The mine methane index at Brzeszcze mine (PKW) in 2024 was 87.7 m^3 CH_4/Mg of coal, while the average for the entire PKW was 16.4 m^3 CH_4/Mg of coal. The mine methane index for Bumech, which operates a single mine (Silesia), was 31.7 m^3 CH_4/Mg

Table 1. Methane emissions from Polish coal mines, 2024 – selected indicators

Tabela 1. Emisja metanu z polskich kopalń węgla kamiennego w 2024 r. – wybrane wskaźniki

No.	Mine	Absolute methane emission (mln m^3 per year)	Ventilation methane emission (mln m^3 per year)	Methane capture rate (%)
Polska Grupa Górnicza S.A. (PGG Corp.)				
	ROW joined coal mine			
1	Marcel mine	13.3	10.4	22.2
2	Rydułtowy mine	14.8	11.0	25.7
3	Jankowice mine	16.6	12.0	27.8
4	Chwałowice mine	27.4	18.2	33.7
	Ruda joined coal mine			
5	Halemba mine	21.5	14.8	30.9
6	Bielszowice mine	14.6	14.2	2.7
	Piast-Ziemowit joined mine			
7	Piast mine	–	––	–
8	Ziemowit mine	–	–	–
	Staszic-Wujek joined mine			
9	Murcki-Staszic mine	32.4	24.2	25.2
10	Wujek mine	1.9	1.5	24.2
11	Bolesław Śmiały mine	– (~0.1)	– (~0.1)	– (~0.0)
12	Sośnica mine	45.0	20.9	53.5
13	Mysłowice-Wesoła mine	51.2	32.1	37.2
Południowy Koncern Węglowy S.A. (PKW Corp.)				
1	Janina mine	–	–	–
2	Sobieski mine	–	–	–
3	Brzeszcze mine	87.7	41.7	52.5
Lubelski Węgiel Bogdanka S.A. (LWB Corp.)				
1	Bogdanka mine	–	–	–
Węglokoks KRAJ Sp. z o.o. (WKRAJ Ltd.)				
1	Bobrek-Piekary mine	–	–	–
Jastrzębska Spółka Węglowa S.A. (JSW Corp.)				
	Borynia-Zofiówka mine			
1	Borynia mine	22.3	16.8	244.0
2	Zofiówka mine	67.9	47	30.7

No.	Mine	Absolute methane emission (mln m^3 per year)	Ventilation methane emission (mln m^3 per year)	Methane capture rate (%)
	Knurów-Szczygłowice mine			
3	Knurów mine	42.5	37.5	11.8
4	Szczygłowice mine	62.5	39.2	37.3
5	Budryk mine	100.6	53.6	46.8
6	Pniówek mine	86.8	54.8	36.9
Private mines				
1	Silesia mine (Bumech Corp.)	27.3	13.1	51.9
2	Siltech mine (Siltech Ltd.)	–	–	–
3	Eko-Plus mine (Eko-Plus Sp. Ltd.)	–	–	–

Source: own elaboration based on data from Poland's State Mining Authority (SMA 2025) and coal companies.

of coal in 2024. Values determined based on the absolute methane emissions of the mines and the production of coal in 2024 for individual mines and companies (Equation 1) are presented in Figure 2 (PGI-NRI 2024; SMA 2025).

$$\text{Mine Methane Index}\left[\frac{m^3CH_4}{\text{Mg coal}}\right]=\frac{\text{Absolute Methane Emission}\left[m^3CH_4\right]}{\text{Coal production}\left[\text{Mg coal}\right]} \quad (1)$$

↳ Absolute Methane Emission and coal production based on data from Poland's State Mining Authority (SMA 2025) and coal companies data.

