EURACOAL
European Association
for Coal and Lignite
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EURACOAL paper on incentives (and penalties) under the EU Methane Regulation

Summary

The EU Methane Regulation (2024/1787) includes far-reaching provisions on emissions from coal mines. These measures will apply primarily to operating underground coal mines in Poland, addressing emissions of coal mine methane (CMM) and ventilation air methane (VAM). Rules on abandoned mine methane (AMM) will affect thousands of former coal mines across much of the EU. The regulation allows for incentives and stipulates penalties to encourage compliance and promote the adoption of methane capture and use technologies, although the relationship between incentives and penalties is unclear.

During public consultation, EURACOAL suggested several incentives to support the reduction of methane emissions. Notably, projects using methane from coal deposits could be excluded from the EU Emissions Trading System (ETS) to encourage investment in methane capture. Additionally, methane capture projects could be included in the EU guidelines on State aid for climate, environmental protection and energy which aim to secure environmental benefits without distorting market competition. While active mines are not legally required to use methane, doing so has significant environmental benefits.

From January 2025, the inefficient flaring of methane at coal mines will be banned and, from January 2027, the venting of methane via ventilations shafts must not exceed certain volumes per tonne of raw coal output. From January 2030, the venting and flaring of methane from abandoned mines will be largely banned, except where its use is not technically feasible. The penalties for non-compliance can be severe, with fines reaching up to 20% of a company's annual turnover – very much higher than fines under other EU legislation.

The Methane Regulation does not specify the types of incentives that policymakers could introduce. This paper analyses the text of the regulation from a legal perspective, examines the many types of economic incentives, reviews applicable EU rules and offers international examples of incentives for methane capture and use. On technologies, a distinction is made between the use of drained methane (CMM) in combined heat and power plants (CHP) and the destruction of the low-concentration methane vented to atmosphere via ventilation shafts using ventilation air methane (VAM) technologies. While CMM is an established technology that can function well with the right economic incentives, VAM is still at the research and pilot demonstration stage, so each would need different support models.

For CMM and VAM project developers, capex support via dedicated public funds or private Green Bonds should be explored, but opex costs may still be a barrier to success. The incentives foreseen in the Methane Regulation will thus be important. When designing economic incentives, policy-makers should pay attention to EU State aid and carbon trading rules, as well as to international carbon offsets. It is recommended that Poland reaches a bilateral agreement with Japan to participate in the Green Transformation emission trading system (GX-ETS) via the Joint Credit Mechanism (JCM). Beyond that, incentives should be equitable to prevent any disproportionate benefits for certain sectors or companies and hence avoid unfair competition. The schemes used in Belgium, France and Germany to support the use of methane from abandoned coal mines are good models to follow.

On penalties, those based on a fee-per-tonne of methane released above regulatory limits would not be compliant with the regulation which requires them to be gradually increased for repeated infringements. Policymakers should rather opt to replicate the well-developed national penalty schemes under the Industrial Emissions Directive.

1 Introduction

This paper examines the incentives and penalties that member states may consider when implementing the EU regulation on the reduction of methane emissions in the energy sector (2024/1787). EURACOAL is mainly concerned here with the parts of the regulation that cover methane emissions from underground coal mines which can include:

- coal mine methane (CMM),
- ventilation air methane (VAM),
- abandoned mine methane (AMM), and
- coalbed methane (CBM) drainage prior to mining.

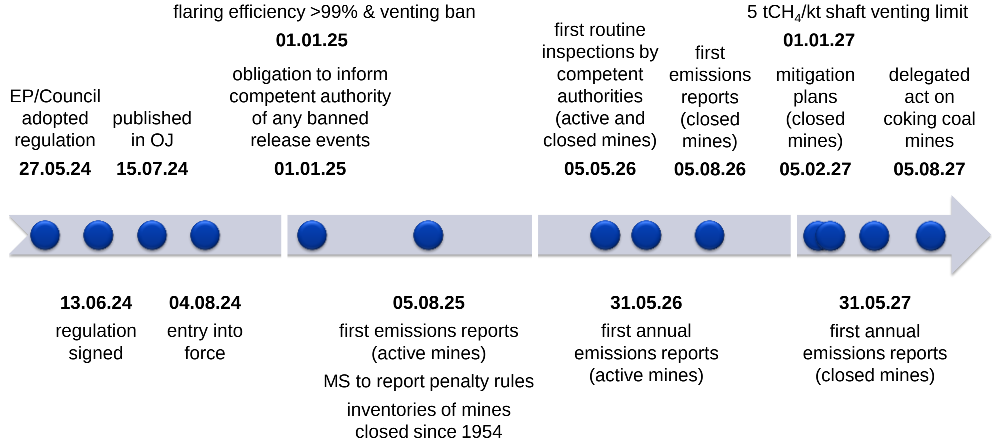
A EURACOAL position paper dated 26 April 2021 reflects the views of EURACOAL members and makes two recommendations on incentives to encourage investment in CMM projects at coal mines:

- the exclusion from the EU ETS of installations using methane from coal deposits (CMM, VAM, AMM and CBM); and
- the inclusion under State-aid guidelines of projects using methane from coal deposits (CMM, VAM, AMM and CBM).

In this section, relevant text from the regulation is cited as a necessary backdrop to the approach member states may adopt when designing incentives and penalties. The following section outlines, from an academic perspective, the options open to policymakers and categorises their attractiveness. Moving from theory to practice, Section 3 examines State aid and the EU rules governing such aid. In a section on existing incentive schemes for coal mine methane capture and use, we detail schemes from around the world with enough information to allow meaningful comparison. Methane mitigation technologies are explored in Section 5. Section 6 examines the way forward with recommendations on approaches that would encourage methane capture and use at underground coal mines without overburdening industry or regulators. Finally, the paper concludes with a section on penalties which, in the case of surface mines, concern only the monitoring and reporting of emissions.

The steps to implement the Methane Regulation at underground coal mines over the coming three years are shown as a timeline in Figure 1. Although the regulation applies across the EU, it does not concern all member states. In the case of active underground hard coal mines, the only ones that must comply with methane emission limits lie in Poland as the only other deep mine – in Czechia – will likely close before any limits apply. However, abandoned underground coal mines are present in many member states: Austria, Belgium, Bulgaria, Croatia, Czechia, France, Germany, Greece, Hungary, Italy, Netherlands. Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

Figure 1 – Methane Regulation timeline – underground coal mines



1.1 Methane Regulation Articles 22 and 26 – Mitigation measures

The regulation imposes bans on venting and inefficient flaring and places limits on methane emissions from coal mines. According to Article 22(4), operators can be incentivised to comply:

> 4. Without prejudice to Articles 107 and 108 of the Treaty on the Functioning of the European Union (TFEU), 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.

EU State-aid rules on incentives are formulated based on the EU treaties. However, it is not clear how incentives can be *"based on fees, charges or penalties"*:

- Should the cost of incentives be covered by fees or charges levied elsewhere?
- Should penalties themselves be the incentive (in which case why refer to State aid law)?
- Should incentives be similar in structure to (*i.e.* based on) penalties?

Here, Recital 61 provides some additional background, although the relationship between incentives and penalties, if any, remains unclear:

> (61) In order to reduce methane emissions from active coal mines, Member States should be allowed to introduce systems of incentives for the reduction of methane emissions, subject to applicable State aid rules. Those systems could in particular incentivise investments into methane capture and injection to the grid and the reduction of methane emissions from ventilation shafts and from flaring. Member States should be allowed to introduce dedicated systems of fees and charges to facilitate investments into the reduction of methane emissions, inter alia, as part of State aid programmes aimed at the decommissioning of coal production capacities, subject to applicable State aid rules.

