



Effective Management of Coal Mine Methane at National Level: Monitoring, Reporting, Verification and Mitigation

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Global Methane Initiative



- Information presented here is based on Best Practice Guidance GMI prepared for UNECE. GMI partners with UNECE for increased impact.
- Launched in 2004, the Global Methane Initiative (GMI) is an international public-private partnership that advances cost-effective, near-term methane (CH₄) reductions. This is achieved through technical support to deploy CH₄-to-energy projects around the world.
- GMI focuses on reducing barriers to the recovery and use of CH₄ as a clean energy source from 5 key sectors:

Oil & Gas Systems



Coal Mines



Wastewater



Agriculture

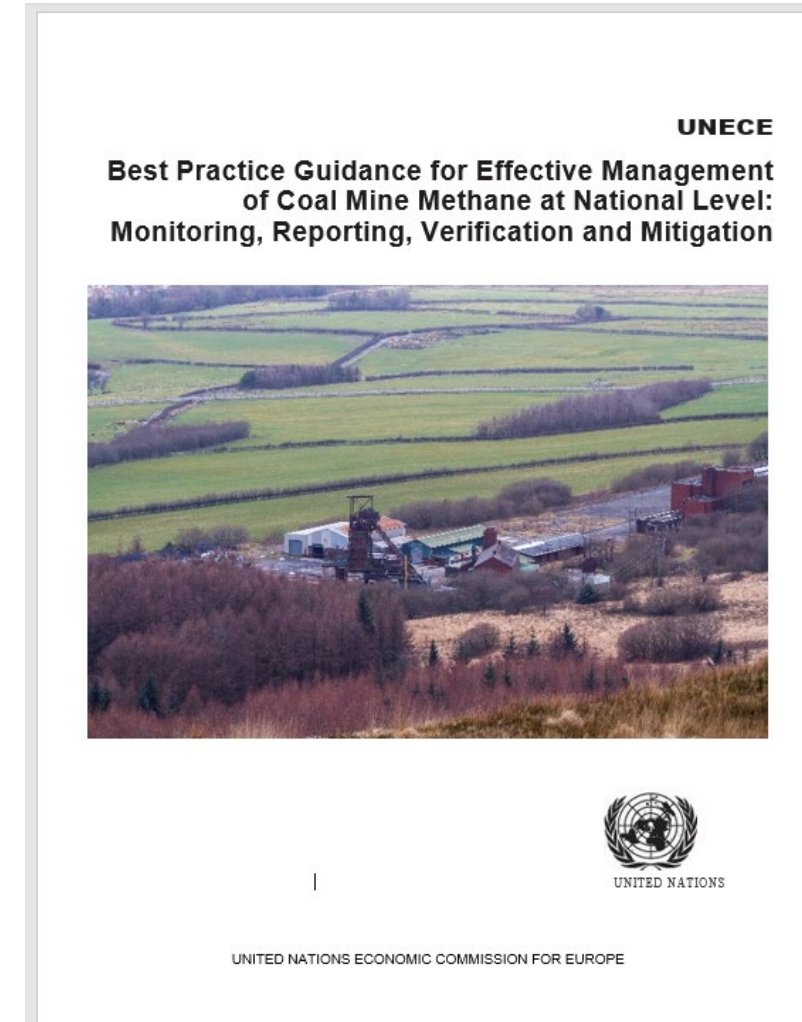


Municipal Solid Waste



New Report: Best Practices in Monitoring, Reporting Verification of CH₄ Emissions from Coal Mining

- Coal mines release ~10% of global anthropogenic CH₄ emissions
- National programs for monitoring, reporting, and verification (MRV) are an essential component of a successful mitigation strategy, when MRV programs ensure:
 - **Monitoring** of emissions, such as through direct measurements at facilities following adequate methodologies
 - **Reporting** of emissions data in a way that is easy to access and using a reporting platform that eases documentation & data management
 - **Verification** of reported data & calculations as well as facilitating an independent check
- Report is available on [UNECE](#) and [GMI](#) webpages



The Role of National Monitoring, Reporting & Verification in CH₄ Management

- National MRV programs support national inventories, but also:
 - Help understand emissions to design impactful policies, mechanisms & incentives
 - Track mitigation action & impact
 - Understand sector mitigation options, such as for ventilation air methane (VAM), which comprises 70-80% of coal mine methane (CMM) and is low-concentration
- Mitigation and its financing depend on transparent, standardized MRV systems that support development, planning and tracking of mitigation projects by:
 - Establishing a clear baseline of CH₄ availability
 - Forming an understanding of the variation in CH₄ flows & concentrations
 - Providing developer confidence in gas availability over time.