The EU Methane Regulation limits pertain to the release of methane into the atmosphere from ventilation shafts in coal mines. The primary and fundamental action is therefore the capture and utilization of methane, which leads to a reduction in its emissions. A key parameter is the methane capture rate, which indicates the volume of gas captured relative to the total methane released. The Methane Regulation limits apply to the emissions of the remaining (uncaptured) volume. In PGG's methane-bearing mines in 2023, the gas capture rate ranged from 2.7% (Bielszowice mine) to 53.5% (Sośnica mine). The Chwałowice and Jankowice mines are connected by mine workings, with methane directed to the degassing station in Jankowice, which was accounted for in the analysis. The average methane capture rate in PGG in 2023 was only 33.1%. As mentioned earlier, PKW operates three mines: Sobieski, Janina, and Brzeszcze. The first two facilities operate in non-methane-bearing beds, while the Brzeszcze mine operates in methane-bearing beds of the highest methane

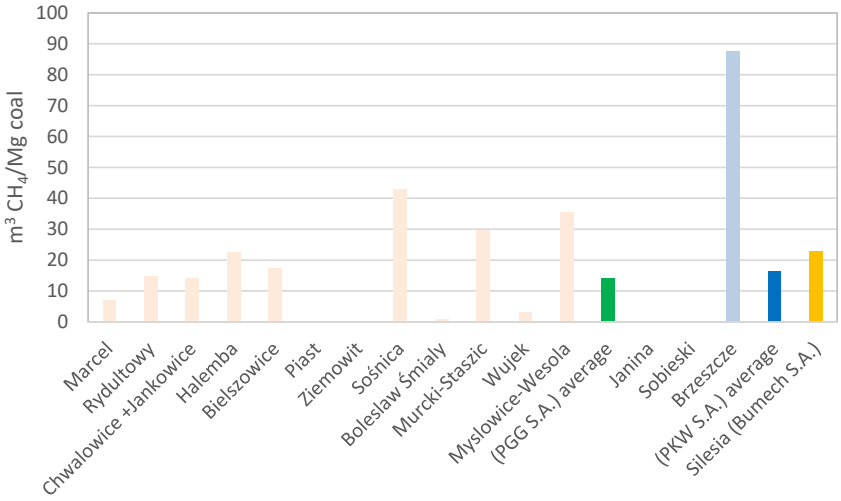

Fig. 2. Mine Methane Index (MMI) based on Absolute Methane Emissions and production of coal (2024)

Rys. 2. Wskaźnik metanowości kopalń wyznaczony na podstawie metanowości bezwzględnej (2024 r.)

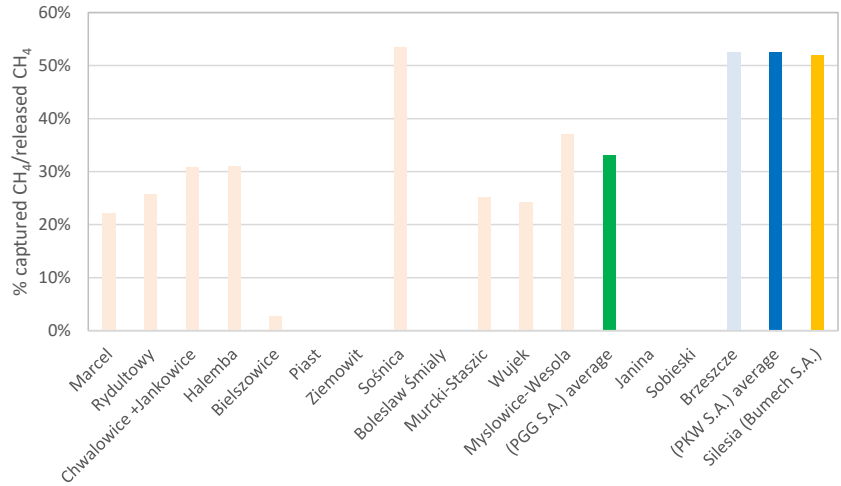

Fig. 3. Methane capture index in the mines of PGG, PKW and Bumech corporations (2024)

Rys. 3. Wskaźnik ujęcia metanu w kopalniach PGG S.A., PKW S.A., Bumech S.A. (2024 r.)

hazard category. The CH_4 capture rate at the last mine is among the highest in the Polish hard coal mining industry, reaching 52.5% in 2023 and 49.8% in 2024. Similarly high values, exceeding 50%, are achieved at PG Silesia, owned by Bumech (SMA 2025).