In an analysis of the regulation, the authors of an Oxford Institute for Energy Studies paper note that Article 22(4) "effectively renders the use of financial penalties for non-compliant coal mines optional".[1]

Article 26 bans venting and flaring above a *de-minimus* 0.5 tonnes of methane per year at abandoned mines from 1 January 2030 unless use of the methane is not technically feasible. Importantly, there is no such utilisation requirement at active mines (notwithstanding Article 33(5)(h)). Thus, the use of methane at active mines would go beyond what is required by law (and has environmental benefits where it displaces other fossil power generation).

1.2 Methane Regulation Article 33 – Penalties

The regulation describes penalties in detail: much more detail than in Article 79 of the Industrial Emissions Directive (IED – see Annex). While penalties remain a national competency, member states are required to design and apply penalties in an effective and consistent way across the Union. Member states must notify the European Commission of the rules and measures on penalties by 5 August 2025.

[1] Olczak, M., A. Piebalgs, and J. Stern, (2024), "Analysing the EU Methane Regulation: what is changing, for whom and when?", Energy Insight 153, Oxford Institute of Energy Studies, June.

1. Member States shall lay down the rules on penalties applicable to infringements of this Regulation and shall take all measures necessary to ensure that they are implemented.

The penalties provided for shall be effective, proportionate and dissuasive and shall include at least:

(a) fines proportionate to the environmental damage and impact on human safety and health, set at a level which:

(i) at least deprives those responsible of the economic benefits derived from the infringement in an effective way; and

(ii) gradually increases for repeated serious infringements;

(b) periodic penalty payments to compel operators, undertakings, mine operators or importers to put an end to an infringement, comply with a decision ordering remedial actions or corrective measures, provide information or submit to an inspection, as applicable.

According to a study based on literature and case law carried out on behalf of DG Environment, the term "effective, proportionate and dissuasive" which is used often in EU law means:[2]

- *Effectiveness:* penalties are capable of ensuring compliance with EU law and achieving the desired objective.
- *Proportionality:* penalties adequately reflect the gravity of the violation and do not go beyond what is necessary to achieve the desired objective.
- *Dissuasiveness:* penalties have a deterrent effect on the offender which should be prevented from repeating the offence and on the other potential offenders to commit the said offence.

Note that any penalty scheme based on a fee per tonne of methane released above the regulation's limit thresholds of Article 22(2) (5 tCH_4/kt and later 3 tCH_4/kt) would not comply with the condition of Article 33(1)(a)(ii) to *"gradually increase for repeated serious infringements"* (see also Box 1).

Article 33(2) details the *administrative penalties and measures* (*i.e.* those imposed by the competent authorities) for infringements of requirements on monitoring and reporting at active underground and surface mines and on coal importers (*n.b.* infringements of mitigation measures at active mines and infringements at abandoned mines are not included here). Fines can reach up to 20% of annual turnover – a punitive level compared with other EU legislation (*e.g.* 3% under the IED):

In the case of legal persons, the amount of the administrative fines referred to in point (e) shall not exceed 20 % of the annual turnover in the preceding business year. In the case of natural persons, the amount of those fines shall not exceed 20 % of the annual income in the preceding calendar year.

Article 33(5) lists the types of infringements that shall be subject to penalties, including venting and flaring in points (g), (h), (j) and (k).

When imposing penalties, member states must consider the nine criteria of Article 33(7):

[2] Milieu Ltd., (2011), "Provisions on penalties related to legislation on industrial installations", Document on Good Practices prepared for the European Commission DG Environment, Milieu Ltd., Brussels, October.

7. Member States shall take into account at least the following indicative criteria for the imposition of penalties, as appropriate:

(a) the duration or temporal effects, the nature and the gravity of the infringement;

(b) any action taken by the operator, undertaking, mine operator or importer to timely mitigate or remedy the damage;

(c) the intentional or negligent character of the infringement;

(d) any previous or repeated infringements by the operator, undertaking, mine operator or importer;

(e) the economic benefits gained or losses avoided, directly or indirectly, by the operator, undertaking, mine operator or importer due to the infringement, if the relevant data are available;

(f) the size of the operator, undertaking, mine operator or importer;

(g) the degree of cooperation with the authorities;

(h) the manner in which the infringement became known to the authorities, in particular whether, and if so to what extent, the operator, undertaking, mine operator or importer timely notified the infringement;

(i) any other aggravating or mitigating factor applicable to the circumstances of the case, including third party actions.

1.3 Criminal law

The Methane Regulation does not foresee any criminal penalties. The EU Environmental Crime Directive (ECD – 2024/1203) entered into force in May 2024 and establishes severe penalties for certain offences that cause serious damage and destruction of the environment. A list of offences deemed to be criminal includes "the production, placing on the market, import, export, use, or release of ozone depleting substances". While various halomethanes are within the scope of the ECD, methane is not.[3]

2 Economic Incentives

Economic incentives are financial rewards or penalties that influence the behaviour of individuals, businesses, or other entities by altering the costs or benefits associated with certain actions or decisions. Such extrinsic incentives are based on economic principles and aim to motivate behaviours that align with desired outcomes, such as promoting economic growth, enhancing productivity, improving social welfare, reducing environmental damage, or mitigating climate change.

The following subsections describe economic incentives and public policymaking from a general academic perspective. It does not consider any specific aspects of the EU Methane Regulation but is included as a guide on the range of possibilities when designing incentives to reduce methane emissions.

2.1 Common examples of economic incentives include:

- *Subsidies:* Government subsidies provide financial assistance or support to businesses to encourage specific behaviours or activities. Examples include subsidies for renewable energy, agricultural production (or non-production), ethanol production, and exports. Subsides may cover capital expenses (capex) or operational expenses (opex).

[3] Methane tends to reduce the ozone-depleting impact of halocarbons in the stratosphere.

- *Grants and loans:* Governments may offer grants or low-interest loans to support projects or initiatives that align with public policy goals. Examples include SME loans and R&D grants.
- *Tax incentives:* Tax incentives or tax benefits, such as tax credits, deductions, exemptions, relief or refunds, reduce the tax burden on certain activities or investments. Examples include tax credits for R&D, energy-efficiency upgrades or renewable energy projects, and tax refunds for exporters.
- *Price mechanisms:* Price mechanisms, such as carbon pricing, internalise external costs to encourage more sustainable behaviour. By assigning a price to negative externalities, such as pollution, price mechanisms incentivise businesses to reduce their environmental impact.
- *Negative incentives:* Negative economic incentives, or disincentives, punish businesses financially for taking certain actions. This encourages actions without making them compulsory.
- *Fines:* Fines are imposed by public authorities for non-compliance with regulations.

2.2 Ideally, economic incentives should be:

- *Legal:* In the EU, financial incentives for businesses above a *de-minima* must be registered with the European Commission. Aid that falls outside the General Block Exemption Regulation (GBER) must be formally notified and the Commission will determine if it is compliant with EU rules on State aid.
- *Simple:* Economic incentives require bureaucratic administration. The administrative burden on the state and businesses should be as small as possible to achieve the desired outcomes.
- *Efficient:* Economic incentives should encourage businesses to allocate resources more efficiently by aligning their behaviour with desired outcomes.
- *Flexible:* Economic incentives should offer flexibility when addressing complex socio-economic and environmental challenges. Unlike regulatory mandates and restrictions, economic incentives allow policymakers to tailor interventions to specific contexts and stakeholders, making them more adaptable and effective.
- *Innovative:* Economic incentives should stimulate innovation by rewarding businesses who develop new technologies, products or services that address societal needs or improve the environment. By creating economic opportunities, incentives foster a culture of innovation and entrepreneurship, driving progress and competitiveness.
- *Cost-effective:* Economic incentives should be a cost-effective tool for achieving policy objectives compared with blunt regulatory approaches. Instead of imposing costly mandates with enforcement mechanisms, incentives lever market forces to achieve desired outcomes, often at lower costs to taxpayers.