National Approaches to Accounting Coal Mining Emissions (IPCC Tiers as Stated by Countries)

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

Type of emissions from coal mining	United States	China	Russia	Australia
Working underground coal mines	Tier 3	Tier 2	Tier 2	Tier 3
Abandoned underground coal mines	Tier 3	Tier 1	"Not a source"	Tier 2/Tier 3 mix
Surface coal mines	Tier 2	Tier 1	Tier 1	Tier 2/Tier 3 mix
Post-mining emissions	Tier 2	Tier 2	Tier 1	Tier 2

Source: National Inventory Reports submitted to UNFCCC; China: National Communication and Biennial Update Report submitted to UNFCCC

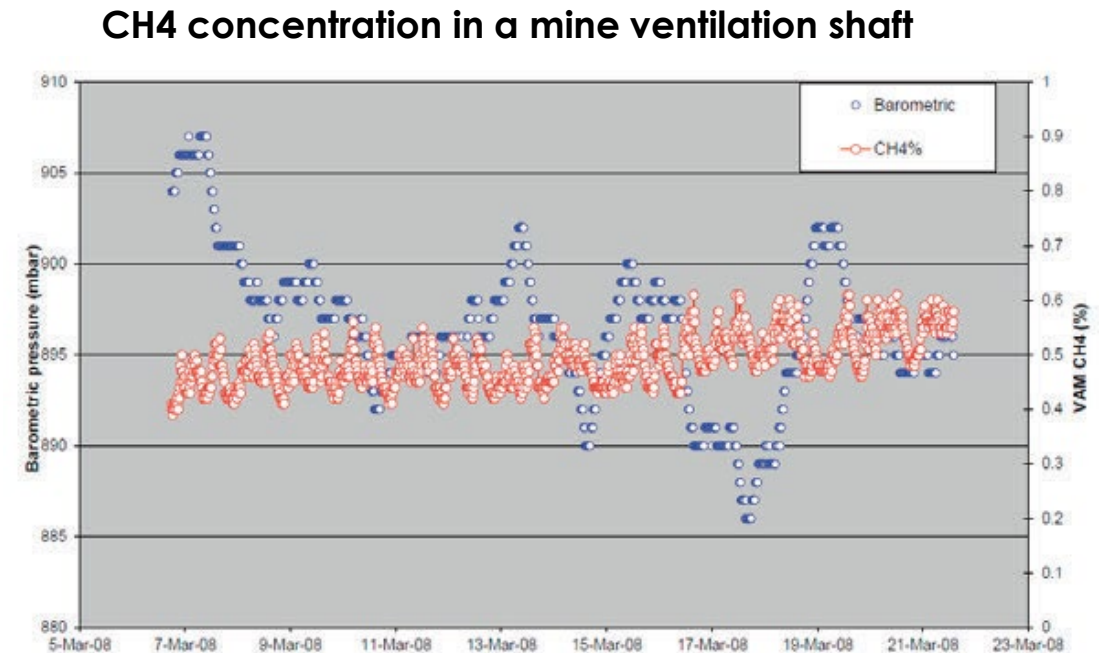
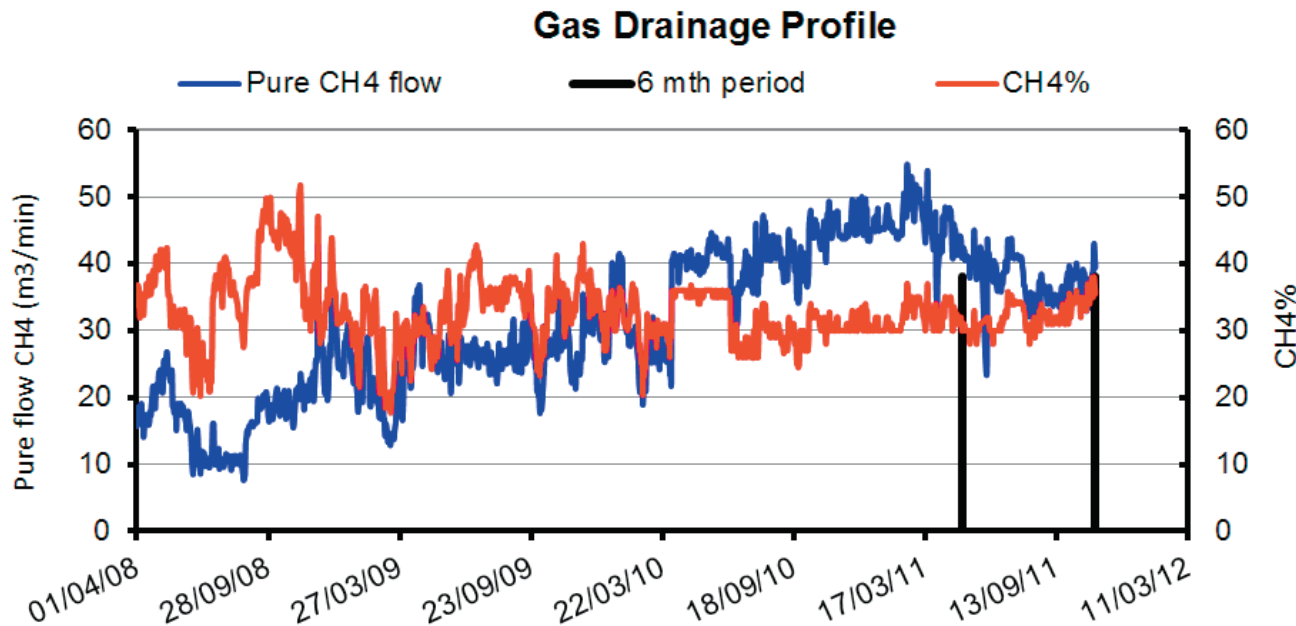
Best Practices for Monitoring Coal Mine Methane for Mitigation Purposes

