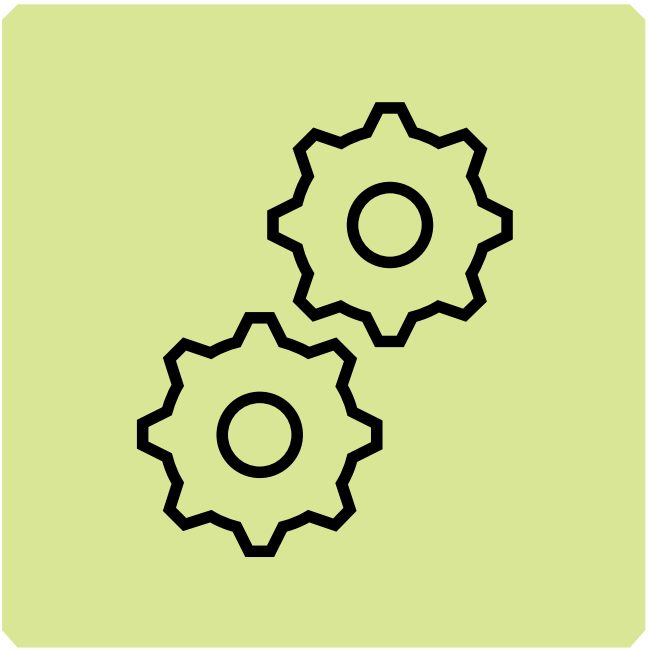
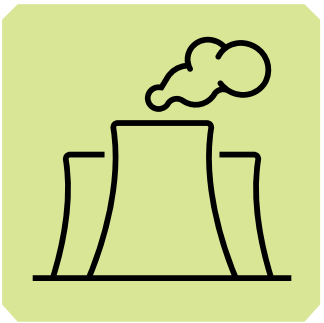
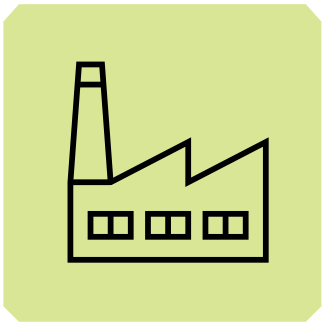
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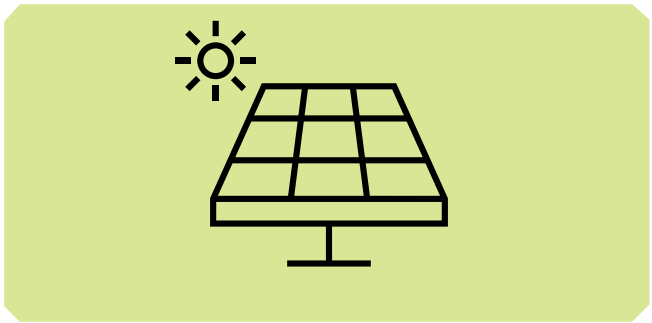


Estimating emissions and energy from coal mining guideline

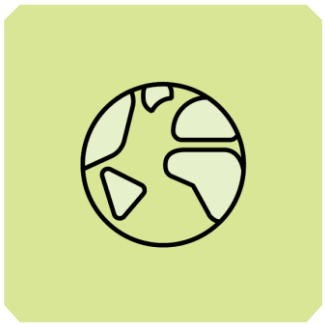
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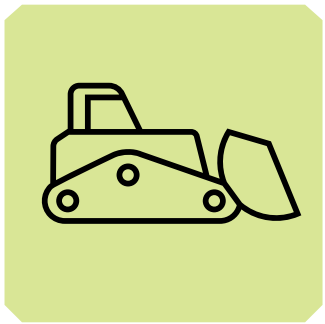












National Greenhouse and Energy Reporting

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Definitions and abbreviations

Term	Meaning
ACARP Guidelines	Guidelines for the Implementation of NGER Method 2 or 3 for Open Cut Coal Mine Fugitive GHG Emissions Reporting (C20005), published by the Australian Coal Association Research Program (ACARP) in December 2011.
ACARP U/G Guidelines	Measurement and Reporting of Fugitive Emissions from Underground Coal Mines (C21002), published by ACARP in September 2020.
ACCU Scheme	Australian Carbon Credit Unit (ACCU) Scheme, formerly known as Emissions Reduction Fund, means the Australian Government's voluntary scheme that aims to provide incentives for a range of organisations and individuals to adopt new practices and technologies to reduce emissions.
BoP	Basis of preparation. A BoP records the methodology by which an NGER report has been prepared, including details such as facility layout, data sources and calculation methods.
C	Celsius (temperature scale)
CEM	Continuous Emissions Monitoring per Part 1.3 of the NGER Measurement Determination
CER	Clean Energy Regulator
CH_4	Methane
C_{jct}	The proportion of gas type (j) – being CH_4 and CO_2 – in the volume of the gas stream at the time of measurement (being a fraction between 0 and 1) – as defined in section 1.21(1) of the NGER Measurement Determination in respect of estimating emissions using Method 4.
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalence
$CO_{2\text{-ej,gen}}$ = $CO_{2\text{-ej,gen,total}}$	The total mass of gas type (j) – being CH_4 and CO_2 generated from the mine during the year before capture and flaring is undertaken at the mine, measured in CO_2-e and estimated per Method 4 – as defined as $CO_{2\text{-ej,gen,total}}$ in section 3.6 of the NGER Measurement Determination. In this guideline, $CO_{2\text{-e-ej,gen}}$ is divided into $CO_{2\text{-ej,gen,vent}}$ and $CO_{2\text{-ej gen,sis}}$ (refer definitions below) to reflect 2 occurrences of the source for the parameter that require significantly different measurement approaches, with the following equation: • $CO_{2\text{-e-ej,gen,total}} = CO_{2\text{-e-ej,gen}} = CO_{2\text{-ej,gen,vent}} + CO_{2\text{-e-ej,gen,sis}}$
$CO_{2\text{-ej,gen,sis}}$	Underground gas drainage emissions (surface in seam, sis): Mass of CH_4 and CO_2 drained from mining area to surface measured in CO_2-e and estimated per Method 4 – as a subset of $CO_{2\text{-ej,gen total}}$ as defined in section 3.6 of the NGER Measurement Determination (refer above, and table 3 and chapter 3.3 of this guideline).

Term	Meaning
$CO_{2\text{-ej,gen,vent}}$	Underground ventilation emissions: Mass of CH_4 and CO_2 in coal mine return ventilation measured in CO_2-e and estimated per Method 4 – as a subset of $CO_{2\text{-ej,gen,total}}$ as defined in section 3.6 of the NGER Measurement Determination (refer above, and table 3 and chapter 3.2 of this guideline).
EERS	The Clean Energy Regulator's Emissions and Energy Reporting System, which is used for NGER reporting
E_j	Fugitive (vented) emissions of gas type (j) – being CH_4 and CO_2 – that result from the extraction of coal from the mine during the year, measured in t CO2-e – as defined in section 3.6 of the NGER Measurement Determination. No other meaning to 'E_j' is used in this guideline.
FR_{ct}	The flow rate of the gas stream in m^3/s at the time of measurement – as defined in section 1.21(1) of the NGER Measurement Determination in respect of estimating emissions using Method 4.
GJ	Gigajoule
GWP	Global Warming Potential
K	Kelvin (temperature scale)
kPa	Kilopascal (pressure scale)
m^3	Cubic metre
m^3/s	Cubic metre per second (a measure of flow rate)
MTBI	Matters to be identified, as specified in Schedule 4 of the NGER Measurement Determination.
N_2O	Nitrous oxide
NGER	National Greenhouse and Energy Reporting
NGER Act	*National Greenhouse and Energy Reporting Act 2007*
NGER legislation	NGER Act, NGER Measurement Determination and NGER Regulations
NGER Measurement Determination	National Greenhouse and Energy Reporting (Measurement) Determination 2008
NGER Regulations	National Greenhouse and Energy Reporting Regulations 2008
PEM	Periodic Emissions Monitoring, as defined in Part 1.3; or sections 3.7 to 3.13 of the NGER Measurement Determination.
Q_{cap}	The quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas captured for combustion from the mine during the year, measured in m^3 at STP – defined as $Q_{ij,cap}$ in section 3.6 of the NGER Measurement Determination.
Q_{flared}	The quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas flared from the mine during the year, measured in m^3 at STP – defined as $Q_{ij,flared}$ in section 3.6 of the NGER Measurement Determination.

Term	Meaning
Q_{tr}	The quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas transferred out of the mining activities during the year, measured in m^3 at STP – defined as $Q_{ij,tr}$ in section 3.6 of the NGER Measurement Determination.
ROM coal	Run-of-mine coal, meaning the coal that is extracted by mining operations before screening, crushing or preparation of the coal has occurred.
Safeguard Mechanism	The Australian Government's mechanism to contribute to the achievement of Australia's greenhouse gas emissions reduction targets. See the Safeguard Mechanism[1] for more information.
Scope 1 emission	Per 2.23 of the NGER Regulations, *means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility*.
Scope 2 emission	Per 2.24 of the NGER Regulations, *means the release of greenhouse gas into the atmosphere as a direct result of one or more activities that generate electricity, heating, cooling or steam that is consumed by the facility but that do not form part of the facility.*
Standard conditions, STP	Standard temperature (15°C = 288 K) and pressure (101.325 kPa) per subsection 2.32(7) of the NGER Measurement Determination.
t	Tonnes (metric)
tpa	Tonnes per annum
U/G	Underground

Terms in NGER legislation may have specific meanings within the law. These key words and phrases are normally identified under a heading such as Definitions, Interpretation or Dictionary or in other parts of the document.

For more information on interpreting legislation see Federal Register of Legislation - Understanding Legislation[2].

[1] https://cer.gov.au/schemes/safeguard-mechanism
[2] https://www.legislation.gov.au/help-and-resources/understanding-legislation/reading-legislation

Disclaimer

This guideline has been developed by the Clean Energy Regulator (CER) to assist entities to comply with their reporting obligations under the *National Greenhouse and Energy Reporting Act 2007*[3] (NGER Act) and associated legislation.

This guideline only applies to the 2025–26 NGER reporting year and should be read in conjunction with the NGER Act, National Greenhouse and Energy Regulations 2008[4] (NGER Regulations), and National Greenhouse and Energy Reporting (Measurement) Determination 2008[5] (NGER Measurement Determination), as in force for this reporting period. These laws and their interpretation are subject to change, which may affect the accuracy of the information contained in the guideline.

The guidance provided in this document is not exhaustive, nor does it consider all circumstances applicable to all entities. This guidance is not intended to comprehensively deal with its subject area, and it is not a substitute for independent legal advice. Although entities are not bound to follow the guidance provided in this document, they must ensure they meet their obligations under the National Greenhouse and Energy Reporting (NGER) Scheme[6] at all times. The CER encourages all users of this guidance to seek independent legal advice before taking any action or decision on the basis of this guidance.

The CER and the Australian Government will not be liable for any loss or damage from any cause (including negligence) whether arising directly, incidentally or as consequential loss, out of or in connection with, any use of this guideline or reliance on it, for any purpose.

If an entity chooses to meet their obligations under the NGER Scheme in a manner that is inconsistent with the guidance provided in this document, CER, or an independent auditor, may require the entity to demonstrate that they are compliant with requirements of the NGER Act, NGER Regulations, and/or the NGER Measurement Determination. Entities are responsible for determining their obligations under the law and for applying the law to their individual circumstances.