2.3 However, there can be challenges when implementing economic incentives:

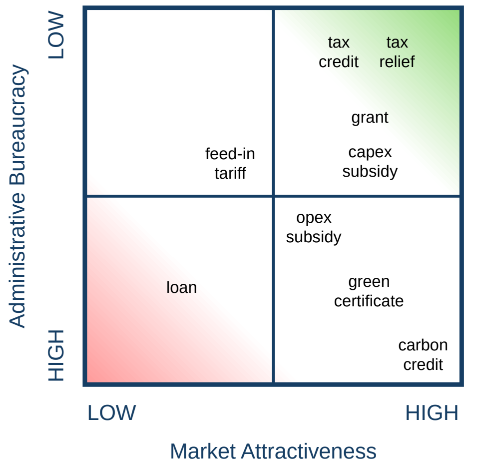
- *Equity concerns:* Economic incentives may disproportionately benefit certain businesses or sectors to the disadvantage of others.
- *Unintended consequences:* Economic incentives can lead to market distortions, perverse incentives or other unintended behavioural responses. For example, subsidies for renewable energy may increase energy consumption or encourage unsustainable practices (*e.g.* the Renewable Heat Incentive scandal in Northern Ireland).

- *Complexity:* Designing and implementing effective economic incentives can be complex, requiring careful consideration of many factors, including market dynamics, stakeholder interests and regulatory frameworks. Policymakers are unlikely to foresee all the unintended side effects so must be ready to make revisions as and when needed.
- *Behavioural response:* Businesses may not respond predictably to economic incentives; policymakers must account for these behavioural dynamics and design incentives that align with real-world decision-making.

2.4 When developing incentives, policymakers should:

- *Identify desired behaviour:* Policymakers must first identify the specific behaviour or outcome they seek to promote, such as energy saving, waste reduction or investment in innovation.
- *Design targeted incentives:* Incentives should be targeted, transparent and aligned with the desired behaviour, tailored to the context and stakeholders, taking into account market dynamics, regulatory frameworks and behavioural insights.
- *Monitor and evaluate:* Continuously monitor and evaluate the effectiveness of economic incentives in promoting positive behaviour. Collect data, track progress, and assess outcomes to ensure that incentives are achieving their intended objectives and adjust them as needed.
- *Combine with other policy tools:* Economic incentives should be part of a broader policy toolkit that can include regulatory measures and capacity-building initiatives. By combining economic incentives with complementary policies, policymakers can maximise their effectiveness.

Figure 2 – Bureaucratic burdens on the state administration
and attractiveness to market players of different types of subsidy



3 EU State aid

Under Article 107(1) of the Treaty on the Functioning of the EU (TFEU), State aid is any direct or indirect measure taken by public authorities and through public resources which grants an economic advantage on a selective basis to certain undertakings or for the production of certain goods which distorts or threatens to distort competition on the internal market and which affects trade between member states. Examples include:

- direct state grants or subsidies, such as rescue aid;
- tax or social security payment exemptions;

- loans at preferential interest rates;
- guarantees or indemnities on favourable terms;
- disposal by the state of land or buildings at less than full market value;
- debt write-offs;
- export assistance; and
- forgiveness of liabilities (*e.g.* employers' social security payments or licence fees).

3.1 Types of EU State aid

EU State aid typically falls into one of four categories: investment support, operating aid, tax incentives and material aid.

3.1.1 Investment support

Either direct payment or favourable credits covering at least part of the capital cost (capex) to build a factory or infrastructure. In the EU, the Temporary Crisis and Transition Framework and the Important Projects of Common European Interest (IPCEI) allow for direct grants *e.g.* supporting the construction of battery factories or hydrogen-based steel plants.

Alternatively, the state can take over the liabilities of a company. This model was often applied during the post-2008 banking crisis to bail out badly performing banks by purchasing their illiquid securities.

3.1.2 Operating aid

The state pays or issues valuable certificates to the operator in exchange for the product at a higher rate than the market. This opex aid is proportionate to output. Feed-in tariffs or green certificates fall into this category. The German EEG for instance defines guaranteed rates for the electricity produced from renewable energy sources, waste and mine gas. Rates are set *ex-ante* according to several criteria, such as the competitiveness of energy sources and size of plant, and may decline annually by a predefined factor. In some instances, feed-in tariffs are intended to be a bridging instrument before a new technology reaches full market competitiveness.

The revised electricity market design regulation (EU) 2024/1747 envisages a common form of support for renewable electricity from 17 July 2027 via two-way contracts for difference (CfDs) or equivalent schemes with the same effect. This requirement applies only to new low-carbon, non-fossil fuel power-generation. Feed-in tariffs can continue to be used as a support model for certain other types of new generation such as small-scale renewable installations, demonstration projects and coal mine methane plants.

3.1.3 Tax incentives

The recipient is exempt from certain taxes or pays a favourable rate. An important distinction occurs between general or profit-based and targeted or cost-based incentives, with the former being easier to apply but the latter generally recommended by the IMF and OECD.[4,5] Profit-based incentives can exempt new investors from income or other taxes for a defined period (*e.g.* tax holidays), or reduce tax for certain investors.

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[4] https://www.elibrary.imf.org/downloadpdf/book/9781484315194/ch06.pdf
[5] https://www.oecd-ilibrary.org/docserver/813bef22-en.pdf

Cost-based tax incentives reduce the tax base (tax allowance) or the tax due (tax credit). The US Inflation Reduction Act of 2022 includes many tax incentives, *e.g.* a 100%, year-one deduction from the tax base of the cost of an energy-efficient commercial building. The US already provided wide-ranging industrial support under the Internal Revenue code, for example Section 45Q tax credits since 2018 for "Carbon Oxide Sequestration". The IRA added a new Section 45U tax credit of 0.3 c/kWh for zero-emission nuclear power production. In Europe, new investments in Polish Investment Zones (apart from certain sectors, *e.g.* coal, metallurgy, iron and steel) are eligible for up to 50% tax credits for up to 15 years. Another targeted tool is accelerated depreciation, aimed at boosting investment.

In addition, some countries apply import-related tax exemptions, exempting certain types of raw material imports from VAT or import duties for a defined period.

3.1.4 Material aid

The state provides inputs, services, property or land for free or at favourable prices. In the EU, only support for core business is considered State aid, distinguishing this from aid for infrastructure or training which comes under regional economic policy. Urban redevelopment projects such as the London Docklands, Hamburg's Hafencity or the restoration of brownfield sites at public expense are typical examples of material aid.

For all types of incentives, the state can either act by itself or instruct a state-owned company to act on its behalf. Both types are assessed according to the same State-aid rules.

3.2 EU Rules on State aid

In Article 107(1) TFEU, State aid that distorts or threatens to distort competition is prohibited unless authorised by the European Commission who must confirm its compatibility with the internal market. To assess compatibility, the Commission has published regulations and guidelines such as the General Block Exemption Regulation (GBER) and the Climate, Energy and Environmental Aid Guidelines (CEEAG).

3.2.1 General Block Exemption Regulation (GBER)

For State aid below the GBER thresholds (Article 4), no prior notification to the Commission is necessary. GBER lists several categories and types of measures that are exempt from notification, among them *"aid for environmental protection"* (Article 1(c)) up to a notification threshold of *"€15 million per undertaking per investment project"* (Article 4(s)). State aid for environmental protection is considered compatible with the EU treaties if *"it shall enable the beneficiary to increase the level of environmental protection resulting from its activities by going beyond the applicable Union standards"* (Article 36(2)(a)). However, only 40% of the additional costs necessary to go beyond the Union standards are eligible. For medium-sized enterprises, aid can reach 50% and for small enterprises 60%. An additional 5% can be given to *"facilitate the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest"* (Article 107(3)(c) TFEU). In line with the Just Transition Mechanism, carbon-intensive regions should qualify for this additional 5%.