- IPCC does not define any Tier approach as “best practice” but encourages use of higher level Tiers where possible.
- For mitigation purposes, an approach may be deemed “best practice” if it provides the most accurate accounting of emissions and establishes a reliable baseline for mitigation projects.
- Project developers typically do not accept data based on IPCC Tier 1 or Tier 2 methodologies to investigate, plan, develop, and finance mine CH₄ mitigation projects; they generally require site-specific methodologies.



Monitoring & Variability of CMM Emissions

- Flow of CH₄ at a source can **vary within the day** & often – **hourly**
 - Depends on pace of coal production, geology, ventilation velocities, barometric pressure



Source: UNECE, 2021. Best Practices in Monitoring, Reporting, Verification of CH₄ Emissions from Coal Mining

- Accuracy of measurement → frequency of measurement ← cost vs. benefit

Monitoring Best Practice for Mitigation of CH₄ from Coal Mining

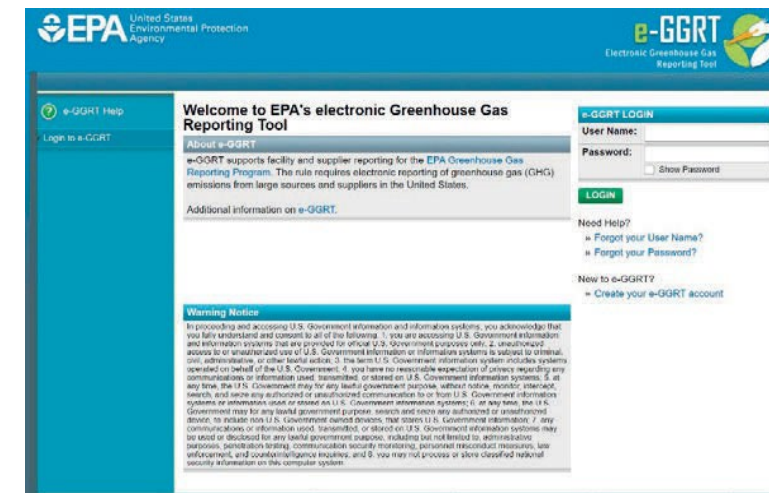


Mine Methane Source	Best Available Monitoring Approach from the Perspective of Mitigation Action	Examples of Countries where Approach is Included in MRV Methodology/Inventory
Working underground coal mines (ventilation and drainage)	Calculation based on data from Continuous Emissions Monitoring System (CEMS)	Australia (along with periodic measurements) United States (along with periodic measurements)
Abandoned underground mines	Regional decline curves using vent flow measurements, starting from gas flow at closure and mine status (sealed/ vented/flooded), allowing for flooding rate	Australia, United Kingdom, United States
Surface mines	Emission factor applied to coal production at the regional or mine-specific level and validated with local seam gas content measurements	Australia, United States, Germany
Post-mining	Emission factor established through residual gas content of coal after leaving the mine, applied to coal production that shows emissions during storage, processing and transport	Australia, United States

Reporting & Verification in the Coal Sector



- If a country of setting up an MRV program, in addition to sound **monitoring** approaches, reporting systems and verification are needed to deliver quality data.
- **Reporting** considerations:
 - Balance the burden to reporters and the level of detail sufficient for mitigation?
 - Do facilities have the technical capacity to correctly monitor, measure and report data?
 - Is the cost of requirements commensurate with the benefits derived from the reported data?
 - Is adequate reporting system in place?
- **Verification** considerations:
 - Ensure individual measurements are consistent, complete, and in alignment with protocols and equipment standards & procedures
 - Ensure results are calculated accurately and checked for consistency, against time series and algorithmic checks
 - Enable independent verification, if possible.