[3] https://www.legislation.gov.au/C2007A00175/latest/versions
[4] https://www.legislation.gov.au/F2008L02230/latest/versions
[5] https://www.legislation.gov.au/F2008L02309/latest/versions
[6] https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme

2025–26 updates

Changes in this document for the 2025–26 reporting year:

- Chapter 2.1: Updated to highlight the importance of record keeping to support open cut and decommissioned underground coal mining fugitive emissions estimations.
- Chapter 5.1: Updated to include clarification on the definition of a gassy mine as being based on volume of methane in volume of air.
- Chapter 7.3: Updated to include learnings from the thematic audits of facilities applying higher order methods for estimating fugitive emissions from open cut coal mining.
- Minor stylistic and formatting changes have also been made to this document.

Read about the changes to the NGER Legislation for the 2025–26 reporting period[7].

1. Purpose of this guideline

Coal mining companies have reporting obligations under the NGER legislation, comprising the NGER Act, the NGER Regulations and the NGER Measurement Determination.

It is important that data relating to greenhouse gas emissions, energy consumption and energy production of corporations, provided under the NGER Scheme, is accurate and complete, and complies with the requirements of the legislation. The information is used to:

- inform government policy formulation and the Australian public
- meet Australia's international reporting obligations
- assist Commonwealth, State and Territory government programs and activities
- ensure, under the Safeguard Mechanism[8], that net covered emissions of greenhouse gases from the operation of a designated large facility do not exceed the baseline applicable to the facility.

This guideline is intended to promote better reporting by assisting registered corporations and responsible emitters to:

- estimate and report emissions (including fugitive emissions) from coal mines
- estimate and report energy production and energy consumption from coal mines.

It may also be useful for auditors and other users or preparers of NGER data and reporting from coal mining.

[7] https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme/report-emissions-and-energy/amendments-to-national-greenhouse-and-energy-reporting-legislation
[8] https://cer.gov.au/schemes/safeguard-mechanism

1.1 Focus of this guideline

Coal mines must report on several activities, as outlined in Table 1. Coal mines may have further data depending on the specific activities occurring at the facility.

Table 1 – Typical activities and activity data for coal mines.

Activity	Typical coal mine NGER data	Other required coal mine NGER data (depending on activities)
Fugitive emissions from underground mines	• Gas flow and gas concentration from mine return ventilation • Gas flow, gas concentration, gas pressure for gas drainage emissions and flaring • Emissions from decommissioned underground mines	• Gas temperature, pressure • Post-mining emissions from gassy mines
Fugitive emissions from open cut mines	• Run-of-mine (ROM) coal production • Gas in extracted gas bearing strata, based on in-situ gas sampling and gas modelling	
Energy production	• Production of 'saleable coal on a washed basis'	• Gas captured for on-site combustion, flaring, or gas transferred outside the facility (if injected into pipeline) • On-site electricity generation (if exceeding reporting threshold)
Fuel combustion / Energy consumption and emissions	• Diesel consumption in heavy mining equipment • Gas captured for on-site combustion or flaring if injected into pipeline • Purchased electricity consumption	• Other fuel combustion, e.g. diesel or petrol for light vehicles • Oils and greases consumed • Non-combusted diesel usage, e.g. use as flocculent or in explosives
Other data or emissions	• Uncertainty assessment • Raw coal production (as a Matter to be identified (MTBI)), reported as ROM coal	• Emissions from sulphur hexafluoride (SF_6) where applicable

This guideline will focus primarily on key coal mining related NGER reporting challenges, including sector specific emissions and energy sources and activities:

- good practice NGER reporting in coal mining – refer section 2
- fugitive (vented) emissions from extraction from underground coal mining, including from mine return ventilation and gas drainage – refer section 3
- energy and emissions from coal mine waste gas – refer section 0

- fugitive emissions from post-mining activities from gassy underground mines – refer section 5
- fugitive emissions from decommissioned underground mines – refer section 6
- fugitive emissions from open cut mines – refer section 7
- energy production, particularly from coal production – refer section 8
- other noteworthy NGER data requirements for coal mines – refer section 9.

This guideline clarifies reporting requirements for coal mine facilities, including reporting requirements specifically applicable to coal mining activities:

- fugitive emissions from coal mining, as per Part 3.2 of the NGER Measurement Determination
- coal energy production, as per Part 6.1 of the NGER Measurement Determination and 2.25 of the NGER Regulations.

This guideline will not cover general NGER reporting requirements such as determining facility and operational control and using the Emissions and Energy Reporting System (EERS).

See NGER Reporting Guides[9] for NGER reporting matters not covered in this guideline.

2. Good practice NGER reporting in coal mining

Registered reporters must keep records of the data they used to prepare their NGER reports (section 22 of the NGER Act). Records must be kept for 5 years and should enable the CER to ascertain whether the reporting meets requirements of the NGER legislation. These records must be easily accessible for inspection and audit.

The record-keeping requirements include recording source and activity data capture and processing data using the general estimation principles in section 1.13 of the NGER Measurement Determination, described in Table 2 below.

Table 2 – General estimation principles in s1.13 for NGER reporting in coal mining.

General estimation principles	Example implication for coal mine NGER reporting
Transparency Emission estimates must be documented and verifiable	• All key decisions and assumptions made to prepare NGER reporting should be documented and updated each year. This includes assumptions concerning sampling approaches and locations to estimate fugitive emissions, as well as other key decisions. • All activity data must be recorded with a clear audit trail. This includes all samples made to support fugitive emissions estimates, for example, including barometric pressure if used for venting emissions.

[9] https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme/report-emissions-and-energy/nger-reporting-guides

General estimation principles	Example implication for coal mine NGER reporting
Comparability Emission estimates using a particular method must be comparable with estimates produced by similar entities in that industry sector using the same method	• Appropriately applying the requirements of the NGER Measurement Determination will achieve this for most data and emissions estimates in coal mining. • Using coal mine industry practice to achieve comparability, for example when estimating fugitive emissions. It should also meet other requirements such as 'Transparency' and 'Accuracy'. Using industry practice can only be accepted if it also meets the other principles and requirements set out in the NGER Measurement Determination.
Accuracy Having regard to the availability of reasonable resources and the requirements of the NGER Measurement Determination, uncertainties in emissions estimates must be minimised and any estimates must be neither over- nor under-estimates of the true values at a 95% confidence interval	• Sampling, e.g. for fugitive emissions or for energy production, should be performed for a duration and frequency to enable reliable data. This is particularly relevant: » where higher order methods are used, for example Method 4 for fugitive emissions, sampling frequency should support an appropriate 95% confidence interval » where industry practice may be used to capture data, for example, if used for flaring emissions. • Estimates should be neutral and without bias. Use of a 'conservative' estimate, for example, overstating fugitive emissions or understating flaring when compared to the likely true value is not allowed.
Completeness Subject to any applicable reporting thresholds, all emission sources identified in section 1.10 of the NGER Measurement Determination, and production and consumption of all fuels and energy commodities listed in Schedule 1 of the NGER Regulations, must be accounted for.	• All typical source types for coal mining as defined by the NGER Measurement Determination appropriately identified and reported. • Identifying and documenting all instances and occurrences of relevant sources, for example, if additional activity data needs to be captured, such as for new gas drainage well or contractors on-site.

2.1 Applying the principles in coal mining

An executive officer must provide a declaration that the report to be submitted to CER, has been prepared in accordance with the legislation, including that the general principles described above have been appropriately applied in alignment with section 1.13 of the Measurement Determination. Registered corporations, responsible emitters and the accountable Executive Officer must identify and implement the reporting processes and internal controls that are required to report compliantly under the NGER Scheme. This should include repeatable processes and internal controls, that have been formalised.

Recommendations for compliant NGER reporting in the coal mine sector include the following:

- Formalising NGER reporting governance. Due to the complexity for many corporations with coal mining facilities, formalising the governance arrangements may be important. This may include formalising governance roles such as:
  - Accountable (senior) manager. This role would be accountable for executing the annual reporting process and preparing it for the executive officer's signature. This could include:
    - accountability for ensuring the process and documentation complies with the requirements of NGER legislation
    - allocating sufficient resources to execute the process, including ability to instruct appropriate people to perform duties defined under the NGER reporting process – either directly, or via reference to the signing executive officer.
  - Responsible NGER process owner. This role would be accountable for design, review and implementation of the annual reporting process, with reference to the accountable (senior) manager. It includes updating the annual basis of preparation (BoP) and collaborating with data owners to define data requirements that comply with the requirements of the NGER legislation. The responsible NGER process owner may comprise more than one individual in a small, centralised team – it may also include facility (coal mine operations) level responsible NGER process owners.
  - Responsible data owners. This role would be accountable for measuring and documenting data in accordance with the requirements of the NGER legislation, see further below.
- Formalising reliance on existing data processes. Existing data processes controlled by different data owners may be suitable for NGER reporting. In coal mining this may include:
  - Diesel consumption data measured based on invoices for diesel deliveries (that is, criteria 'A' or 'AA'), with purchasing or accounts payable in control of the data records, and with accounts reconciling the amounts paid to fuel deliveries and recorded in the accounting system.
  - Ventilation data measured using ventilation surveys and gas composition data used to monitor safe subsurface mining conditions – usually 'owned' or controlled by the site's ventilation officer.
  - Gas drainage data, which may be controlled by mine engineering.

Where the data may be the responsibility of several individuals or teams, formalising the data owners' accountability for ensuring the data used for NGER reporting are complete and accurate may be appropriate. This can include:

- A formal sign-off on completeness and accuracy of the annual activity data. This way data owners formally acknowledge that the signing executive officer relies on the data they control.
- 'Sense checks' on total amounts to be reported – where possible, it can be useful to perform 'sense-checks' on total amounts to be reported in the NGER report to underlying systems. For example, the $-value for diesel purchases during the year as recorded in the accounting system to the NGER amount in kilolitres (kL) to be reported, and sense-checking the implied $-value paid per litre (L). Such analysis can form part of the data-owner sign-off process.

In larger corporate groups with several mines, some of the data processes may be centralised, for example, centralised purchasing and recording of diesel fuel data. It is important to identify the data handling processes that are necessary for NGER reporting, and the personnel responsible for managing those processes.

Where existing coal mine processes are insufficient at delivering suitable NGER data, additional data processes should be formalised. This may include estimating fugitive emissions from open cut coal mines using Method 2, or gas drainage emissions. In such cases, a reliable data capture and reporting process may need to be established and formalised.

> **Records relating to gas models for open cut coal mining and decommissioned underground coal mines will need to be retained in order to support reporting. This may require retaining records for longer than the mandatory five years.**

- Creating a BoP document – supports a reporter in meeting NGER record-keeping requirements. The CER encourages reporters to consider submitting their BoP (or a summary thereof) with each year's NGER report to clarify key assumptions and decisions applied.

2.2 Managing Safeguard baseline

Many coal mines are required to keep emissions within a baseline under the Safeguard Mechanism. If emissions exceed the baseline, the responsible emitter for the mine may face significant financial liabilities.

The oversight and control of NGER data may also be important for the coal mine to manage its obligations under the Safeguard Mechanism, particularly if it exceeds the baseline emissions threshold.

2.3 Contact CER if method temporarily not available

Reporters should observe the requirements in section 1.19 of the NGER Measurement Determination for down time of equipment used to monitor emissions:

- if the down time in a year is 6 weeks (42 days) or less, each day of the down time can be estimated consistent with the principles of section 1.13 of the NGER Measurement Determination.