Article 44(3)(b)(iii) exempts electricity *"generated from methane emitted by abandoned coalmines"* from the minimum tax rates set by the EU according to Annex I to Directive 2003/96/EC. High-efficiency combined heat and power generation is similarly exempt. However, the economic relevance of this is limited as national tax rates are far above the minimum rates.

3.2.2 Climate, Energy and Environmental Aid Guidelines (CEEAG)

The non-legislative CEEAG is a Commission communication that provides guidance on permitted forms of State aid under the exemption clause of Article 107(3)(c) TFEU.

The Commission assesses the compatibility of any proposed aid measures by firstly considering whether they facilitate or incentivise the development of certain economic activities within the Union (a positive condition), and then by ensuring that the measures are necessary, appropriate and proportionate and do not adversely affect trading conditions to an extent contrary to the common interest (a negative condition). In a final step, the Commission balances any identified negative impacts of the aid measures with their positive impacts. Here, the Commission also refers also to the "green list" of environmentally sustainable economic activities under the Taxonomy Regulation 2020/852.

Instead of providing a list of eligible sectors, the CEEAG gives general criteria for the compatibility of aid with the EU treaties. For example, under §4.1.2.2: *"all technologies that contribute to the reduction of greenhouse gas emissions are in principle eligible, including aid for the production of low-carbon energy or synthetic fuels produced using low-carbon energy, aid for energy efficiency including high-efficiency cogeneration, aid for CCS/CCU, aid to demand response and energy storage where this reduces emissions, and aid for the reduction or avoidance of emissions resulting from industrial processes, including the processing of raw materials"*. Projects that generate heat and electricity from coal mine methane would be eligible for aid up to an amount that reflects the additional costs over and above the alternative of say flaring. Note also that electricity used in the production of hard coal is also eligible for susbisdy.[6]

4 Examples of incentives for CMM capture and use from around the world

4.1 Australia – capex subsidies and carbon trading

Australia has a very large coal sector comprising 69 surface and 30 underground mines with an annual production of 425 million tonnes in 2023. In addition, the CBM sector is well developed in Queensland: CBM gas production totalled 30 bcm in 2023, about one quarter of Australia's total natural gas production. Licencing of coal mining and gas exploitation under the Mineral Resources Act of 1989 and Petroleum and Gas (Production and Safety) Act of 2004 in Queensland and the Mining Act of 1992 and Mineral Resources Act of 1989 in New South Wales (NSW) imposes requirements on how pre-and post-drainage methane is to be used or flared. Royalties in both Queensland and NSW are set at levels to encourage CMM use. More generally, Australia targets net-zero greenhouse gas (GHG) emissions by 2050.

CMM development has been primarily driven by mine safety concerns and includes eleven projects generating power from drainage gas and the WestVAMP project which oxidises ventilation air methane (VAM) at West Cliff colliery. The Resource Methane Abatement Fund Program is supporting further VAM projects with two expected to complete in April 2025. In addition, the Powering the Regions Fund (PRF) makes competitive grants available to support industrial decarbonisation: Kestrel Coal in Queensland has received a A$37.2 million grant for a VAM project.

[6] §4.11 on "Aid in the form of reductions from electricity levies for energy-intensive users" lists the mining of hard coal (NACE code 0510) as an eligible activity. Coal mining companies that face competition from imports of non-EU coal may benefit from up to 75% to 85% relief from the costs of environmental levies (*e.g.* renewable and CHP levies) and social tariffs, but not network charges or capacity mechanism charges.

The coal sector has also benefitted from national and state-based incentive schemes to encourage a shift towards fossil gas, including CBM and CMM. In past years, financing under the Greenhouse Gas Abatement Program (GGAP) provided up to A$43.47 million in grants for power plants using CMM. More recently, the Low Emissions Investment Partnerships (LEIP) Program in Queensland provides A$520 million while the NSW state government has allocated A$100 million to the Coal Innovation fund (CINSW) for emerging technologies (*e.g.* VAM). Additionally, VAM-related projects are supported under the Australian Coal Association Research Program (ACARP) managed by Australian Coal Research Limited (ACRL). Established in 1992, ACARP is funded by a 5 cents per tonne levy on saleable black coal.

Under the Safeguard Mechanism, which is the Australian government's primary policy to reduce GHG emissions from the largest industrial facilities, coal mines emitting more than 100 000 tCO_2e, including methane, must purchase Australian carbon credit units (ACCU) since 1 July 2023. If their emissions are below a baseline, operators can obtain tradable Safeguard Mechanism Credit units (SMC), a new alternative to ACCUs. SMCs will be available to trade in early 2025.[7]

4.2 Belgium – green certificates for CHP

Annual coal production in Belgium peaked at 30 million tonnes in the 1950s before gradually declining as the Walloon and Limburg mines closed, the last in 1992. Alongside coalbed methane (CBM), methane from abandoned coal mines (AMM) has been considered for energy production. In 2019, Gazonor Benelux, a subsidiary of La Française de l'Energie, completed the first exploitation project – a 3 MW combined heat and power plant at Anderlues.[8] Gazonor benefits from a 65 €/MWh premium under a bilateral agreement with Luminus, a green electricity supplier.[9]

A Royal Decree of 2002 on the promotion of electricity produced from renewable energy established a national green certificate scheme whereby the transmission system operator (Elia) is obliged to buy green certificates issued anywhere in Belgium at minimum floor prices. Electricity suppliers must secure certain quotas of these green certificates either directly at auctions organised by Elia or via the secondary market in which certificates are traded. This national scheme can be complemented by regional schemes with higher floor prices.

Under this EU-approved green certificate scheme, the Belgian region of Wallonia issues certificates for the carbon emissions avoided for electricity generation with emissions below a gas-fired CCGT baseline (456 kg/MWh). According to the *Commission wallonne pour l'Energie* (CWaPE),[10] the carbon emissions from Gazonor's AMM plant are similar to the same plant running on natural gas, so the green credit arises from the cogeneration of heat and power which raises overall efficiency.

4.3 China – a range of support measures

China seeks to augment its domestic energy production with CBM and CMM: over one thousand mines have implemented CMM projects, and a few mines have commissioned VAM pilot and demonstration projects. In 2017, coal mine methane use totalled 4.7 bcm,[11] and China plans to increase this to 6.0 bcm by 2025 under its *Methane Emission Control Action Plan* of 2023.[12]

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7 https://cer.gov.au/markets/carbon-credits

8 https://www.francaisedelenergie.fr/wp-content/uploads/2019/10/fde_cp_anderlues1er_moteur_25032019_v6cleanof_vd.pdf

9 https://press.luminus.be/du-gaz-de-mine-a-lelectricite-verte--luminus-partenaire-energetique-de-gazonor-benelux

10 CWAPE (2019), Note d'examen CD-19a17-CWaPE-0062

11 https://www.unece.org/info/media/presscurrent-press-h/sustainable-energy/2017/newcentre-of-excellence-on-coal-mine-methane-in-china-will-help-to-reduce-the-greenhousegas-footprint-of-coal-mining-and-enhance-safety/doc.html

12 https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202311/W020231107750707766959.pdf

The Chinese state supports the use of coal mine methane with various economic incentives. Indirect support includes exemptions from prospecting and licensing fees for CBM development, and direct support comes from the multi-billion renminbi state budget for coal mine safety projects. Coal mine owners or developers implementing CMM projects can receive VAT rebates as well as benefitting from generous, first-year capital depreciation allowances of 40%.