A key parameter in the context of meeting the requirements of the Methane Regulation is the methane emission index (mass-based), which takes into account VAM emissions and defines the proportion of released CH_4 relative to the amount of produced coal. According to the Regulation, starting from 2027, the mass-based methane emission index (expressed in Mg) calculated on this basis per 1,000 Mg of produced coal must not exceed 5 (and from 2031, it must not exceed 3). The Regulation allows for the collective accounting of a group of mines or a company, as the established threshold is applied annually on a per-mine and per-operator basis if a single entity operates multiple mines.

Based on data regarding hard coal production and the VAM emissions, the mass-based methane emission index per 1,000 Mg of produced coal was estimated. To determine this index, methane emissions were expressed in Mg, assuming a methane density of 0.717 kg/m^3. In 2024, the mass-based index for individual methane-bearing mines of PGG ranged between 1.8 (Wujek mine) and 15.9 (Mysłowice-Wesoła mine), while the average index for the entire PGG was 6.8 Mg CH_4/1000 Mg of coal. It should be noted that in 2023, due to higher coal production in non-gassy mines, this index was only 5.5. In 2024, the mass-based index at Brzeszcze mine was 31.6 Mg CH_4/1000 Mg of coal, and when considering coal production in the company's mines (Janina, Sobieski), the index for the entire PKW was 5.9 Mg CH_4/1000 Mg of coal. For Silesia mine, the mass-based methane emission index per 1,000 Mg of produced coal in 2024 was 7.9. The estimated mass-based methane emission index values per thousand Mg of produced coal for individual mines (Equation 2) are presented in Figure 4. The black line indicates the limit applicable from 2027, while the red line denotes the limit that will apply from the beginning of 2031.

$$\text{Mass-based methane emission index} \left[\frac{\text{MgCH}_4}{1000\ \text{Mg coal}}\right] = \tag{2}$$

$$= \frac{\text{Ventilation air methane emission}\ [\text{MgCH}_4]}{\text{Coal production}\ [\text{Mg coal}]}$$

↳ Ventilation air methane emission and coal production based on data from Poland's State Mining Authority (SMA 2025) and coal companies data.

3.3. Discussion of results – analysis of potential measures to meet the requirements of the EU Methane Regulation

Analysis of the possibilities for adapting mining production to the requirements of the Methane Regulation includes a review of key actions that can be implemented by mining companies. The source data considered in the analysis, concerning the volumes of hard coal

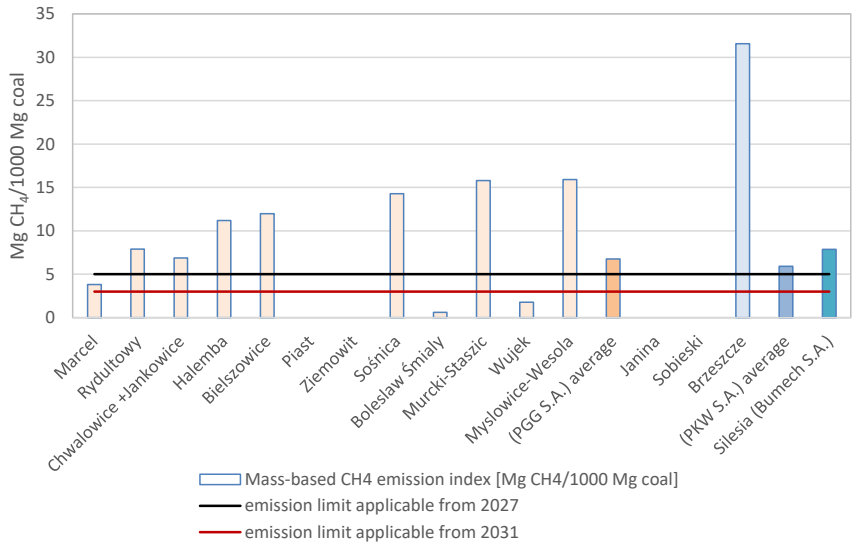

Fig. 4. Estimation of the mass-based methane emission index (based on 2024 data) per thousand Mg of coal produced for individual mines of PGG, PKW, and Bumech corporations

Rys. 4. Oszacowanie wskaźnika emisji metanu (według danych z 2024 r.) w odniesieniu na 1000 Mg wydobytego węgla dla poszczególnych kopalń PGG S.A., PKW S.A., Bumech S.A.

production, methane emission, and the methane capture rate, were based on 2024 values. Additional factors affecting the operation of mining companies were also taken into account, including the schedule for mine closures in accordance with the Social Agreement of 2021 (Agreement 2021).