  Note: for continuous emissions monitoring (CEM) to be applicable, the down time cannot exceed 10% of the year (36.5 or 36.6 days), that is, maximum 5 weeks and one day (excluding down time for calibration), as per subsection 1.26(4)

- if the down time exceeds 6 weeks in a year, and within 6 weeks after the day when down time exceeds 6 weeks, the registered controlling corporation or responsible emitter must inform the CER in writing of the following:
  - the reason why down time is more than 6 weeks
  - how the reporter plans to minimise down time
  - how emissions have been estimated during the down time.

Whilst this 'down time' requirement in practice may be of most relevance for CEM using Method 4, it is a global requirement for all emissions sources. Periodic Emissions Monitoring (PEM) using Method 4 can also be affected, noting that if monthly emissions monitoring is applied, only one measurement period can be missed. It also applies to all other emissions sources, for example failure of orifice plate to measure flow of coal mine waste gas to flare, even when using Method 1, 2 or 3.

Where there has been more than 6 weeks down time in a year, and Method 2, 3 or 4 has been used to estimate emissions for a separate occurrence of a source, the CER may require a reporter to use Method 1 to estimate emissions.

3. Emissions from venting at underground mines

Fugitive emissions from underground coal mines typically involve the release of methane (CH_4) and carbon dioxide (CO_2) due to the fracturing of gas-bearing strata disturbed by coal extraction.

Division 3.2.2 of the NGER Measurement Determination provides the methodologies available for estimating fugitive emissions from underground coal mining. This includes the following occurrences of the fugitive emissions source:

- Fugitive emissions from extraction of coal, requiring emissions of methane and carbon dioxide to be estimated using Method 4 (direct emissions monitoring) per subdivision 3.2.2.2 of the NGER Measurement Determination. This source has 2 main occurrences, with significantly different approaches to the measurement of required activity data:
  - » fugitive emissions from mine return ventilation comprising diffused gas streams measured with high flow rate and low gas concentrations and measured as an area-based source in ambient conditions - see chapter 3.2 of this guideline for more information
  - » fugitive emissions from gas drainage comprising gas streams with high gas concentrations and may be under significant pressure and measured at a point source – see chapter 3.3 of this guideline for more information.
- Fugitive emissions from venting or other fugitive release of gas before extraction of coal, is treated as a separate fugitive emission under subsection 3.4(5) of the NGER Measurement Determination. This may also include pre-gas drainage during mine development prior to extraction of coal at the facility. It requires emissions of methane and carbon dioxide to be estimated using Method 4 under Part 1.3 of the NGER Measurement Determination. This is included within the description of 'Estimating fugitive emissions from gas drainage' in chapter 3.3 of this guideline. This is because the Method 4 required for this occurrence of the source is substantially the same.

3.1 Fugitive emissions from extraction of coal – general overview

Only Method 4 is available for estimating fugitive emissions from the extraction of coal in underground mining. These emissions arise from venting through mine ventilation and surface venting caused by gas drainage. Section 3.6 of the NGER Measurement Determination (Subdivision 3.2.2.2) provides the following formula to estimate the fugitive methane (CH_4) and carbon dioxide (CO_2) vented:

$$E_j = CO_{2-e_{j,gen,total}} - \gamma_j(Q_{ij,cap} + Q_{ij,flared} + Q_{ijtr})$$

Where:

E_j is the fugitive emissions of gas type (j) – being methane and carbon dioxide – that result from the extraction of coal from the mine during the year, measured in tonnes carbon dioxide equivalence (t CO_2-e).

$CO_{2-e_{j,gen,total}}$ is the total mass of gas type (j) – being CH_4 and CO_2 – generated from the mine during the year before capture and flaring is undertaken at the mine, measured in t CO_2-e and estimated using continuous emissions monitoring in accordance with Part 1.3 of the Measurement Determination, or periodic emissions monitoring as set out in sections 3.7–3.13. This factor is referred to as $CO_{2,\ ej\ gen}$ throughout this guideline when it is the total, or $CO_{2\text{-}ej,gen,vent}$ or $CO_{2\text{-}ej,gen,sis}$ when it concerns the 2 main occurrences of the source, refer table 3 below.

y_j is the factor for converting a quantity of gas type (j) from m^3 at standard conditions to t CO_2-e:

(a) For CH_4 – 6.784 x 10^{-4} x $GWP_{methane}$; and

(b) For CO_2 – 1.861 x 10^{-3}.

$Q_{ij,cap}$ is the quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas captured for combustion from the mine during the year, measured in cubic metres (m^3) at standard conditions (STP) – referred to as Q_{cap} throughout this guideline.

$Q_{ij,flared}$ is the quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas flared from the mine during the year, measured in m^3 at STP – referred to as Q_{flared} throughout this guideline.

Q_{ijtr} is the quantity of gas type (j) – being CH_4 and CO_2 – in coal mine waste gas transferred out of the mining activities during the year measured in m^3 at STP – referred to as Q_{tr} throughout this guideline.

Note: $GWP_{methane}$ means the Global Warming Potential of methane, which is defined as 28 in 2.02 of the NGER Regulations.

STP is defined in subsection 2.32(7) of the NGER Measurement Determination as gas measured on a dry basis at:

- air pressure of 1 atmosphere or 101.325 kilopascals (kPa)
- air temperature of 15 degrees Celsius (°C) or 288 Kelvin (K)
- air density of 1.225 kilograms per cubic metre (kg/m^3).

In practice, using Method 4 implies that vented emissions (E_j) must be measured directly using measurement equipment at the emissions source, being vented via coal mine return ventilation or surface gas drainage where occurring. Table 3 outlines the key data (where applicable) that must be monitored and recorded.

Table 3 – Data requirements for fugitive venting emissions from the extraction of coal in underground mining.

Activity	Data required	s3.6 parameter	Emissions?	Energy?
Coal mine return ventilation	Mass of CH_4 and CO_2 in coal mine return ventilation measured in t CO_2-e ($CO_{2\text{-}ej,gen,vent}$)	$CO_{2-e_{j,gen,total}}$ Hereinafter: $CO_{2\text{-}ej,gen}$ = $CO_{2\text{-}ej,gen,vent}$ + $CO_{2\text{-}ej,gen,sis}$	Yes Estimated using Method 4 per section 3.6	No
Gas drainage to surface	Mass of CH_4 and CO_2 drained from mining area to surface measured in t CO_2-e ($CO_{2\text{-}ej,gen,sis}$)			
	Volume of CH_4 and CO_2 drained from mining area to surface and combusted by facility measured in m^3 at STP	$Q_{ij,cap}$ Hereinafter: Q_{cap}	Yes Estimated using Method 1, 2 or 3 per Part 3.2 for emissions from combustion of gaseous fuel	Yes, for flaring if gas is injected into a pipeline Energy production per Part 6.1

Activity	Data required	s3.6 parameter	Emissions?	Energy?
	Volume of CH_4 and CO_2 drained from mining area to surface and flared by facility measured in m^3 at STP	$Q_{ij,flared}$ Hereinafter: Q_{flared}	Yes Estimated using Method 1, 2 or 3 per sections 3.14 – 3.16.	Energy consumption per Part 6.2
	Volume of CH_4 and CO_2 drained from mining area to surface and transferred outside facility measured in m^3 at STP.	Q_{ijtr} Hereinafter: Q_{tr}	No Not at the facility where gas is captured	Yes Energy production per Part 6.1

The Australian Coal Association Research Program (ACARP) has developed Guidelines for the Measurement and Reporting of Fugitive Emissions from Underground Coal Mines[10] (ACARP U/G Guideline). The ACARP U/G Guideline supplements the guidance provided below on how to measure and estimate the $CO_{2\text{-}ej,gen}$ parameter in section 3.6.

As indicated in Table 3 (see above), the approach to monitoring and estimating emissions from mine return ventilation ($CO_{2\text{-}ej,gen,vent}$) is significantly different to the approach used to monitor and estimate emissions from gas drained to the surface ($CO_{2\text{-}ej,gen,sis}$). In practice, they should be treated as 2 separate monitoring and estimation processes – reflected in this guideline at:

- chapter 3.2 for estimating emissions from mine return ventilation
- chapter 3.3 for estimating fugitive emissions from gas drainage.

3.1.1 Measurement Determination Section 1.21(1) – parameters required to estimate fugitive emissions using Method 4

The required activity data, mass in t CO_2-e per gas type (being methane (CH_4) and carbon dioxide (CO_2), is calculated as the product of the volumetric flow rate of the gas stream in m^3 at STP and the proportion of the gas type in question in the gas stream. Accordingly, the parameters in the equation in subsection 1.21(1) of the NGER Measurement Determination are required:

$$M_{jct} = \frac{MM_j \times P_{ct} \times FR_{ct} \times C_{jct}}{8.314 T_{ct}}$$

Where:

M_{jct} is the mass of emissions in t for gas type (*j*) – being CH_4 and CO_2 – released per second

MM_j is the molecular mass of gas type (*j*) – being CH_4 and CO_2 – measured in t per kilomole:

(a) For CH_4 – 16.04 x 10^{-3}

(b) For CO_2 – 44.01 x 10^{-3}

[10] https://www.acarp.com.au/abstracts.aspx?repId=C21002

P_{ct} is the pressure of the gas stream in kPa at the time of measurement

FR_{ct} is the flow rate of the gas stream in cubic metres per second (m^3/s) at the time of measurement

C_{jct} is the proportion of gas type (j) – being CH_4 and CO_2 – in the volume of the gas stream at the time of measurement (being a fraction between 0 and 1, and often labelled the 'gas concentration' when expressed in percent)

T_{ct} is the temperature, in degrees K, of the gas at the time of measurement.

Once M_{jct} has been calculated for methane and carbon dioxide respectively, it should be converted into t CO_2-e using the applicable 'global warming potential' of each gas, as stipulated in 2.02 of the NGER Regulations (with methane currently being at 28 t of CO_2-e per t of CH_4). The average mass emissions per gas type should then be calculated, and the total annual mass of emissions for methane and carbon dioxide respectively calculated.

The flow rate (FR_{ct}) and the proportion of methane and carbon dioxide in the gas stream (C_{jct}) are the most important parameters to measure completely and accurately, followed by pressure (P_{ct}) where the gas stream is under pressure (which it might be for gas drainage). However, all the parameters of the formula in section 1.21(1) of the NGER Measurement Determination should be appropriately measured.

3.1.2 Overview of Method 4 monitoring requirements

The fugitive emissions should be monitored using standards and requirements, as outlined in Table 4.

Table 4 – Summary of standards and requirements for direct measurement of venting emissions.

Monitoring approach	Monitoring requirements per occurrence of fugitive emissions source
Continuous emissions monitoring (CEM) – standards and requirements for: • sampling positions (locations) • measurement of flow rate • measurement of gas concentration • frequency of measurement • performance characteristics of equipment.	• Fugitive emissions from extraction of coal including: » emissions from mine return ventilation » emissions from gas drainage. • Venting or other fugitive release before extraction of coal. CEM requirements for both defined in Part 1.3 in NGER Measurement Determination.
Periodic emissions monitoring (PEM) – standards and requirements for: • sampling positions (locations) • measurement of flow rate • measurement of gas concentration • representative data • performance characteristics of equipment.	• Fugitive emissions from extraction of coal including: » emissions from return mine ventilation » emissions from gas drainage. PEM requirements defined in sections 3.7 through to 3.13 in the NGER Measurement Determination. • Venting or other fugitive release before extraction of coal. PEM requirements defined in Part 1.3 in NGER Measurement Determination.