China also offers a subsidy scheme for CBM/CMM use of RMB 0.3 per cubic metre of methane which provincial and local governments can boost by RMB 0.1 per cubic metre (equivalent in total to an electricity feed-in tariff of 12 €/MWh).[13] Additional international support has come from the UNFCCC Kyoto Protocol's Clean Development Mechanism which allows CMM project developers to register verified emission reductions as tradeable GHG mitigation credits. Following this same route, CMM projects can qualify for the China Certified Emission Reduction (CCER) programme, relaunched in January 2024.

4.4 France – CMM feed-in tariffs

In France, several CMM projects operate at abandoned mines supplying gas for power generation, industrial use and pipeline injection. Gazonor, a subsidiary of La Française de l'Energie (LFE), is the biggest operator with plants totalling 22.5 MW at six sites in Hauts-de-France and Lorraine in France and Wallonia in Belgium.

Article D314-15 (10) of the *Code de l'énergie* sets preferential rates for electricity sales from coal mine gas installations below a capacity of 12 MW (updated in *Arrêté du 19 octobre 2016*):

- 57.6 €/MWh for units >4.8 MW,
- 76.6 €/MWh for units <1.5 MW, and
- a sliding scale for plants between 1.5 MW and 4.8 MW.

EDF or another system operator is obliged to purchase at these feed-in tariffs for a period of 15 years and is reimbursed for the additional costs by the French state. In its 2015 approval decision (SA.40713), DG Competition wrote that *"the use of mine gas to produce electricity therefore contributes to the reduction of greenhouse gas emissions. It also allows to save primary resources. Indeed, otherwise, other fuels would be used to produce electricity."* Furthermore, DG Competition confirmed the necessity for State aid as the AMM plants would otherwise be uncompetitive.

With recognition that its projects reduce greenhouse gas emissions, LFE has issued Green Bonds in the market to raise substantial finance for its expansion.

4.5 Germany – renewable feed-in tariffs

The legal framework for the use of mine gas in Germany is set by the Federal Law on Mining and the Renewable Energy Sources Act (EEG – *Erneuerbare-Energien-Gesetz § 41*). Exploration, extraction, and processing of mine gas are administered by the State Mining Authorities who consider license applications after an applicant has submitted a plan that is sufficient for the type, scope and purpose of the methane extraction. Licenses are granted for a 30-year period. Taxes on gas extraction are waived in Germany if gas is removed for safety reasons.

According to the EEG, CMM is considered as a renewable energy source from which power generation can be supported by state subsidy. Hence, Germany incentivises CMM recovery and use with a feed-in tariff which requires grid operators to connect CMM plants, bear the costs of any grid

[13] UNFCCC (2023), *The People's Republic of China Fourth National Communication on Climate Change*, p.110

upgrades, and guarantee priority purchase and transmission of all electricity from such plants. Germany has over one hundred CMM plants with a total capacity of around 136 MW and mostly built between 2001 and 2004.[14] As no single unit is above 20 MW_{th}, these plants are not required to participate in the EU ETS even at sites where multiple units operate.

The EEG provides a guaranteed, fixed feed-in tariff for new plants for a 20-year period. Until 1 January 2024, tariffs were:

- 59.8 €/MWh for units <1 MW,
- 38.1 €/MWh for units <5 MW, and
- 33.7 €/MWh for units >5 MW.

and will decrease by 1.5% every year from 2024. This feed-in tariff incentive scheme was approved by DG Competition on 29 April 2021 (SA.57779). However, as most CMM plants in Germany were built around 2004, the beneficial feed-in tariffs ended around 2024 leaving plants uneconomic. The German government thus attempted to introduce rates for CMM plants older than 20 years under a proposed EEG § 102. This was not approved following a decision of 9 December 2021 in which the Commission argued that the assumed operating costs were excessive.[15]

Like other projects supported under the EEG, CMM projects received priority during the statutory planning process.

In addition to the feed-in tariffs, CMM operators in Germany have, in the past, sold carbon credits generated by their projects under the UNFCCC Joint Implementation (JI) mechanism.[16] During Phase III of the EU ETS (2013-2020), JI emission reduction units (ERU) and CDM certified emission reductions (CER) were only accepted from new projects if located in one of the least developed countries. Credits from all types of projects were accepted, except nuclear power, afforestation/reforestation, and the destruction of industrial gases (HFC-23 and N_2O). Under EU ETS Phase IV (2021-2030), no JI or CDM credits are allowed.

4.6 United Kingdom – emissions trading and tax relief

At its peak around 2010, CMM was used at 46 sites in the UK, split equally between operating and abandoned mines. Operators installed 1-2 MWe internal combustion engines similar to those used in the landfill gas industry. Many of the sites continued to operate even after coal mines closed – the last major underground coal mine in the UK closed in December 2015. Today, the North Sea Transition Authority is responsible for the licencing of coal gas extraction. It reports twenty-one operating sites, with Infinis and Arevon Energy being the largest operators in this niche business sector.

The UK Emissions Trading Scheme ran from 2002 to 2009 as the first industry-wide carbon trading system in the world, although purely voluntary. It was a testbed for later, mandatory schemes such as the EU ETS that began in 2005.

The UK ETS was based on an auction process and participants were exempted from the Climate Change Levy – an energy tax introduced in 2001 which, as of 1 April 2024, is set at £7.75/MWh. Bidders at the reverse auction promised to deliver carbon emission reductions below their 1998-2000 baselines to secure a share of the £215 million incentive fund offered by the state. After nine rounds,

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[14] MaStR, https://www.marktstammdatenregister.de, accessed 6 August 2024
[15] https://www.bmwk.de/Redaktion/DE/Downloads/Energie/04_EEG_2023.pdf?__blob=publicationFile&v=8, p.247
[16] https://ji.unfccc.int/JI_Parties/DB/1JUS6UM3SH2O9VJ0RWUQDB99J8DWTJ/viewDFP

thirty-four players bid successfully in the March 2002 auction which closed at a carbon price of £53.37 /tCO_2e. Each agreed to hold enough allowances to cover their actual emissions and participate in a cap-and-trade system with an annually reducing cap.

Some direct participants successfully reduced their emissions below their caps and could sell allowances to others with excess emissions (including to non-direct participants with Climate Change Agreements) or retain them for future years. Experience was gained in auctioning, trading, MRV and carbon management strategies. Unlike the EU ETS, the UK ETS covered all greenhouse gases: carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons.

In terms of emission reduction pledges, UK Coal Mining Ltd with baseline annual emissions of 4.5 $MtCO_2e$ was one of the largest participants in the UK ETS, alongside the oil and gas company BP plc. It received an incentive of £21 million to gradually reduce methane emissions from its operating coal mines by 8.8% over the five-year period to 2006 (an abatement incentive of £17.79 /tCO_2e). In the event, the company installed small power generation units to generate electricity from mine gas and reduced its methane emissions by 7.7%, missing its target by 0.05 $MtCO_2e$. UK Coal Mining Ltd was therefore obliged to purchase additional allowances in the market where allowance prices fell at times to a low of £2 /tCO_2e because other players had significantly overachieved.

Since the UK ETS ended, there have been no further incentives for CMM. The Climate Change Levy exemption expired in November 2008. Most UK coal mines are now fully flooded and no longer emit methane. At the more recently closed coal mines, water levels are still recovering and the UK Coal Authority monitors emissions at points across the coalfield areas.

4.7 United States – carbon offsets, renewable standards and capex subsidies

All US coal mines are owned and operated by private companies. Coal is produced across three major regions in Wyoming, West Virginia and Virginia, Kentucky, Pennsylvania, and Illinois. In addition, there are >7 500 abandoned underground mines reflecting the country's industrial history. In 2023, coal production was 527 million tonnes. Since the 1990s, the US has been a leader in CMM recovery and use, mainly at mines east of the Mississippi river. As of January 2023, 25 coal mine methane projects at 16 active mines and 35 abandoned mine methane projects at 66 abandoned (closed) mines are operational. A VAM project at Murray Energy's Marshall County mine (formerly McElroy) in West Virginia began destroying methane in May 2012, and is the largest VAM project in the US, while a VAM project was commissioned in 2022 at the Buchanan mine complex near Oakwood in Virginia.