The first of the possible actions is to increase the methane capture rate from the ventilation shafts. Importantly, to reduce emissions of captured methane, its full utilization is necessary, which is achievable through the sale of methane to external recipients or by using the gas to generate electricity and heat in proprietary installations. Mining companies must strive for the complete utilization of captured methane. In this context, at the largest mining company, PGG, the methane utilization rate should improve in the future. According to the company's data, in 2023, the average utilization rate was only 69.2%. In the tables, for each mining company, the values of the capture rate at which compliance with the Regulation's limits would be feasible (assuming 100% utilization of captured methane) are indicated, which is a necessary condition due to the prohibition of methane flaring (effective from the beginning of 2025).

Experiences from the domestic hard coal mining industry and current data obtained from mining companies indicate that the average volume of methane captured from the total volume of released methane was around 30% at the beginning of the last decade (Kaliski et al. 2014), while currently, this rate ranges between 35% and 50%. At PGG, in 2023–2024,

this rate was 33–34% and would need to reach 50% by 2027 if the low coal production levels from 2024 are maintained. Increasing this efficiency to approximately 50% would allow the company to avoid additional charges in the years 2027–2030. PGG is also undertaking investment projects related to the construction of additional gas engine generator sets powered by methane, which will allow for a short-term reduction in the volume of CH_4 emitted from degasification stations. At PKW, the methane capture rate is currently 52.5%, and it would need to increase by 7 pp to meet the limits, while at PG Silesia, it is around 50% and would need to increase by 20 pp.

While the efficiency of methane capture in longwalls can reach up to 70%, at the scale of an entire mine or company, the technical limit is only around 50%, which is related to the technical constraints of the methane drainage process. For this reason, such actions will be effective only in PGG mines, as both in Brzeszcze mine (PKW) and Silesia mine (Bumech), improvements in methane capture (and an increase in the capture rate) are limited due to technical constraints.

In addition to actions aimed at increasing methane capture, measures related to changing the production model are also possible, such as reducing production in methane-emitting coal mines or increasing production in non-gassy mines. In this context, production volumes that would enable compliance with the Regulation's requirements were determined for each of the companies.

Table 2. Analysis of potential measures to meet the requirements of the EU Methane Regulation for PGG Corp.

Tabela 2. Analiza możliwych działań w celu wypełnienia limitów Rozporządzenia Metanowego dla PGG S.A.

Parameter	Unit	2023	2024	2027 (fc)	2031 (fc)
Coal production	1,000 Mg	21,100	17,000	15,550	13,500
Absolute methane emission	m^3 CH_4	243,170	239,620	219,000	190,150
Ventilation air methane emission	m^3 CH_4	160,590	160,190	146,530	127,210
Ventilation air methane emission	Mg	115,140	114,860	105,060	91,200
Methane capture rate (share of CH_4 captured within the designated area)	%	34.0	33.1	33.1	33.1
Mass-based methane emission index (as defined in the EU Methane Regulation)	Mg CH_4 per 1000 Mg coal	5.5	6.8	6.8	6.8
Proposed solutions					
Increase required methane capture rate to meet the EU Methane Regulation limit	%	39.5 (↑5.5 pp.)	50.5 (↑17.4 pp.)	50.5 (↑17.4 pp.)	70.3 (↑17.4 pp.)
Increase coal production in non-gassy mines	1,000 Mg	1,875	5,970	5,460	16,900
Decrease coal production in mines with the highest methane content (methane-emitting coal mines)	1,000 Mg	1,480	2,740	2,500	3,930

Source: own elaboration.