The NGER Measurement Determination stipulates 2 alternate Periodic emissions monitoring (PEM) approaches for different emissions sources. The key difference is that sections 3.7 through to 3.13 of the NGER Measurement Determination allow measurement in accordance with applicable legislation, enabling the use of equipment and approaches used for coal mine safety monitoring. This is particularly useful for monitoring emissions from mine return ventilation.

This PEM approach is not allowed for venting or other fugitive release occurring before extraction of coal occurs at the facility. In practice, this occurrence of fugitive emissions source is likely related to gas pre-drainage during mine development.

Whilst the compliance requirements notionally are the same, in practice the approach to estimate mine return ventilation emissions differs substantially from estimating gas drainage emissions, with significant differences in how the required parameters are measured.

3.2 Estimating emissions from mine return ventilation ($CO_{2\text{-}ej,gen,vent}$)

Management of air quality is central to controlling operational hazards in the underground environment. Underground coal mines have extensive mechanical ventilation systems for this purpose. These ventilation systems work by injecting ambient air into the mine to displace and dilute toxic (chiefly carbon monoxide), and explosive (mainly hydrocarbon) gases to safe levels. This displaced air is then vented via return roadways leading to one or more ventilation shaft(s).

This is a highly regulated safety area, with standards governing operating air quality limits and required gas monitoring defined in state-based mine safety legislation.

The amount of emissions from mine return ventilation is mostly a function of how gassy the coal seams being extracted are, and the amount of open coal faces during the year. In preparing an estimate of emissions from this source, the parameters which typically have the largest impact on the final estimate are the volumetric flow rate (FR_{ct}) and the gas proportion (C_{jct}) of methane in mine return vented air.

In applying the NGER Measurement Determination to an individual mine, it is a requirement to directly measure these parameters, along with temperature and pressure for the purposes of correcting to STP.

3.2.1 Monitoring requirements for emissions from mine return ventilation

The return mine ventilation emissions must be directly measured using either CEM in accordance with Part 1.3 of the NGER Measurement Determination; or PEM in accordance with sections 3.7 to 3.13 of the NGER Measurement Determination.

It is permissible to use state or territory-based requirements for measuring gas flow and proportion when using PEM to monitor emissions from mine return ventilation under NGER. This enables coal mines to apply monitoring equipment and approaches already in use for safety purposes. Many coal mines use this option. When undertaking this form of measurement, it is important to observe whether the PEM requirements and the general principles in section 1.13 of the NGER Measurement Determination are met.

The approach taken to meet the NGER monitoring requirements should be documented and become part of the record-keeping requirements.

Monitoring equipment

The requirements for the equipment used to measure the parameters, including calibration of equipment is covered further below in respect of measuring flow rate and gas concentration.

Sampling positions

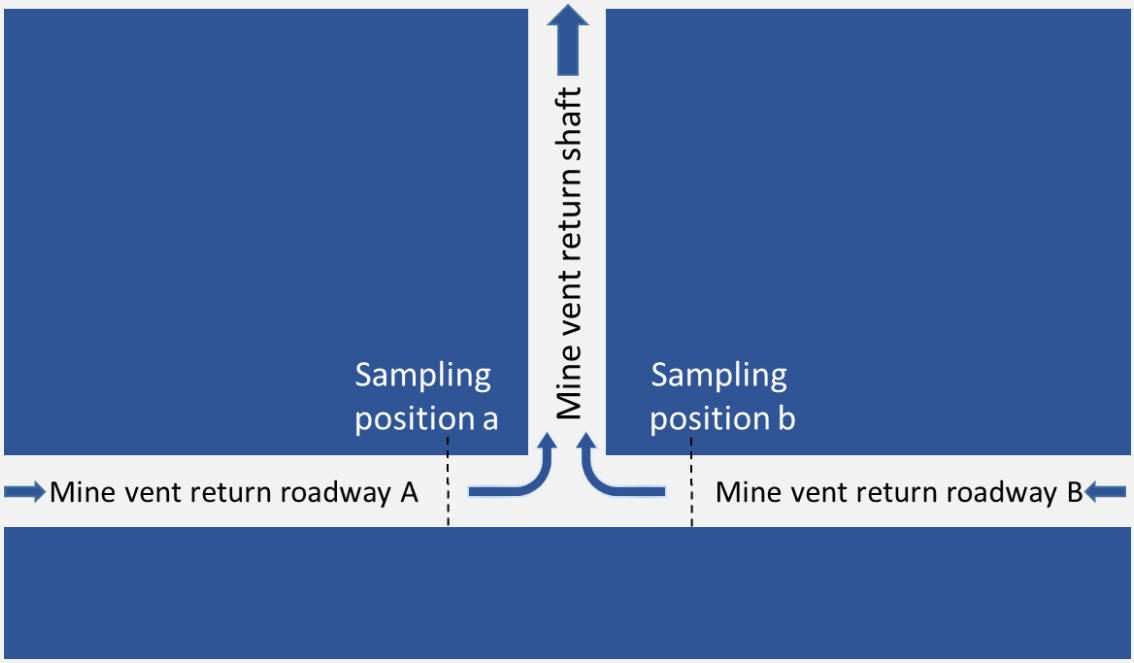
Sampling positions should be appropriate to measure the key parameters completely and accurately. This includes ensuring that all return ventilated air is monitored, and without any undue disturbances that could influence the measured gas flow and proportion.

A typical location is in the return air roadways leading to the ventilation shaft. The sampling should monitor the complete return air ventilated, for example, all the return roadways with air vented through the ventilation shaft, and for all ventilation shafts where more than one exits.

Example 1 – locations for mine ventilation emissions monitoring

The image below illustrates an example of how sampling locations 'a' and 'b' are in each of the 2 mine vent return roadways leading to the mine vent return shaft.

Figure 1 – Example sampling positions for mine return ventilation.



In this example:

- adding up the samples for those 2 locations enables the measurement of the total flow rate for mine return air being ventilated through the shaft
- using weighted average of the measured gas proportion for each sample position enables the calculation of the gas proportion of the mine return air ventilated through the shaft.

Sampling frequency

Measurements of the parameters should be performed and recorded for sufficient duration and frequency to produce representative data. Key considerations include:

- The emissions estimate should meet the general principles of emissions estimation in section 1.13 of the NGER Measurement Determination. This requires sample data for the measured parameters that faithfully represent the variance in the underlying conditions for the measured parameter over the year.

- When applying PEM, proactive determination may be necessary to plan and execute sampling duration and frequency for each parameter. It may not be possible to retrospectively address the variance in a parameter if insufficient samples have been obtained during the year.
- The planned duration and frequency can be determined based on historical, expected and known variance in the parameter:
  - » if historical and expected variance is low, fewer planned samples can be justified
  - » if the variance reasonably can be expected to be higher, for example, due to significant changes in mining operations, then more samples should be planned to account for the expected increase in the variance in the measured data for the parameter.
- The historical variance in the parameter can be estimated using statistical methods:
  - » for example, by estimating the standard deviation and 95% confidence interval based on the samples obtained and assess whether the variance in the data is at an acceptable level
  - » such statistical analysis can be used to document that the samples obtained during the year for a parameter are sufficiently frequent; and can be used to determine and plan future sampling frequencies.
- Due to significant difference in the variance in the flow rate and gas concentration, sampling frequency requirements used to achieve representative sampling for the 2 parameters may vary significantly. Each parameter is covered in detail below.

3.2.2 Monitoring flow rate in mine return ventilation

The parameter to be measured is the flow rate (FR_{ct}) in the gas stream in cubic meters per second (m^3/s).

The flow rate of mine ventilation of underground coal mines is extensively monitored for safety purposes using a combination of continuous measurement and periodic checks.

For NGER, most coal mines will measure flow rate based on existing safety monitoring of gas flow using PEM. If a mine applies a different monitoring approach for its flow rate, it should observe all the requirements including applicable standards for the approach applied, for example, if using CEM.

Periodic ventilation surveys required under safety legislation are often the most suitable source for the PEM sampling of the measured flow rate. These surveys must be performed at least monthly, or when there is a significant change in mining operations.

An anemometer may be used to measure flow velocity (in m/s) in the return roadways leading to the ventilation shaft. The cross-sectional area of the return roadway is then used to convert the figure into a volumetric flow rate in m^3/s.

If the equipment used for the ventilation survey to measure flow rate is appropriately calibrated, it will (under PEM) meet the performance requirements of equipment for this parameter (as it will meet the safety legislation requirements).

Sampling frequency for periodic monitoring of flow rate in return mine ventilation

The flow rate in mine return ventilation is often stable (± 5-10%) under similar mining conditions. Significant changes in flow rate typically align with major operational changes. Whilst it cannot be automatically assumed, where no major operational change affects ventilation settings, flow rate measurements from monthly ventilation surveys may produce a representative measurement of flow rate over the year for the purposes of NGER reporting.

As a minimum, it is expected that an appropriate flow rate measurement is made right after significant changes in mining conditions have occurred. This may coincide with similar requirements for ventilation surveys after significant changes in mining conditions.

Examples 2 and 3 – frequency for flow rate measurement in mine return ventilation

Example 2 – monthly measurement of flow rate may be sufficient

Where:

- ventilation flow is known to be at a consistent level across and during each month of the year due to similar mining conditions
- no ventilation anomalies have occurred, for example, a shutdown or fan adjustment, it may be reasonable to assume the flow rate measurement based on monthly ventilation surveys may be representative.

The variance (for example, measured as the standard deviation) of measurements across samples will be low, enabling fewer samples to be required to achieve representative data.

Example 3 – monthly measurement of flow rate may not be sufficient

Where:

- the ventilation flow is inconsistent across each month during the year, for example, due to significant operational changes, additional flow rate measurements may be required to achieve representative sampling.

Examples of operational changes that could affect flow rates include opening an additional mining area with a material change to the ventilation requirements or starting to mine in more gassy coal seams requiring increased ventilation to achieve safe subsurface air quality.

3.2.3 Monitoring the proportion of methane and carbon dioxide in mine return ventilation

The parameters to be measured are the proportion of methane and carbon dioxide respectively in the volume of the gas stream at the time of measurement – or gas concentration per gas type (C_{jct}).

Gas concentration in the ambient subsurface air is extensively monitored for safety purposes. It always needs to be below legislated safety levels and legislation requires automatic and manual monitoring of various gases, including methane and carbon dioxide.

Fugitive gas release via return mine ventilation is expected to trend with the gas levels in the coal seams mined. Higher gas proportion may result when gassier coal seams are mined under constant ventilation.

Performance requirements for measurement equipment

Underground mines may use existing automatic monitoring to estimate the proportion of methane and carbon dioxide, if capable of producing representative unbiased gas proportion measurements at the location of the flow rate measurement. This can include a tube bundle analyser if the tube bundle sampling locations are in the return ventilation roadways. This may perform automatic gas proportion analysis recorded onto an on-site automatic data system.

Such a system could potentially enable the gas proportion monitoring to meet CEM requirements in Part 1.3 of the NGER Measurement Determination. If it does not meet the CEM requirements, for example, if

measurement frequency is less than required for CEM, it may meet the PEM requirements with frequent sampling.

If the existing automatic monitoring of gas proportion is not suitable, another approach is required. This may include manual gas bag samples analysed in a gas chromatograph. When using this approach, it is important to ensure that the manual samples are unbiased and not contaminated (refer further in section 3.3.4 on common challenges for gas monitoring). Any approach needs to be consistent with the requirements of the NGER legislation.