The US is a major producer of coalbed methane (CBM) with established production facilities in ten coal basins (primarily San Juan, Black Warrior, and Central Appalachian). Total CBM production of an estimated 21 bcm in 2023 was 2% of the US's total dry natural gas production of 1 073 bcm. Since 1994, the US Environmental Protection Agency has led the Coalbed Methane Outreach Program (CMOP), a voluntary programme that aims to reduce coal mine methane emissions. The EPA provides much data and advice to those considering CMM exploitation.

In addition to selling electricity to local utilities, several voluntary carbon markets in the US offer opportunities for CMM project developers. A CMM project may be eligible for carbon credits depending on its start-up date, end-use technology (electricity generation or pipeline gas sales), methane origin (active or abandoned mines, surface or underground mines). In addition, each GHG registry has its own rules governing project eligibility, additionality, and registration. Voluntary carbon markets include:

- Verra, formerly the Verified Carbon Standard (VCS), follows the UNFCCC Clean Development Mechanism (CDM) methodology for CMM projects at active mines (ACM0008), and has extended this for surface mines (VMR0001 of 2009, awaiting revision) and abandoned mines (VMR0002 of 2010, awaiting revision).[17]
- Climate Action Reserve (CAR) is a not-for-profit registry in California and has a methodology of October 2012 on capturing and destroying methane from US coal and trona mines.[18]
- American Carbon Registry (ACR) is open to CMM projects that comply with its methodology of August 2022, but none are registered.[19]
- California Air Resources Board (CARB) operates a regulated GHG cap-and-trade system that allows CMM projects (but not for gas pipeline sales) to benefit from its compliance offset programme according to its Mine Methane Capture (MMC) Protocol of April 2014.[20] Credits can be recognised and traded from CMM projects anywhere in the US and have stimulated renewed interest because of the high value of offset credits under CARB.

Many US states have renewable energy portfolio standards (RPS) or clean energy goals (CEG) that require minimum percentages of electricity from eligible energy resources by certain dates. Utilities in many states offer customers premium green tariffs backed by carbon credits. Five states include CBM or CMM in their renewable, alternative, or clean energy standards with requirements similar to those for landfill gas projects:

- Colorado – renewable energy certificates (RECs)
- Indiana – incentives to help pay for compliance projects
- Ohio – RECs and forgivable or non-forgivable loans
- Pennsylvania – alternative energy credits
- Utah – RECs
- Virginia – considers incentives beyond the CMM/VAM support under its green energy job tax credit

Whether carbon offsets, RPS compliance or CEG standards, the value of credits can be attractive but also uncertain. In 2023, the average CARB credit auction price was US$32.93/t$CO_2$e.[21]

The Abandoned Mine Land (AML) Reclamation Program is funded primarily by a tonnage fee on coal producers (known as the AML fee). Now with a US$11.3 billion budget over 15 years, the fund's scope has been extended under the Infrastructure Investment and Jobs Act of 2021 to support methane mitigation projects as part of its programme of mine land rehabilitation and economic development. Participants should *"consider prioritizing projects in a manner that maximizes the amount of methane emissions that can be reduced"*.[22] AML grant support can be up to 100% although many projects secure funding from other sources.

[17] https://verra.org/methodologies-main/
[18] https://www.climateactionreserve.org/how/protocols/waste/coal-mine-methane/
[19] https://acrcarbon.org/methodology/capturing-and-destroying-methane-from-coal-and-trona-mines-in-north-america/
[20] https://ww2.arb.ca.gov/our-work/programs/compliance-offset-program/compliance-offset-protocols/mine-methane-capture-projects
[21] https://icapcarbonaction.com/en/ets/usa-california-cap-and-trade-program
[22] https://www.doi.gov/pressreleases/biden-harris-administration-announces-availability-725-million-bipartisan

5 Methane mitigation technologies at coal mines

Mitigation technologies for coal mine methane (CMM) include the destruction of drained methane using flares, the generation of electricity and heat from drained methane using combined heat and power (CHP) plants, the supply of drained methane to industrial customers or into gas networks, and the destruction of the low-concentration methane vented to atmosphere via ventilation shafts using ventilation air methane (VAM) technologies. The conversion of methane to carbon dioxide (CO_2) by combustion in flares or other means is beneficial as CO_2 is a far less damaging greenhouse gas than methane.

5.1 Coal mine methane technologies

The coal industry has experience in applying CMM mitigation techniques at active and abandoned mines, often with incentives to produce electricity and heat rather than simply destroying methane in flares. Degasification systems capture high-concentration methane from coal deposits via in-seam drainage boreholes or degasification wells from the surface. These systems reduce methane emissions before, during and after coal production. CHP plants can continue to be operated on methane drained from mines after closure, at least until flooding stops further methane releases. The minimum methane concentration for operating gas engines needs to be as high as 25-30% which can be consistently reached at underground hard coal mines. In Australia, some surface hard coal mines are now being degassed prior to exploitation: degassing at the Curragh surface mine is supported by the Low Emission Technology Australia (LETA) fund for innovative coal technologies. Since 2006, LETA (formerly known as COAL21) has committed A$700 million from a voluntary levy on coal production.

5.2 Ventilation air methane technologies

VAM is challenging due to the large volumes of air that need to be processed and the extremely low concentration of methane. Of the demonstrated technologies, regenerative thermal oxidation (RTO) is the first choice (*e.g.* as used at the Buchanan coal mine in the USA), followed by catalytic thermal oxidation (CTO) which allows methane oxidation at lower temperatures. Technical aspects of VAM processes are being assessed in the three-year ProVAM research project which began in October 2023 co-funded by the EU Research Fund for Coal and Steel (RFCS). Within ProVAM, obstacles to implementing VAM technologies are being analysed (*e.g.* variable air flow rates, low methane content, humidity, and dust loads), together with the interaction of VAM reactor modules with the mine ventilation network to ensure mine safety under different ventilation conditions. Finally, ProVAM will develop a business case for RTO technology.

The United Nations Economic Commission for Europe (UNECE) has estimated that the capital cost (capex) and operating costs (opex) of a VAM processing plant for a coal mine with a ventilation airflow of 500 000 m^3/h and a methane concentration 0.18-0.7 %vol, assuming a design life of 20 years.[23] It concluded that even with energy recovery, VAM appears to be uneconomic as the gas recovery cost would be between 3 994 €/MWh and 15 321 €/MWh, compared with the 27.3 €/MWh average EU wholesale gas price in the first quarter of 2024.[24] If VAM is to be applied beyond research and demonstration, a substantive incentive scheme would be necessary, going beyond incentives for CMM.

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[23] UNECE (2024), *Best Practice Guidance on Ventilation Air Methane (VAM) Processing*, Committee on Sustainable Energy. Group of Experts on Coal Mine Methane and Just Transition, ECE/ENERGY/GE.4/2024/3, United Nations Economic Commission for Europe, Geneva, January.

[24] https://energy.ec.europa.eu/data-and-analysis/market-analysis_en

Through research and showcasing VAM technology at pilot plants, other world regions are also supporting the deployment of VAM mitigation. For example, the Australian Catalytic VAM Abatement Commercialisation project is supported by LETA and Mining3, research organisations supported and directed by their global mining industry members. The Powering the Regions Fund is supporting six projects designed to significantly cut emissions from Australia's largest methane emitters, including A$37.2 million to reduce ventilation air methane emissions at the Kestrel coal mine in Queensland's Bowen Basin. The Australian government's VAM policy incorporates elements of research funding as well as public funding to cover VAM investment, with instruments that are similar to the EU Research Fund for Coal and Steel and the EU ETS Modernisation Fund.