In PGG (Table 2), maintaining the 2024 mine production levels would require an increase in production from non-gassy mines by nearly 5,500 thousand Mg to meet the methane emission limit (5 Mg CH_4/1,000 Mg of coal) by 2027, which is a challenging task. An alternative is to reduce production in methane-emitting coal mines by approximately 2,500 thousand Mg. Analysis for 2031, with a reduced methane emission limit of 3 Mg CH_4/1,000 Mg of coal, indicates the need to decrease production in methane-emitting coal mines by 3,930 thousand Mg, which would significantly impact production and sales. Therefore, production reduction measures must be complementary to other methane emission reduction actions outlined earlier. The analysis, in line with the Social Agreement, already accounts for the phasing out of production at Bolesław-Śmiały mine (2028) and Sośnica mine (2029). At the same time, it is worth noting that the higher coal production level in non-gassy mines in 2023 resulted in a significantly lower mass-based methane emission index (5.5 Mg CH_4/1,000 Mg of coal), meaning that changes in the production structure to meet emission limits would not need to be as substantial.

In PKW (Table 3), actions related to reducing production in the methane-emitting coal mine (Brzeszcze) or increasing production in non-gassy mines (Sobieski, Janina) are also possible. In the first case, an estimated analysis for 2027 indicates the need to reduce production

Table 3. Analysis of potential measures to meet the requirements of the EU Methane Regulation for PKW Corp.

Tabela 3. Analiza możliwych działań w celu wypełnienia limitów Rozporządzenia Metanowego dla PKW S.A.

Parameter	Unit	2023	2024	2027 (fc)	2031 (fc)
Coal production	1,000 Mg	4,500	4,500	4,470	3,860
Absolute methane emission	m^3 CH_4	87,710	73,640	73,280	63,200
Ventilation air methane emission	m^3 CH_4	41,670	36 990	36 780	31 700
Ventilation air methane emission	Mg	29,870	26,520	26,370	22,750
Methane capture rate (share of CH_4 captured within the designated area)	%	52.5	49.8	49.8	49.8
Mass-based methane emission index (as defined in the EU Methane Regulation)	Mg CH_4 per 1,000 Mg coal	6.6	5.9	5.9	5.9
Proposed solutions					
Increase required methane capture rate to meet the EU Methane Regulation limit	%	64.2 (↑11.7 pp.)	57.4 (↑7.6 pp.)	57.4 (↑7.6 pp.)	74.4 (↑24.6 pp.)
Increase coal production in non-gassy mines	1,000 Mg	1,470	800	800	3,700
Decrease coal production in mines with the highest methane content (methane-emitting coal mines)	1,000 Mg	380	150	150	390

Source: own elaboration.

(and consequently methane emissions) by approximately 150 thousand Mg at Brzeszcze mine. Alternatively, if production in non-gassy mines can be increased, the additional coal production volume is estimated at around 800 thousand Mg in 2027. By 2031, due to stricter limits, these values would need to be 390 thousand Mg (reduction) or 3,700 thousand Mg (increase), respectively.

In Bumech (Table 4), due to the high methane content of the deposits exploited by Silesia mine, reducing production volume alone cannot ensure compliance with the Methane Regulation limits. The owner's announcements indicate the possibility of utilizing the deposit's resources and continuing production for another 4–8 years. However, as early as 2027, achieving a methane emission rate below the required limit (5 Mg CH_4/1,000 Mg of coal) will not be feasible due to the high methane content of the deposit. As previously mentioned, technical limitations also restrict improvements in methane capture. To further comply with the Regulation's limits without incurring additional costs, it is possible to integrate the mine into another mining company.

Table 4. Analysis of potential measures to meet the requirements of the EU Methane Regulation for Bumech Corp.

Tabela 4. Analiza możliwych działań w celu wypełnienia limitów Rozporządzenia Metanowego dla Bumech S.A.