Sampling accuracy of equipment

A key consideration is whether the equipment has appropriate sampling accuracy to measure the range and variability of gas proportion in the gas stream to accurately estimate emissions for NGER reporting. Equipment installed for safety purposes focusses primarily on monitoring that the gas proportion remains within safe operating thresholds.

However, for NGER reporting the safety threshold is not the key concern. The actual gas proportion of the volume of gas stream in the mine return ventilation during the year must be measured. This proportion will be at a lower level than the safety threshold and may be out of the range for accurate measurement by the installed measurement equipment.

Establishing and documenting that the equipment used is appropriate for measuring the full range of the variability in the gas proportion is important. Where measurements frequently fall below or outside the equipment calibration range, the equipment may not be suitable to use for measuring gas proportion in the gas stream for the purpose of NGER reporting.

Equipment maintenance

The equipment needs to be maintained and calibrated appropriately – also a requirement under safety regulation. Where appropriate equipment is installed, calibration and maintenance usually meet the performance requirements for NGER, when the requirements of the original equipment manufacturer are met.

Sampling frequency

More frequent sampling may be required for gas proportion than for flow rate to produce representative data.

Gas proportion levels primarily depend on how much methane is released from the mined coal seams. The variability of the gas proportion can be significantly greater than in the flow rate, even where mining operations have little alterations.

Variability can easily exceed ±20% and be up to ±50%. With such variability, monthly sampling may not produce a representative measurement of the gas proportion over the year for the purposes of NGER reporting, and more frequent sampling may be required.

Where there are significant changes in mining operations, additional sampling should be performed for flow rate if PEM is applied. As a minimum, it would be expected that a gas sample be taken right after significant changes in mining conditions have occurred. As for flow rate, this may coincide with similar requirements for ventilation surveys after significant changes in mining conditions.

Adjusting for moisture content

The measured gas proportions should be adjusted for moisture in the gas streams – as C_{jct} used in the formula in section 1.21(1) of the NGER Measurement Determination is on a dry basis. An overestimation of actual emissions may result if moisture content adjustment is not performed.

3.2.4 Correcting gas volumes to standard temperature and pressure

The measured volume of methane and carbon dioxide in the mine return ventilation gas stream should be adjusted to STP – being one atmosphere (101.325 kPa); and air temperature of 15°C (or 288 K); and air density of 1.225 kg/m^3. The correction of gas volumes is required and must be performed appropriately[11].

The NGER Measurement Determination does not have specific requirements for measuring temperature and pressure for coal mine return ventilation. It should be at the point of measuring flow and gas concentration of the gas stream, and it should enable representative data. The estimation of temperature and pressure at the point of measurement should be appropriate and documented.

- Temperature: An appropriate approach to adjusting to standard temperature can include using the temperature measurement of the periodic (minimum monthly) mine ventilation survey, on a dry-bulb basis. This temperature can be measured using a sling psychrometer, measuring both the wet-bulb and dry-bulb temperature (with the difference used to determine the moisture content in the gas stream).
- Pressure: An appropriate approach to adjusting to standard pressure can include using a surface barometer. The pressure at the underground point of measurement can be estimated using known accepted adjust factors for collar-pressure and vertical difference between the surface barometer and the measurement point in the mine.

The ACARP U/G Guideline provides useful guidance and formulas for these corrections. The basis for the corrections should be documented and form part of NGER record-keeping requirements.

3.2.5 Subtracting gases from other sources in mine return ventilation

Corrections for measured greenhouse gas emissions that do not occur as a result of extraction of coal should be made to avoid overestimating the emissions in the mine return ventilation.

- Correcting for gas in mine ventilation intake – the ventilated air constantly displaces air in the mine by injecting ambient air into a mine intake ventilation shaft or duct. Ambient air contains carbon dioxide and may contain minor traces of methane and thus be included in mine return ventilation.

  No specific determination exists for how to make this correction. 2 approaches are acceptable:

  - Measuring gas composition in intake air – preferably performed by correcting gas proportion in mine return ventilation using measured gas composition in the ventilation air intake. This can be measured, using a tube bundle analyser or other appropriate equipment.
  - Using standard ambient air gas composition – if a reliable gas composition measurement for intake air is not available, the gas proportion in the mine return ventilation gas stream should be adjusted with the average proportion of carbon dioxide in the atmosphere.
- Correcting for underground fuel combustion emissions – where underground fuel combustion occurs, an estimate of the greenhouse gas emissions from this source should be calculated and subtracted from the estimated t of CO_2-e of methane and carbon dioxide respectively in the mine return ventilation.

  The estimate of emissions from underground fuel combustion should be performed in accordance with Chapter 2 of the NGER Measurement Determination in respect of estimating emissions from fuel

[11] Per the ideal gas law applied in formula in subsection 1.21(1) of the NGER Determination, the correction from ambient to standard conditions is unlikely to be more than 1-2% of the total measured in t CO_2-e. This is because standard conditions for gas is relatively close to the typical mean and variance occurring for the ambient conditions that the subsurface temperature and pressure typically will be at.

combustion. Any estimation should also be in accordance with the general principles listed within Section 1.13 of the NGER Measurement Determination.

3.2.6 Working with the ventilation officer

It may be necessary to liaise with the Ventilation officer to obtain and record the required data to estimate mine return ventilation emissions.

The Ventilation officer is that person who is responsible for ensuring that the mine's ventilation enables mining in a safe sub-surface environment. This includes monitoring gas flow and composition, including:

- performing the monthly ventilation survey
- determining the sampling locations in the mine, including for the monthly ventilation survey
- determining the effective range of the monitoring equipment, as well as its appropriate maintenance and calibration.

It is good practice for a Ventilation officer to verify that measurements meet the requirements of the NGER Measurement Determination, and document that determination in an auditable record. The ventilation officer may also be required to execute additional monitoring if required for NGER. Working closely with the ventilation officer may therefore be important.

3.3 Estimating fugitive emissions from gas drainage

Gas drainage at underground mines is typically performed for safety reasons:

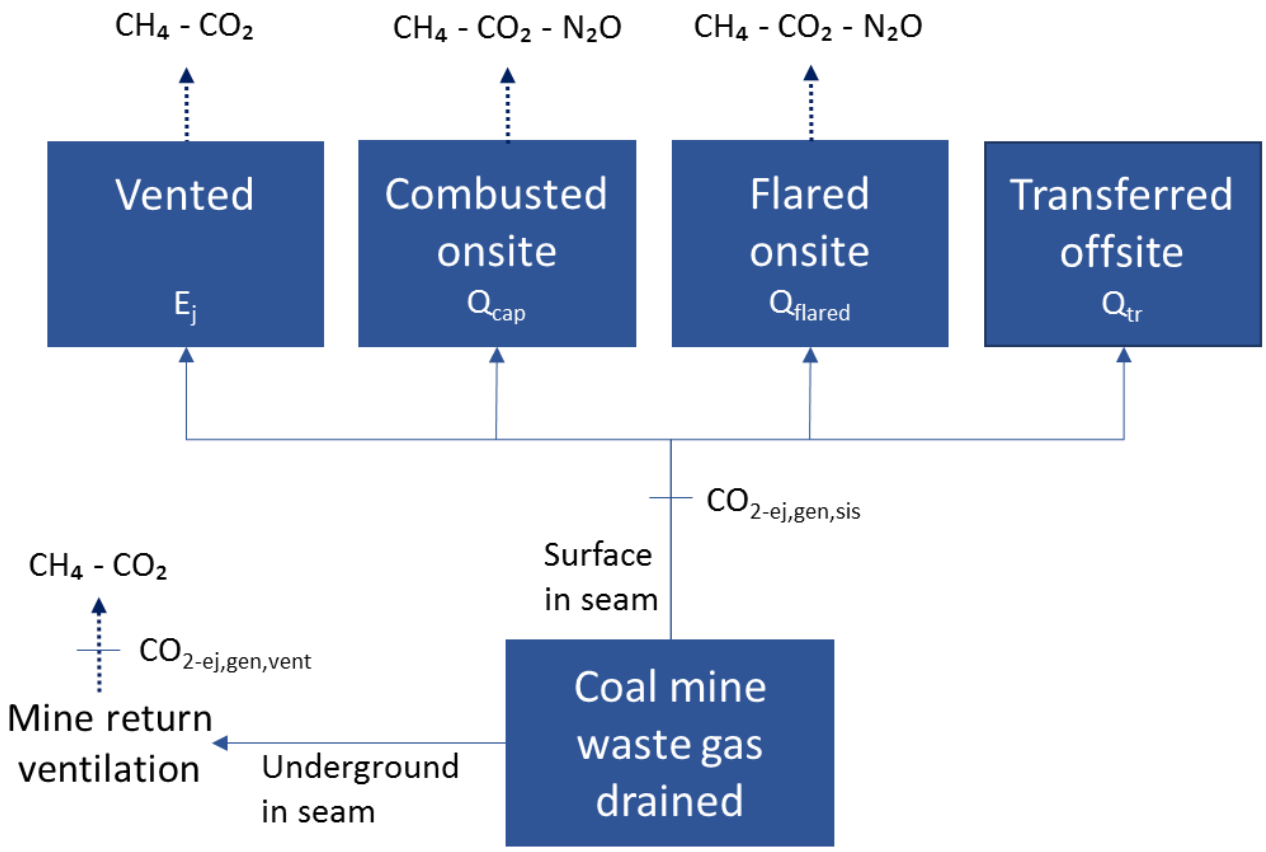
- pre-gas drainage occurs prior to mining in an area, primarily to avoid safety hazards from potential outbursts that could result during extraction. Where the gas concentration in the coal seam is high, the gas needs to be drained prior to mining the strata.

  Pre-gas drainage can be:

  - surface in seam (SIS) where wells are drilled into the targeted coal seam from the surface, and gas is drained to the surface
  - underground in seam (UIS) where wells are drilled into the targeted coal seam from the underground roadways, and gas is drained to the underground area and will be vented via the mine's return ventilation. The emissions occurring as a result of this type of drainage will be measured as part of the emissions from the mine's return ventilation (CO_2-ej,gen,vent), refer section 3.2 above.
- post-gas drainage occurs after mining an area, primarily to reduce the toxic or potential explosive coal mine waste gas in sealed off goaf areas. Gas drained this way is typically piped to the surface.

Gas drained from a coal mine is 'coal mine waste gas' and differs from coal seam methane. Both are defined in 1.03 of the NGER Regulations. Figure 2 provides an overview of the emissions to be estimated, whether pre- or post-drainage, with the parameters of section 3.6 of the NGER Measurement Determination specified.

Figure 2 – Overview over gas drainage emissions.



Drained gas may be flared, captured for on-site combustion (for example, to run an on-site electricity generator) or transferred off-site, either as a by-product of draining gas for safety purposes or as the primary objective. This reduces the coal mine's emissions profile, which may assist the mine meeting its emissions baseline number under the Safeguard Mechanism.

The total mass of methane and carbon dioxide drained to the surface ($CO_{2\text{-ej,gen,sis}}$) must be measured directly using Method 4. Any gas diverted for on-site combustion (Q_{cap}) and flaring (Q_{flared}); or off-site transfer (Q_{tr}) should be subtracted from the measured gas drained to surface. In accordance with section 3.6 of the NGER Measurement Determination, the residual is the gas vented (E_j) as a result of drainage to surface, as outlined in Table 5.

Venting or other fugitive release before extraction of coal in practice may occur from gas drainage during mine development before extracting coal from the mine. For this instance of the fugitive emissions source, emissions must be estimated using Method 4 under Part 1.3 of the NGER Measurement Determination.