China has been active in VAM research and demonstration with projects supported by the Ministry of Ecology and Environment, the National Development and Reform Commission, and the National Energy Administration. Important VAM pilot and demonstration projects are at Lu'an Group's Gaohe coal mine in Shanxi province (using 12 RTO units from Dürr of Germany to process 945 378 Nm^3/h), Binchang Co.'s Dafosi coal mine in Shaanxi province (with power generation) and at the Dingji coal mine of the Huai Hu Coal Power Co. Ltd. in Anhui province (with heat recovery and power generation). Some of these projects mix ventilation air methane with drained methane to achieve higher performance, but with safety risks that must be well managed. Notably, none of the projects claims commercial viability and all operate within a public support framework that can include credits under the UNFCCC clean development mechanism (CDM) and, since 2012, the separate and voluntary China Certified Emission Reduction (CCER) programme which was revamped in 2024.

6 Incentive options under the Methane Regulation

As seen in the section above on national models to support the use of coal mine methane, most countries have opted to integrate CMM and AMM plants into carbon trading schemes or renewable support schemes. The former can be more valuable but is also more bureaucratic whereas the latter can be more certain and simpler to administer. Importantly, the Methane Regulation mandates large reductions in methane emissions from active coal mines, so only greenhouse gas emission reductions that go beyond this legal requirement would be eligible for any incentives under EU State-aid rules. However, the regulation says nothing on CMM use at active mines (notwithstanding Article 33(5)(h)). Incentivising heat and power generation from CMM at active mines goes beyond what is required and thus can be incentivised under EU State-aid rules; it uses a resource that would otherwise be wasted and reduces emissions from heat and power generation elsewhere.

The German EEG refers explicitly to mine gas and has been approved by the European Commission under EU State-aid rules (SA.57779, 29 April 2021). However, the Commission has also stated that such a support model needs to have economically justifiable rates to avoid any preferential treatment of CMM plants *vis-à-vis* other energy sources. Hence, on 9 December 2021, DG Competition bilaterally informed the German government that the proposed rates for written-down mine gas plants (*i.e.* those that had already benefited from past, long-term support) were incompatible with State-aid rules. Previously agreed rates for new CMM plants under § 41 are not affected by this decision.

The French support scheme, obliging DSOs to buy electricity produced from AMM plants at a preferential rate, has also been approved by DG Competition (SA.40713, 10 December 2015). While this decision concerned the budget attributed to compensating the DSOs for the preferential purchases over the 2015-2020 period, no objections have been raised since then and it can be assumed that the Commission's reasoning for the 2015 approvals – reduction of greenhouse gas emissions – still holds. In Belgium, CMM use is supported in the same way as CHP.

The support schemes in Belgium, France and Germany are all in line with §4.1.2.2 of the 2022 guidelines on State aid for climate, environmental protection and energy (CEEAG) as they *"contribute to the reduction of greenhouse gas emissions"*. Such support is not limited to renewable or zero-emission technologies, as high-efficiency cogeneration and "*aid for the reduction or avoidance of emissions resulting from industrial processes"* are also eligible. CEEAG advises the following points should be addressed when designing aid schemes:

- demonstrate that the project would not be carried out without aid (*i.e.* a residual market failure exists) (¶¶ 90-91);
- update relevant costs and revenues every three years with a view to terminating unnecessary aid (¶ 92);
- be subject in general to an open, competitive bidding (¶ 103) unless projects are <1 MW or demonstrate an innovative technology selected in an open, cross-border call led by several member states (¶ 107);
- estimate the subsidy per tonne CO_2e avoided (¶ 115); and
- not displace less-polluting forms of energy (¶ 126).

The level of aid should follow from a competitive bidding process or be set at the minimum level necessary to meet the objective of the aid (¶¶ 47-48). The Commission takes this seriously, as shown on 9 December 2021when it rejected the rates proposed by Germany to support written-down CMM plants as their assumed opex costs were assessed to be too high.

If projects are below 20 MW_{th}, they are exempt from the EU ETS (Annex I (6)) and larger projects using multiple gas engines, with each unit <20 MW_{th}, have been similarly exempt.

As CMM projects contribute to the reduction of EU greenhouse gas emissions, member states could consider carbon trading. The EU ETS allows member states to unilaterally add non-CO_2 greenhouse gases to the system providing a protocol has been agreed beforehand. Designing such protocols is complex and, in the case of CMM, risks a price on methane emissions from all sources. International carbon offsets can be an attractive source of income. For example, J-credits under the Green Transformation emission trading system (GX-ETS) launched in April 2023 in Japan where a Joint Credit Mechanism (JCM) allows international credits under Article 6 of the UNFCCC Paris Agreement. Bilateral agreements have been signed with 29 partner countries, including with the UAE in April 2023 and with Ukraine – a UNFCCC Annex I country – in February 2024.

Capex support via the EU ETS Modernisation Fund or national grants dedicated to supporting the energy transition offer straightforward ways to incentive CMM capture and use. Operators of CMM plants can also tap other sources of funding usually unavailable to the coal sector, such as in France where Green Bonds have provided an additional source of capex finance.

7 Penalties

Financial penalties are used as an instrument of civil and criminal law to punish natural or legal persons who fail to comply with provisions of the law. A frequently used instrument to ensure compliance with EU law, penalties are a double-edged sword. On the one hand, penalties dissuade those who break the law. On the other hand, some infringements, especially of environmental law, can be unintentional or unavoidable, and punitive penalties risk depriving companies of the financial resources needed to invest for compliance. Moreover, unduly high penalties can cause socio-economic problems if a company has to raise prices or lacks funds to pay wages.

There are three typical penalty schemes:

1. **Monetary sanctions or fines:** a company must pay a specified sum to a public authority for each instance of non-compliance. Usually, this sum is proportionate to the severity and scale of the infringement, adjusted for repetition, co-operation and other factors. Penalties enter the general public budget or are hypothecated (purpose-bound) to remedy damages or fund compensatory measures.
2. **Compensation:** compensation for any damages caused is paid by a company directly to those affected. Sometimes, it is difficult to attribute direct causality between a specific company and any (environmental) damages caused. Companies can also be held responsible to compensate customers, *e.g.* for bad service. However, this approach risks incentivising a company to pay penalties rather than comply.
3. **Adjustments to regulated revenues:** these can be made in sectors with a natural monopoly such as infrastructure where non-compliance can result in adjustments to the regulated revenues of a company in subsequent years.

Penalties might apply after the first recorded infringement or after a defined number of repeated incidents. A well-known example of the latter is penalty points for speeding while driving. In the EU common fisheries regulation (1224/2009), a similar system is established: a fishing license holder who accumulates more than a certain number of points in a three-year period will have its licence suspended for at least two months.

Penalties can be determined and imposed by administrative authorities at different levels: local, regional, state, national or supranational such as the EU institutions.

7.1 Penalties under EU law

The **Industrial Emissions Directive** (IED 2010/75/EU) is the EU's most important legislation to regulate emissions of fourteen key pollutants from industry and certain agriculture. Under the IED, penalties for the most serious infringements should be at least 3% of a company's annual EU turnover. Member states lay down the rules on penalties which must be *effective, proportionate and dissuasive*. The IED lists three criteria to consider where applicable: nature, gravity and extent of infringement, population affected and repetition.

The **Emissions Trading System** (ETS 2003/87/EC) is the most important instrument of EU climate policy. Here, non-compliant companies must pay a fine proportionate to their failure to surrender sufficient emission allowances – €130 per missing allowance – *and* surrender all the missing allowances (Article 16). The penalty payments are collected at member state level.