Parameter	Unit	2023	2024	2027 (fc)	2031 (fc)
Coal production	1,000 Mg	900	1,200	1,200	-
Absolute methane emission	m^3 CH_4	23,610	27,340	27,340	-
Ventilation air methane emission	m^3 CH_4	11,620	13,160	13,160	-
Ventilation air methane emission	Mg	8,331	9,436	9,436	-
Methane capture rate (share of CH_4 captured within the designated area)	%	50.8	51.9	51.9	-
Mass-based methane emission index (as defined in the EU Methane Regulation)	Mg CH_4 per 1,000 Mg coal	9.3	7.9	7.9	-
Proposed solution					
Increase required methane capture rate to meet the EU Methane Regulation limit	%	73.4 (↑22.6 pp.)	69.4 (↑17.5 pp.)	69.4 (↑17.5 pp.)	–

Source: own elaboration.

Conclusions

Efforts to reduce methane emissions are evident not only in the European Union but also globally, although the pace of actions in this regard varies. The adopted regulation on methane emissions in the energy sector places primary emphasis on reducing gas emissions

in hard coal mines, which disproportionately affects Poland – the only EU country where hard coal mining is still carried out on a large scale.

In this context, the EU Methane Regulation poses a significant challenge for domestic mining companies. However, amendments introduced in its final version, including raising the methane emission limit to 5 Mg CH_4 per 1000 Mg of coal, provide opportunities to mitigate the risk of incurring additional fees for exceeding the limits set by the Regulation, provided appropriate measures are implemented.

Analysis indicates that domestic companies are pursuing increasingly effective methane management policies, and the risk of unforeseen additional incidents in this area is assessed as low. To comply with the requirements of the Methane Regulation, it will be necessary to undertake actions related to:

- increasing the utilization of captured methane,
- improving the efficiency of methane capture by methane drainage systems, and
- reducing production in methane-emitting coal mines or increasing production in non-gassy mines.

The utilization of captured methane is a fundamental action, as recovered gas can be sold or used for heat and electricity production, a practice that has become increasingly common among mining companies in recent years.

Under local conditions, methane capture efficiency can reach up to 70%. However, at the level of an entire mine or mining company, due to technological limitations and the dispersed nature of emissions, the maximum achievable efficiency is approximately 50%. Mining companies (mainly PGG S.A.) must strive to increase methane capture efficiency to this value, wanting to avoid additional fees in 2027–2030. Further actions that could be taken by PGG include limiting production in non-gassy mines while increasing production in methane-emitting coal mines. This would make it possible to meet the regulation limits beyond 2031 as well.

In the case of PKW, increasing the share of utilized methane is not feasible, as the current utilization rate is already close to 100%. Reducing emissions of captured gas by increasing capture efficiency is also limited – currently, Brzeszcze mine has one of the highest methane capture rates at 52.5% (2023), which represents the technical limit under existing conditions. A justified course of action is to change the coal production structure. To meet the regulatory requirements in 2027–2030, it would be necessary to reduce production at Brzeszcze mine (by approximately 150,000 Mg) or increase production at the remaining mining sites (by approximately 800,000 Mg). These actions could be further expanded to comply with emission limits from 2031 onwards.

Due to the high methane content of the deposit mined by Bumech (Silesia mine) and the technical limitations in increasing methane capture, achieving the required methane emission levels after 2027 will become impossible without a change in operational strategy. Integrating the mine into another mining company may be the only realistic alternative that would allow continued operation without incurring penalties for exceeding emission limits set by the regulation.

It is important to stress that in reducing emissions, companies must prioritize the primary goal of methane drainage, which is to ensure a high level of safety for mining operations and miner health – a requirement also explicitly stated in the regulation. There are also potential technologies for the utilization of methane released through ventilation shafts, but these are extremely expensive and virtually impossible to implement in Polish mines due to very low gas concentrations. National legislation defining penalties for exceeding emission limits will also be crucial for the continued operation of mining companies.

A cost analysis of individual solutions could be the subject of further research, and the analysis should result in the development of strategies to meet the requirements of the regulation. From the perspective of the majority owner of mining companies – the State Treasury – a potential solution could be the consolidation of mine operators belonging to various coal companies. Such integration would allow the methane emission balancing potential of non-gassy mines, such as Bogdanka (LWB), to be used to meet regulatory requirements after 2031. As a result, continued production in methane-emitting coal mines would be possible in accordance with the provisions of the Social Agreement and the needs of domestic energy producers and individual consumers.