Table 5 – Measuring surface gas drainage.

s3.6 parameter	Definition	Measured how?
$CO_{2\text{-}ej,gen,sis}$ **Total gas drained to surface**	Total mass in t CO_2-e of CH_4 and CO_2 drained from mining area to surface	Gas volume for CH_4 and CO_2 measured in m^3 at STP directly using Method 4 and converted to t CO_2-e using formula in s1.21(1) of the NGER Measurement Determination
Q_{cap} **Drainage gas combusted on-site**	Volume of CH_4 and CO_2 drained from mining area to surface and combusted by facility	Gas volume for CH_4 and CO_2 measured in m^3 at STP using measurement criteria for gaseous fuels in Division 2.3.6: • measurement criteria 'AAA' or 'BBB' required for each gas stream – unless a commercial transaction involved in acquiring the gas (unlikely given drainage for safety purpose) • where 'BBB' is used, some form of direct measurement is still expected to achieve representative data (may be due to periodic monitoring or equipment not fully meeting 'AAA' measurement requirement)
Q_{flared} **Drainage gas flared on-site**	Volume of CH_4 and CO_2 drained from mining area to surface and flared by facility	
Q_{tr} **Drainage gas transferred off-site**	Volume of CH_4 and CO_2 drained from mining area to surface and transferred outside facility	
E_j **Drainage gas vented on-site**	Mass of CH_4 and CO_2 drained from mining area to surface and vented, measured in t CO_2-e	• calculated as default of the other parameters using formula in s3.6 • measured directly using Method 4 under Part 1.3 of the NGER Measurement Determination

3.3.1 Sampling locations for gas drained to surface ($CO_{2\text{-}ej,gen,sis}$)

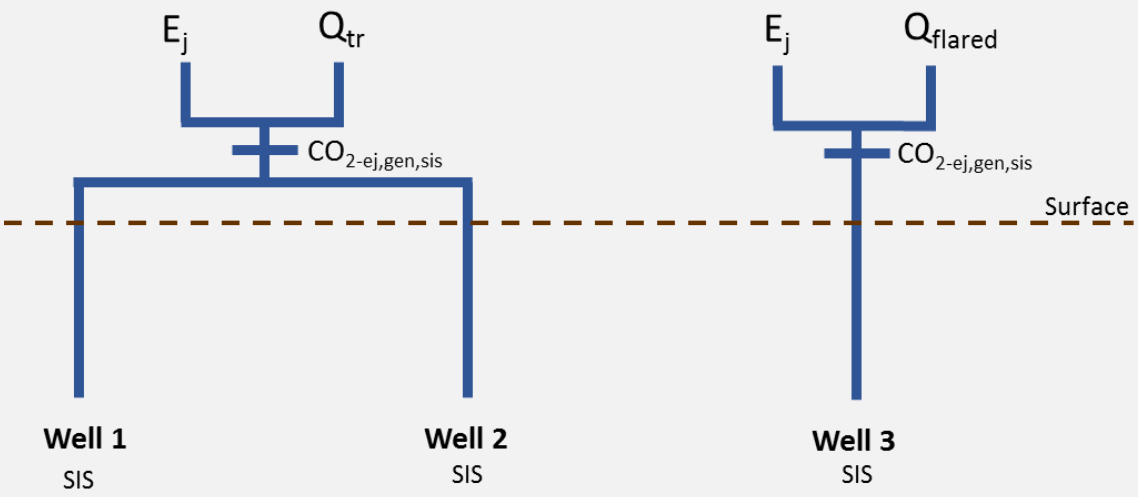
Direct measurement of the total mass of methane and carbon dioxide released via each occurrence of gas drained to surface should be performed. For example, where 2 or more unconnected gas wells are operated, each gas well will be an occurrence of the source of the emission and each well's release of methane and carbon dioxide should be measured directly and independently.

Where several gas wells are linked together by pipes leading the gas to the same destination, they can be deemed to be one occurrence of the source. In this case, the direct measurement of the total mass of methane and carbon dioxide released from the wells connected can be done in one direct measurement – see example 4 below.

Example 4 – locations for gas drainage monitoring

The below image illustrates examples of where monitoring of gas drainage should occur.

Figure 3 – Example with 3 gas wells into 2 occurrences of emissions source.



In this example, 3 'Surface in seam' wells drain coal mine waste gas to the surface.

Wells 1 and 2 are connected via surface piping, merging before being transferred off-site (Q_{tr}) or vented (E_j). This is one occurrence of the source:

- the methane and carbon dioxide drained ($CO_{2\text{-ej,gen,sis}}$) from the 2 wells can be measured using Method 4 at one point
- Q_{tr} should also be measured in accordance with Division 2.3.6 of the NGER Measurement Determination
- E_j can be calculated using formula in section 3.6 of the NGER Measurement Determination.

Well 3 is not connected to any other wells, with the gas directed to a flare. This is one occurrence of the source:

- the methane and carbon dioxide drained ($CO_{2\text{-ej,gen,sis}}$) from the well must be measured using Method 4
- Q_{flared} should be measured in accordance with Division 2.3.6 of the NGER Measurement Determination. It is important to also monitor and record the times where the flare is not operating, as the well may be venting instead
- E_j can be calculated using formula in section 3.6 of the NGER Measurement Determination, that is, the gas sent to the flare needs to be corrected for gas not flared, per above when flare is not operating.

3.3.2 Measuring quantity of gas drained to surface ($CO_{2\text{-ej,gen,sis}}$)

$CO_{2\text{-ej,gen,sis}}$ must be measured directly using Method 4 at for each occurrence of the source, using measurement equipment that complies with appropriate standards as specified in the NGER Measurement Determination (Part 1.3 or sections 3.10 through to 3.13 of the NGER Measurement Determination as applicable).

It is a point source measurement of the flow (FR_{ct}), gas proportion (C_{jct}) and pressure (P_{ct}) of the gas stream in gas pipes. Pressure is a significant parameter especially for pre-drainage, as the gas stream may be under substantial pressure as it desorbs. This will compress the gas volume, making the pressure adjustment of measured gas proportion to STP significant.

Appropriate equipment includes instruments that measure differential pressure, for example, an orifice plate, which can measure flow and pressure). Gas temperature (T_{ct}) should also be measured appropriately.

Measuring methane and carbon dioxide in the coal mine waste gas

The proportion of methane and carbon dioxide may be measured inline (such as by a gas chromatograph, infrared analyser, or tube bundle analyser), or by gas bag sampling (for example, using on-site gas chromatograph or tube bundle analyser).

Gas analysers may be installed, especially if the coal mine waste gas is diverted to electricity generation. This is because they may assist in providing process control and efficient operation of engines or generators.

Note: If the gas is transferred off-site, the gas analysers may be operated by a third party. The coal mine should obtain the gas analysis data from the third party for its reporting, as well as appropriate records to document how the NGER requirements for sampling, measurement frequency and equipment requirements have been met.

No standards are specified for measuring the methane and carbon dioxide proportion in coal mine waste gas. However, it is expected that coal mine waste gas composition should be measured in line with the gas specific general requirements for sampling and testing in:

- Section 2.23 of the NGER Measurement Determination, which provides the following general requirements for gas sampling:
  - a sample should be derived from a composite of amounts of the gas
  - samples must be collected on enough occasions to produce a representative sample
  - samples must be free of bias so that any estimates are neither over- nor under-estimates of the true value
  - bias must be tested in accordance with an appropriate standard
  - the value obtained from the samples must only be used for the reporting period for that it was intended to be representative.
- Section 2.24 of the NGER Measurement Determination, which provides standards for analysing the gas composition, with specific standards specified for coal mine waste gas.
- Section 2.25 of the NGER Measurement Determination, which provides requirements for minimum sampling frequency, being minimum monthly.

Calibration requirement

Measurement equipment should be appropriately maintained and calibrated per section 1.34 of the NGER Measurement Determination. In practice, if the equipment meets the specified requirements, maintenance and calibration should follow the instructions provided by the Original Equipment Manufacturer.

Measurement frequency

If continuous emissions monitoring is applied, the requirements for frequency of measurement by CEM in section 1.26 of the NGER Measurement Determination must be observed.

If periodic emissions monitoring is applied, the measurements should be representative (per sections 1.33 or 3.12 of the NGER Measurement Determination) and should also meet the principles in section 1.13 of the NGER Measurement Determination. The following observations in respect of gas proportion or gas composition and flow rate can be made:

- Gas proportion (C_{jct}) – the gas stream in surface gas drainage will typically be methane rich, implying that the variance in the gas proportion will be significantly lower than for methane in mine return ventilation. Whilst not directly applicable, using the minimum frequency for gas analysis set out in section 2.25 of the NGER Measurement Determination may be appropriate. This specifies minimum monthly monitoring of the gas composition in coal mine waste gas.
- Flow rate (FR_{ct}) – the greater variance may be in flow rate, and monthly measurements is the minimum expected sampling frequency. However, monthly measurements may not be sufficient to account for the full variance in the gas stream's flow rate. Reporters should use the same approach as set out in section 3.2 above for mine return ventilation to determine whether monthly sampling is sufficient.

3.3.3 Measuring quantity of coal mine waste gas diverted from venting

The coal mine should understand the existing coal mine waste gas drainage systems currently implemented at the site, as per example 4 above. The coal mine should measure the quantity of methane and carbon dioxide (in m^3 at STP) in the coal mine waste gas diverted from venting during the reporting year as per Table 5 above – that implies measuring each of the following parameters where applicable:

- Q_{cap} – the volume of methane and carbon dioxide (respectively) in drained coal mine waste gas diverted for on-site combustion (captured for on-site combustion)
- Q_{flared} – the volume of methane and carbon dioxide (respectively) in drained coal mine waste gas diverted for on-site flaring
- Q_{tr} – the volume of methane and carbon dioxide (respectively) in drained coal mine waste gas transferred off-site to third party.

The gas volumes should be measured at STP, including on a dry basis. Where applicable, these parameters must be reported in mass in t CO_2-e as 'Matters to be identified' (refer section 9.4 below).

Note: When reporting energy production and consumption and emissions from flaring and combustion based on the same coal mine waste gas flows as Q_{cap}, Q_{flared} and Q_{tr}, the quantity to be reported may not be the same – especially when using Method 1 for fuel combustion emissions, where the total coal mine waste gas volume combusted rather than its methane component must be reported. See chapter 4 of this guideline for more information.

Examples 5 and 6 – Reporting coal mine waste gas captured

Example 5 – coal mine waste gas flared and combusted on-site

A coal mine has installed a flare and a generator to produce electricity. The coal mine should:

- measure the volume at STP of methane and carbon dioxide sent to the flare and electricity generator to measure Q_{flared} and Q_{cap} respectively and subtract from the total methane and carbon dioxide drained ($CO_{2\text{-}ej,gen,sis}$), to estimate the gas vented from the source (E_j)
- report the mass of Q_{flared} and Q_{cap} in t CO_2-e as 'Matters to be identified' – refer section 9.4 below
- measure the total volume of coal mine waste gas sent to the flare and electricity generator respectively to estimate energy production, energy consumption and emissions from energy consumption – refer section 4. The volume used for these estimates may differ from those used to estimate venting emissions (E_j).