The regulation on setting **Emission Performance Standards for New Passenger Cars and Vans** (Euro 7 2019/631) sets maximum CO_2 levels for car manufacturers' fleets. It establishes a penalty system but avoids the term "penalty". Manufacturers must pay an "excess emissions premium" of €95 per vehicle for each gCO_2/km above their fleet target. Here, the premiums are imposed by the European Commission (Article 8) and become revenue for the EU's general budget.

The **General Data Protection Regulation** (GDPR 2016/679) aims to protect personal data – a right of EU citizens under Article 8 of the Charter of Fundamental Rights of the EU. Even for severe violations, as listed in GDPR Article 83(5), the fine cannot exceed €20 million, or in the case of an undertaking up to 4% of its total global turnover of the preceding fiscal year, whichever is higher.

EU **Rules on Competition** in the single market, as laid down in Council Regulation (EC) 1/2003, provide for fines of up to 1% of total turnover under Article 23(1) for supplying incorrect information to the European Commission, while those infringing competition policy principles can be fined up to 10% of total turnover under Article 23(2).

The Commission **Guidelines on Fines** of 2006 recommend that the starting point for a fine should be up to 30% of the company's annual sales of the product or service concerned by the infringement depending on the gravity of the infringement. Fines can be increased by an infringement duration multiplier or for repeat offences. As a deterrent in cartel cases, the fine will be increased by a one-time amount equivalent to 15%-25% of annual sales.

The **AI Act** (2021/0106) provides for fines of up to 1% of total annual turnover for providing incorrect information. For infringements of its general conditions, such as identifying responsible persons or obligations on importers of AI systems, fines of up to €15 million are possible or, if the offender is an undertaking, up to 3% of its total worldwide annual turnover for the preceding financial year, whichever is higher. For the highest level of infringement – engaging in prohibited AI practices such as manipulation, exploitation or discrimination – penalties of up to €35 million or up to 7% of total global annual turnover are possible.

Table 1 – Summary of infringement fines expressed as percentages of annual turnover

Methane Regulation	<20%
Competition Law	<10%
AI Act	3%-7%
General Data Protection Regulation (GDPR)	<4%
Industrial Emissions Directive (IED)	>3%

7.2 Penalties options under the Methane Regulation

Article 33(5) of the Methane Regulation sets out a non-exhaustive list of infringements subject to penalties whilst Article 33(7) lists criteria to consider when determining penalties, some aggravating, some moderating. Member states must respect both lists when establishing a penalty scheme.

The regulation prescribes a minimum and maximum level of penalty. Article 33(1)(a)(i) explains that penalties should be at least at a level that *"deprives those responsible of the economic benefits derived from the infringement in an effective way"*. In (ii), the regulation requires that a penalty *"gradually increases for repeated serious infringement"*. It follows that member states should define the economic benefits that could derive from infringements. For underground coal mines, the economic benefit (*e.g.* venting through ventilation shafts >5tCH_4/kt) could be either the avoided cost of installing the necessary equipment to meet the regulation's requirements, if available, or the profit from the sale of coal during the infringement period. If the cessation of mining would have ensured compliance, then the economic benefit calculation would be complex and include the cost of sourcing alternative coal supplies for customers.

Note that any penalty scheme based on a fee per tonne of methane released above the regulatory limits of Article 22(2) (5 tCH_4/kt and later 3 tCH_4/kt) would not comply with the condition in Article 33(1)(a)(ii) to *"gradually increase for repeated serious infringements"* (see Box 1).

Article 33(2) of the Methane Regulation details the *administrative penalties and measures* (*i.e.* those imposed by the competent authorities) for infringements of requirements on monitoring and reporting at active underground and surface mines and on coal importers (*n.b.* infringements of mitigation measures at active mines and infringements at abandoned mines are not included here). Fines can reach up to 20% of annual turnover – a punitive level compared with other EU legislation (*e.g.* 3% under the IED).

Box 1 – Social cost of methane emissions

The Methane Regulation aims to reduce methane emissions associated with oil, gas and coal cost effectively from a social and environmental perspective (Recital 6). Penalties for non-compliance should be proportionate to the environmental damage and impact on human safety and health (Article 33). In cost-benefit analyses to inform decision-making, the *social cost of methane* is a measure of the overall social benefits of reducing methane emissions (or the social costs of increasing emissions). It reflects the monetary value of the overall harm to society from emitting one tonne of methane into the atmosphere in a given year. Estimates from the US Environmental Protection Agency incorporate recent scientific advances on climate change and its economic impacts and recommendations by the National Academies of Science, Engineering, and Medicine.[25,26]

Some imagine a system of penalties based on the carbon cost of methane emissions. A Berlin-based think tank, financially supported by green NGOs, envisages fines on methane emissions of 6 000 €/tCH_4. This draconian level is based on an EU ETS allowance price of 205 €/tCO_2 (*i.e.* 75 €/tCO_2 plus the current 130 €/tCO_2 ETS penalty for failing to surrender allowances). Such fines would not comply with a basic principle of the Methane Regulation, namely that fines should gradually increase for repeated, serious infringements.

The envisaged EU ETS price-plus-penalty approach also suggests that the cost to society of global greenhouse gas emissions far exceeds any reasonable analysis – about US$12.5 trillion or 12% of global GDP, whereas the energy sector accounts for around 5% of global GDP and powers 100% of global GDP. If penalties for coal mine operators in the EU were set at a carbon-based social cost of methane, domestic coal mining (a declining sector) would be the first sector in the world to apply such a principle. For example, total EU greenhouse gas emissions in 2023 would have a social cost of €703 billion or 4.1% of EU GDP, far more than the actual EU ETS revenues of *c.*0.25% of EU GDP. At 6 000 €/tCH_4, the oil and gas industry would be looking at a penalty of €1.5 billion for the methane emitted to atmosphere following the sabotage of the Nord Stream 2 pipelines in September 2022 – about 15% of the capex cost of the pipelines. Nord Stream AG estimates that the cost to dewater the pipelines, stabilise, repair and replace the lost gas will be €1.2-1.35 billion, slightly less than the envisaged fine.

As similar pieces of environmental legislation, member states will likely opt to replicate national penalty schemes under the Industrial Emissions Directive when implementing the Methane Regulation.

21 November 2024

[25] EPA (2023), *Report on the Social Cost of Greenhouse Gases: estimates incorporating recent scientific advances*, U.S. Environmental Protection Agency, November.

[26] National Academies of Sciences, Engineering, and Medicine (2017), *Valuing Climate Damages: updating estimation of the social cost of carbon dioxide*, National Academies Press, Washington, DC, January.

Annex – Penalties under the IED

'Article 79

Penalties

1. Without prejudice to the obligations of Member States under Directive 2008/99/EC of the European Parliament and of the Council (*), Member States shall lay down rules on penalties applicable to infringements of national provisions adopted pursuant to this Directive and shall take all measures necessary to ensure that they are implemented. The penalties provided for shall be effective, proportionate and dissuasive.

2. The penalties referred to in paragraph 1 shall include administrative financial penalties that effectively deprive those that committed the infringement of the economic benefits derived from their infringements.

For the most serious infringements committed by a legal person, the maximum amount of the administrative financial penalties referred to in the first subparagraph shall be at least 3 % of the annual Union turnover of the operator in the financial year preceding the year in which the fine is imposed.

Member States may also, or alternatively, use criminal penalties, provided that they are equivalently effective, proportionate and dissuasive to the administrative financial penalties referred to in this Article.

3. Member States shall ensure that the penalties established pursuant to this Article give due regard to the following, as applicable:

(a) the nature, gravity, and extent of the infringement;

(b) the population or the environment affected by the infringement, bearing in mind the impact of the infringement on the objective of achieving a high level of protection of human health and the environment;

(c) the repetitive or one-off character of the infringement.

4. Member States shall without undue delay notify the Commission of the rules and measures referred to in paragraph 1 and of any subsequent amendments affecting them.