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THE IMPACT OF THE EU METHANE REGULATION ON POLAND'S HARD COAL MINING INDUSTRY

Keywords

methane emission, the EU Methane Regulation, mining industry, coal production

Abstract

The Regulation of the European Parliament and of the Council on reducing methane emissions in the energy sector (the Methane Regulation) places significant emphasis on reducing methane emissions from hard coal mines. This issue is particularly acute for Poland, the only EU country where hard coal mining is still carried out on a large scale. Starting in 2025, the flaring of gas and venting of methane from drainage systems shall be prohibited. Furthermore, starting in 2027, the Regulation bans the release of methane into the atmosphere from ventilation shafts in coal mines emitting more than five tonnes of methane per kilotonne of produced coal. From 2031, this limit will be reduced to three tonnes. The high methane content of Polish mines necessitates actions to minimize the risk of additional costs associated with mining operations.

The primary objective of the article is to analyze the feasibility of meeting the Regulation's requirements by Polish mining companies. The analysis indicates that achieving the limits will depend on increasing the efficiency of methane capture (up to at least 50%), full utilization of captured methane (e.g., through sale or use for electricity and heat production), and adjusting production levels based on the methane content of individual mines. Reducing output in high-methane mines could enable compliance with the requirements in the years 2027–2030. From the perspective of the State Treasury, the majority owner of the mining companies, consolidating operators could also be a potential solution, enabling joint emission balancing. Detailed regulations specifying the penalties for non-compliance with the Regulation are still awaited.

WPŁYW ROZPORZĄDZENIA METANOWEGO NA KRAJOWY SEKTOR WYDOBYCIA WĘGLA KAMIENNEGO

Słowa kluczowe

emisja metanu, rozporządzenie metanowe, górnictwo, produkcja węgla

Streszczenie

W Rozporządzeniu Parlamentu Europejskiego i Rady w sprawie redukcji emisji metanu w sektorze energetycznym (tzw. rozporządzenie metanowe) główny nacisk położono na redukcję emisji metanu w kopalniach węgla kamiennego. Problem ten jest szczególnie dotkliwy dla Polski, jedynego kraju UE, w którym wydobycie węgla kamiennego nadal prowadzone jest na dużą skalę. Od 2025 roku zakazane jest uwalnianie do atmosfery i spalanie w pochodni metanu ze stacji odmetanowania, natomiast od 2027 r. rozporządzenie zakazuje uwalniania metanu do atmosfery z szybów wentylacyjnych

w kopalniach węgla emitujących ponad pięć ton metanu na kilotonę wydobytego węgla. Od 2031 r. limit ten zostanie obniżony do trzech ton. Wysoka metanowość polskich kopalń wymusza podjęcie działań mających na celu minimalizację ryzyka ponoszenia dodatkowych opłat.

Głównym celem artykułu jest analiza możliwości spełnienia wymogów Rozporządzenia przez krajowe spółki górnicze. Wyniki analizy wskazują, że kluczowe dla osiągnięcia limitów będzie zwiększenie efektywności odmetanowania (do min. 50%), pełne zagospodarowanie ujętego metanu (np. poprzez sprzedaż lub wykorzystanie do produkcji energii elektrycznej i ciepła) oraz dostosowanie poziomu produkcji do stopnia metanowości poszczególnych kopalń. Ograniczenie wydobycia w kopalniach o wysokim stopniu metanowości mogłoby umożliwić spełnienie wymogów w latach 2027–2030, zwłaszcza że limity mogą być rozliczane na poziomie kopalni lub operatora zarządzającego kilkoma zakładami. Z perspektywy Skarbu Państwa, będącego większościowym właścicielem spółek górniczych, potencjalnym rozwiązaniem byłaby również konsolidacja operatorów, co umożliwiłoby wspólne bilansowanie emisji. Nadal oczekuje się na szczegółowe przepisy określające wysokość kar za naruszenie rozporządzenia.