Example 6 – coal mine waste gas transferred off-site

A coal mine transfers the coal mine waste gas captured through drainage off site. The coal mine should:

- measure the volume at STP of methane and carbon dioxide transferred off site and subtract it from the total methane and carbon dioxide drained ($CO_{2\text{-}ej,gen,sis}$), to estimate the gas vented from the source (E_j)
- report the mass of Q_{tr} in t CO_2-e as 'Matters to be identified' – refer section 9.4 below
- measure the total volume of coal mine waste gas transferred to estimate the energy production – refer section 4. The volume used for this estimate may differ from Q_{tr} used to estimate venting emissions (E_j).

The off-site party will have acquired coal mine waste gas from the coal mine and will be responsible for reporting any consumption and emissions from its combustion.

Criterion AAA or BBB may be used, as described below. As coal mine waste gas is usually drained by the coal mine, usually for safety purposes, no commercial transaction occurs to acquire the gas. Accordingly, criteria A and AA are not applicable.

Measuring quantity of coal mine waste gas using criterion AAA

The measurement should be undertaken using appropriate gas measuring equipment at the point of combustion (including flaring)[12] or transfer to other party.

Separate flow meters are normally installed for flares and combustion devices, including engines and generators used to produce electricity. These are normally installed at the point of combustion.

[12] If Australian carbon credit units are claimed for combustion through a flare, engine or combustion device, then criterion AAA **must** be used.

Flow meter accuracy is specified for orifice plate meters only, based on the maximum daily volume of coal mine waste gas (per section 2.31(4) of the NGER Measurement Determination). There are other equipment standards that apply to natural gases (per section 2.32 of the NGER Measurement Determination) and to different types of flow meters, including:

- although coal mine waste gas is not a 'natural gas' according to the definition in the NGER Regulations, the CER would expect that the flow metering equipment should meet the accuracy requirements specified in section 2.32 to 2.37 of the NGER Measurement Determination
- equipment standards are only specified for orifice plate, turbine and rotary type meters.

Measuring coal mine waste gas using criterion BBB

Criterion BBB (industry practice) may be used where the metering equipment does not meet the accuracy requirements of AAA. If coal mine waste gas is combusted to produce electricity, then the volume of coal mine waste gas may be back-calculated from the electricity produced and an engine electricity efficiency (manufacturer's specification or default of 36%), and the energy content of coal mine waste gas. In this case, the energy content factor for coal mine waste gas that is captured for combustion, from item 19 in Schedule 1 of the NGER Measurement Determination is applicable.

Actual industry practice required for BBB is not defined in the NGER legislation. Industry practice may be interpreted as what would reasonably be expected to occur at a competent, similar facility type of a similar size and age. The following may be used as a guide when establishing the standards to be used for making estimations using industry practice:

- equipment used is maintained in good working order
- equipment used is calibrated in accordance with and at the frequency stipulated by the manufacturer
- faulty equipment is replaced
- appropriate corrections for temperature and pressure are made where required
- assumptions, inherent or applied to the measurement equipment, are clarified – for example, set densities or gas composition are updated at a frequency that ensures that these assumptions are representative of the commodity being measured during the reporting period.

Reporters should document their assessment of how their application of criterion BBB meets industry practice in the BoP. When applying criterion BBB, reporters are required to consider the principles in section 1.13 of the NGER Measurement Determination.

Note: If metering meets the requirements of criterion AAA, you should select AAA in EERS instead of criterion BBB.

Measuring methane and carbon dioxide in diverted coal mine waste gas

These are the same requirements as for measuring methane and carbon dioxide in the coal mine waste gas drained to the surface - see chapter 3.3.2 of this guideline for more information.

Often coal mines will only analyse the composition of the gas once, this is acceptable where the proportion of methane and carbon dioxide in the gas diverted from venting is the same as the gas drained.

3.3.4 Managing the coal mine waste gas monitoring process

Gas stream monitoring tends to be more sophisticated in certain circumstances, particularly where the gas stream is seen as an economic resource, or the emissions as a potential liability, for example because they can cause the mine to exceed its baseline emissions number under the Safeguard Mechanism.

Where the process is streamlined, it may include no new occurrences of the source from year to year. This may be because new gas wells are connected to existing piping to existing destinations. Gas streams may be monitored and recorded electronically in a continuous emissions monitoring set-up.

Addressing common challenges in measuring coal mine waste gas

Challenges in measuring coal mine waste gas include:

- manual periodic emissions monitoring of the $CO_{2\text{-}ej,gen,sis}$ gas stream, which might include:
  - » regular manual reading of orifice plate for differential pressure to measure flow and pressure
  - » regular manual gas bag samples obtained to be analysed manually in an on-site gas chromatograph or tube bundle analyser
  - » handwritten records of the measurements.

  These measurements will need to be performed in a timely manner, with appropriate frequency and diligence and recorded and processed appropriately. In turn, this requires appropriate skill and focus and should ideally undergo regular quality review and quality control, as this approach to sampling and analysis is error prone.
- Measurement focus and priority – reporters must ensure that appropriate resourcing is available to ensure complete and accurate measurement of manual readings and accurate data recording, even in situations of competing priorities, including those individuals performing the manual periodic monitoring have sufficient time among competing priorities to appropriately perform and record the sampling and analysis.
- Accurately measuring diversion from venting of the $CO_{2\text{-}ej,gen,sis}$ gas stream to accurately estimate venting emissions (*Ej*) from the source.

  For example, where a well is connected to a flare (as per well 3 in example 4 above), the gas stream may be assumed to be flared for most part. However, periods when the gas stream is vented rather than flared must be appropriately monitored, to enable an accurate measurement of how much of the $CO_{2\text{-}ej,gen,sis}$ gas stream is diverted to the flare. This may be periods when the flare has extinguished and not re-ignited, causing venting rather than flaring to occur. Vented coal mine waste gas has far higher emissions as measured in mass of CO_2-e due to the global warming potential of methane not destroyed when the gas is vented rather than flared.
- Actively managing instrumentation equipment to monitor and record new emissions sources – where new gas wells are established and not connected to any existing piping, a new emissions source is created. This implies a new point source to be monitored and a new data stream that should be included in the recorded data.

  If the data is captured electrically, for example, through a supervisory control and data acquisition system (SCADA), additional tagging of the instrument in all the electronic databases will be required for a complete and accurate record.

Addressing these challenges requires focus. It is expected that coal mines that have these types of emissions sources will set up an appropriate monitoring process. It needs to have defined roles and responsibilities, including defined accountability, and be sufficiently resourced to perform the roles and responsibilities – see chapter 2.1 of this guideline for more information.

3.4 Reporting data for fugitive emissions

3.4.1 Fugitive emissions from extraction of coal

Table 6 – Data to be reported for fugitive emissions from extraction of coal.

EERS data entry field	Data to be reported
General activity attributes	
Source category	Fugitive emissions
Source	Underground mines
Activity	Fugitive emissions from extraction of coal
MTBIs entered by activity	
Tonnes of raw coal produced	Measured quantity of ROM coal
Tonnes of carbon dioxide captured for energy production on site	CO_2 component of Q_{cap} from chapter 3.1 of this guideline
Tonnes of methane (CO_2-e) captured for energy production on site	CH_4 component of Q_{cap} from chapter 3.1 of this guideline
Tonnes of carbon dioxide captured and transferred off site	CO_2 component of Q_{tr} from chapter 3.1 of this guideline
Tonnes of methane (CO_2-e) captured and transferred off site	CH_4 component of Q_{tr} from chapter 3.1 of this guideline
Tonnes of carbon dioxide flared	CO_2 component of Q_{flared} from chapter 3.1 of this guideline
Tonnes of methane (CO_2-e) flared	CH_4 component of Q_{flared} from chapter 3.1 of this guideline
CO_2 Carbon dioxide	
Total mass of gas generated from the mine during the year before capture and flaring is undertaken at the mine (t CO_2-e)	CO_2 component of $CO_{2\text{-}ej,gen}$ from chapter 3.1 of this guideline
CH_4 Methane	
Total mass of gas generated from the mine during the year before capture and flaring is undertaken at the mine (t CO_2-e)	CH_4 component of $CO_{2\text{-}ej,gen}$ from chapter 3.1 of this guideline

3.4.2 Fugitive emissions from venting or other fugitive release before extraction of coal

Table 7 – Data to be reported for fugitive emissions from venting or other fugitive release before extraction of coal.

EERS data entry field	Data to be reported
General activity attributes	
Source category	Fugitive emissions
Source	Underground mines
Activity	Venting or other fugitive release before extraction of coal
MTBIs entered by activity	
Tonnes of raw coal produced	Raw coal has the same meaning as ROM coal. This source only applies to mines that have not yet produced any 'saleable coal on a washed basis'. If production of saleable coal has commenced gas drainage should be reported as per chapter 3.4.1 of this guideline.
Tonnes of carbon dioxide captured for energy production on site	CO_2 component of coal mine waste gas captured for combustion for energy production on site
Tonnes of methane (CO_2-e) captured for energy production on site	CH_4 component of coal mine waste gas captured for combustion for energy production on site
Tonnes of carbon dioxide captured and transferred off site	CO_2 component of coal mine waste gas captured for combustion transferred out of the facility
Tonnes of methane (CO_2-e) captured and transferred off site	CH_4 component of coal mine waste gas captured for combustion transferred out of the facility
Tonnes of carbon dioxide flared	CO_2 component of coal mine waste gas captured for combustion that is flared
Tonnes of methane (CO_2-e) flared	CH_4 component of coal mine waste gas captured for combustion that is flared
CO_2 Carbon dioxide	
Emissions released during the year (t CO_2-e)	CO_2 component of emissions measured under Part 1.3 of the NGER Measurement Determination.
CH_4 Methane	
Emissions released during the year (t CO_2-e)	CH_4 component of emissions measured under Part 1.3 of the NGER Measurement Determination.

Note: Information on how to report energy and fugitive emissions from coal mine waste gas flared or combusted can be found in chapter 4 of this guideline.

4. Emissions and energy from coal mine waste gas

4.1 Energy production and consumption

Fuel and energy commodities that are produced must be reported as an energy production. This includes coal mine waste gas that is captured for combustion – defined as item 19 in listing of reportable energy commodities in Schedule 1 of the NGER Regulation. If the same gas is consumed on-site it must be reported as energy consumption unless below the reporting threshold of 1,000 m^3. If that consumption is via combustion, the resulting emissions must be reported. See Reporting energy production and consumption guideline[13] for more information on the principles of reporting energy production and consumption.

Determining reportable energy production

The definition of 'captured for combustion' under 1.03 of the NGER Regulations includes the term 'injected into a pipeline'. Accordingly, the CER has adopted the following interpretation:

- If force is applied to capture coal mine waste gas in a pipe by creating differential pressure, it is being 'injected into a pipeline'. An applied force may be a compressor, extraction fan, blower or a pump used to inject the gas into the pipe. Where this occurs it:
  - » meets the definition of 'captured for combustion' in regulation 1.03 of the NGER Regulations
  - » is an energy commodity listed in Schedule 1 of the NGER Regulations
  - » meets the definition of 'energy' in section 7 of the NGER Act
  - » meets the definition of 'production of energy' in regulation 2.25 of the NGER Regulations.

Accordingly:

- Drained coal mine waste gas is reportable as energy production:
  - » When force is applied, by use of a machine, such as a compressor, extraction fan, blower, or pump, to create differential pressure to capture coal mine waste gas into a pipe, for example, a drainage gas well). This applies irrespective of whether the gas is subsequently vented, flared, leaked, or transferred to another facility.
  - » When the gas is combusted for energy purposes, for example, to drive an electricity generator, even if a force was not applied to inject it into a pipeline.
- Drained coal mine waste gas is not reportable as energy production:
  - » When the gas is drained into well pipes by using only the natural force of the decreasing pressure through desorption and the gas is not used for energy purposes, that is, when the gas is flared or vented. This may include 'underground in seam' pre-drainage gas wells.