Verification through Remote Sensing

- It is well known that satellites can **detect** CH₄ emissions using specialized sensors.
 - In the past 5 years, there has been an explosion of interest in applying satellites to **quantify** CH₄ emissions from coal mines.
- Best available sensors (currently – GHG Sat) allow to monitor and quantify emissions from target coal mines up to weekly.
- Aerial surveys (flyovers) could offer more detailed insights at finer resolutions but are more expensive.



Verification through Remote Sensing: Benefits and Considerations

- Potential benefits:
 - Using the best available high-resolution satellites could allow for independent verification and spot-checks of drained and VAM CH₄.
- Considerations:
 - Quantifying CH₄ emissions through remote sensing entails some **uncertainties**, some of which are similar to ground measurements:
 - Detection uncertainty (e.g., cloud cover does not allow to retrieve concentrations)
 - Mine location uncertainty
 - Source allocation uncertainty
 - Quantification uncertainty (e.g., suitability of air pollution dispersion models)
 - Variability of emission volumes and concentrations (equivalent to ground measurements)

MRV for Methane Emissions from Coal Mining: The Framework



- Considerations for countries developing robust MRV programs for mitigation:
 - Adjust to the **policy framework** for the MRV, such as legislative, regulatory & administrative
 - Recognize and define roles for relevant **stakeholders**
 - Understand the **specific sources of sector emissions** (sub-sources) & their monitoring options
 - Assess **feasibility of direct measurements** at facility level (preferred approach) for sub-sources for monitoring
 - Determine the **target sub-sources** (e.g., working, abandoned or surface mines)
 - Prioritize by establishing **reporting thresholds** (e.g., facility type or size, emission size)
 - Develop the **program structure** (reporting frequency, platform, recordkeeping, publication)
- National MRV systems can provide reliable data for mitigation
- In general, national data should be compatible with international reporting efforts, such as UNFCCC

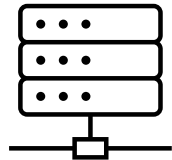
In Summary...



- Inherent variability of CH₄ emissions from coal mines has implication for estimating CH₄ production by coal mines.



- Tier 3 (e.g., mine-level measurements) approach is best suited to facilitate planning, development, and financing of mine CH₄ projects.



- Estimation of emissions from different sources of mine CH₄ is not equally detailed.

- Monitoring of CH₄ emissions at working underground coal mines is often the most precise, particularly when there is an option to use data Continuous Emissions Monitoring Systems (CEMS).



- Reporting and verification are important components of national-level MRV programs.

Thank you for your attention!



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<https://www.globalmethane.org/>