See Reporting energy production and consumption guideline[14] for more information.

The point where coal mine waste gas is 'injected into a pipeline' is considered by the CER to be the point that energy is produced, irrespective of any downstream uses. This point is at the capture point, that is, the gas well. As soon as coal mine waste gas is pushed through a pipe by an extraction fan/blower/compressor, it becomes 'energy'.

[13] https://cer.gov.au/document_page/reporting-energy-production-and-consumption-guideline
[14] https://cer.gov.au/document_page/reporting-energy-production-and-consumption-guideline

There is no reporting threshold for energy production from extraction or drainage of coal mine waste gas.

Determining reportable energy consumption

All consumption of gaseous fuels must be reported if above the reporting threshold of 1000 m^3.

Accordingly:

- drained coal mine waste gas is reportable as energy consumption (if above reporting threshold):
  - when the gas is combusted on-site for energy purposes, for example, to drive an electricity generator, even if a force was not applied to inject it into a pipeline
  - when the gas is produced by being injected into a pipeline, and then consumed on-site – including coal mine waste gas vented or flared, if the gas was injected into a pipeline.
- drained coal mine waste gas is not reportable as energy consumption:
  - when the gas is drained into well pipes by using only the natural force of the decreasing pressure through desorption and the gas is not used for energy purposes, for example, when flared or vented. This may include 'underground in seam' pre-drainage gas wells.
  - when the gas is transferred off-site, even if a force was applied to inject it into a pipeline. This is because it is only produced but not consumed or combusted on-site.

Energy from coal mine waste gas consumed by combustion is automatically calculated in EERS from the quantity entered in the emissions section.

However, for coal mine waste gas that is 'captured for combustion' and consumed without combustion, the consumption should be reported as energy consumed without combustion in EERS if more than 13,000 m^3 is consumed – for example, coal mine waste gas vented through gas drainage where the gas was injected into a pipeline. This is in accordance with section 2.68 of the NGER Measurement Determination.

Estimating energy from capture of coal mine waste gas

The energy production and consumption can be estimated:

- using the quantity of coal mine waste gas measured in accordance with division 2.3.6 of the NGER Measurement Determination, as also measured to estimate venting emissions – see chapter 3.3 of this guideline
- applying the default energy content factor for coal mine waste gas captured for combustion in item 19 of Schedule 1 of the NGER Measurement Determination.

Note: In applying the above approach, the total quantity of coal mine waste gas at STP should be applied rather than the proportion of methane and carbon dioxide as is required for Q_{cap}, Q_{flared} and Q_{tr} to measure quantity of gas diverted from venting.

4.2 Emissions from combustion and flaring of coal mine waste gas

Emissions from the combustion of coal mine waste gas by any means other than flaring are estimated in the same manner as any gaseous fuel as per Part 2.3 of the NGER Measurement Determination. Emissions from flaring of coal mine waste gas are estimate per sections 3.14 to 3.16 of the NGER Measurement Determination.

For both, the emissions can be estimated using Methods 1, 2 and 3.

Method 1 for both is in practice identical. 1.03 of the NGER Regulations defines coal mine waste gas and the alternative *coal seam methane* in a way that determines the drained gas from a coal mine is coal mine waste gas.

Method 1 uses the total volume of coal mine waste gas sent to the flare or for combustion and applies the default energy content and emissions factors specified for coal mine waste gas captured for combustion (item 19) in schedule 1 of the NGER Measurement Determination. Only the quantity of coal mine waste gas should be measured to enable the estimation of emissions.

Note: When using Method 1, the volume of coal mine waste gas is different to Q_{cap} or Q_{flared} measured to estimate gas diverted from venting. Under Method 1, it is the total volume of coal mine waste gas combusted that should be measured, rather than the methane and carbon dioxide proportions of the gas.

Methods 2 and 3 are similar but not identical for both combustion and flaring emissions. Where coal miners choose these higher order methods, the requirements for each emissions source should be complied with.

Emissions from the combustion of coal mine waste gas by any means other than flaring are only reportable if more than 1,000 m^3 of coal mine waste gas is combusted.

Emissions or energy consumption from the flaring of coal mine waste gas does not have a threshold.

Example 7 – Estimating carbon dioxide emissions from coal mine waste gas flaring using Method 2

Coal mining operations often involve the flaring of coal mine waste gas, which releases emissions of carbon dioxide, methane, and nitrous oxide. In this example, a facility flares a coal mine waste gas stream from pre-drainage activities of 1,000,000 m^3 (at standard pressure and temperature) during the year. The gas stream entering the flare is predominantly methane but also contains some carbon dioxide and nitrogen. The reporters in this example have chosen to use Method 2 to estimate emissions. This approach provides the opportunity to develop a carbon dioxide emission factor that more accurately reflects the methane present in the gas stream, as well as account for the in-situ carbon dioxide quantity, which is emitted, but not combusted in the flare. The relevant data for the flaring of coal mine waste gas are as follows in the table below:

Table 8 – Data inputs for carbon dioxide emissions from coal mine waste gas flaring example.

Quantity of coal mine waste gas flared (at standard pressure and temperature) (m^3)	**Component gas type of coal mine waste gas**	**Gas type's percentage of the total coal mine waste gas volume (%)**	**Gas type's volume (m^3)**
1,000,000			
	Methane	91	910,000
	Carbon dioxide	7	70,000
	Nitrogen	2	20,000

Estimate the carbon dioxide emissions using Method 2 in section 3.15 of NGER Measurement Determination

$$\mathbf{E_{ico_2}} = \frac{\mathbf{Q_k} \times \mathbf{EC_i} \times \mathbf{EF_k}}{\mathbf{1000}} \times \mathbf{OF_i} + \mathbf{QCO_2}$$

Where:

E_{ico2} is the emissions of CO_2 released from coal mine waste gas (i) flared from the mine during the year, measured in t CO_2-e.

Q_k is the quantity of methane (k) within the coal mine waste gas from the mine during the year, measured in m^3 in accordance with Division 2.3.6

- The average methane composition of the coal mine waste gas being flared during the year was estimated to be 91%.
- Therefore, to calculate the volume of methane within the coal mine waste gas:

  Coal mine waste gas volume = 1,000,000 m^3

  Methane composition = 91%

  Total volume of methane (Qk) = 1,000,000 x 91÷100 = 910,000 m^3

QCO_2 is the quantity of carbon dioxide within the coal mine waste gas emitted from the mine during the year, measured in t CO_2-e in accordance with Division 2.3.3.

- This was also determined by gas composition analysis of the coal mine waste gas (in accordance with Division 2.3.3).
- The average carbon dioxide composition of the coal mine waste gas being flared during the year was 7%.
- Therefore, to calculate the volume of carbon dioxide within the coal mine waste gas:

  Coal mine waste gas volume = 1,000,000 m^3

  Carbon dioxide composition = 7%

  Total volume of carbon dioxide = 1,000,000 x 7÷100 = 70,000 m^3

- Carbon dioxide m^3 to tonnes conversion factor at standard pressure and temperature (see section 3.21 of the NGER Measurement Determination) = 1.861 x 10^{-3}
- Therefore:

  QCO_2 = 70,000 x 1.861 x 10^{-3}

  QCO_2 = 130.27 t CO_2-e

EF_k is the emission factor for the methane component (k) within the coal mine waste gas from the mine during the year, measured in kilograms of CO_2-e per gigajoule (kg CO_2-e/GJ).

This is determined using Section 2.22 of the NGER Measurement Determination, wherein:

- Subsection 2.22(1): the mol% will be 100 per cent methane as the emissions factor is specifically for methane only.
- Subsection 2.22(4): the carbon dioxide emission factor for the flared methane has been converted to kg CO_2-e/GJ, using:
  - the energy content of coal mine waste gas mentioned in item 19 of Schedule 1 of the NGER Measurement Determination
  - the density of methane as calculated using its molecular weight in Section 2.22 (2) of the NGER Measurement Determination.

In this example, it was estimated that the carbon dioxide emission factor for the methane within the coal mine waste gas = 49.12525 kg CO2-e/GJ.

EC_i is the energy content factor of methane within the coal mine waste gas (i), mentioned in item 19 of Schedule 1 of the NGER Measurement Determination, measured in gigajoules per cubic metre (GJ/m^3). In this example the energy content for coal mine waste gas in Schedule 1 of the NGER Measurement Determination = 37.7×10^{-3} GJ/m^3

OF_i = 0.98, which is the flaring efficiency factor of coal mine waste gas (i) flared.

Therefore, to estimate the CO_2 emissions from coal mine waste gas flared:

Q_k = 910,000 m^3 of methane

$EC_i = 37.7 \times 10^{-3}$ GJ/m^3

EF_k = 49.12525 kg CO_2-e/GJ

OF_i = 0.98

QCO_2 = 130.27 t CO_2-e

$E_{iCO2} = ((910{,}000 \times 37.7 \times 10^{-3} \times 49.12525)/1000 \times 0.98) + 130.27$

$= 1781.90325819221$

Therefore, the estimated total CO_2 emissions from the flaring of coal seam waste gas = 1781.90 t CO_2-e.

5. Emissions from post-mining activities at gassy mines

When coal is extracted from an underground mine that is gassy, the in-situ gas in the gas bearing strata prior to coal extraction is assumed to not fully desorb by the decreasing pressure through coal extraction. The remaining residual in-situ gas is assumed to desorb after the extracted coal has been brought to the surface. The fugitive gas from this desorption is not included in the estimates for gas streams in mine ventilation and gas drainage outlined in chapter 3 of this guideline.

5.1 What is a gassy underground mine?

In NGER, a gassy underground coal mine is defined in section 1.8 of the NGER Measurement Determination as 'an underground mine that has at least 0.1% methane in the mine's return ventilation'. If there is notable methane in the coal extracted, the mine's return ventilation will typically exceed the threshold comfortably. If there is no or negligible methane in the coal extracted the mine's return ventilation will likely be far from the threshold.

Whether a mine exceeds the threshold as gassy for NGER purposes needs to be determined each reporting year. This should be based on the total volume of methane in the total volume of air in the mine return ventilation for that year. See chapter 3.2 of this guideline for how this is measured.

Note: in planning and engineering for an underground coal mine, gas content of the coal seams is considered for safety purposes, and where risks of outbursts exist due to the coal seams being 'gassy', gas drainage will be performed prior to mining. However, these considerations do not apply for NGER, as NGER has its own specific separate definition (as per above).

5.2 Estimating fugitive emissions from post-mining activities

Gassy underground coal mines must estimate post-mining emissions, using Method 1 per section 3.17 of the NGER Measurement Determination.

This is a simple method with only one variable (Q) to be determined – that of ROM coal extracted from the mine during the year measured in tonnes. This variable may be labelled 'ROM tonnes' at many coal mines.

Section 1.8 of the NGER Measurement Determination, ROM coal means 'coal that is produced by mining operations before screening, crushing or preparation of the coal has occurred'. This is consistent with general industry practice for ROM coal. It is expected that a coal mining facility can agree or reconcile the tonnes ROM Coal reported in its NGER reporting with the tonnes of ROM coal reported regularly to management, and to underlying weigh-bridge records (or similar) for ROM coal extracted onto the ROM coal stockpile during the year.

The emission factor to apply is 0.019 t CO_2-e (Method 1 under section 3.5 of the NGER Measurement Determination) post-mining methane emissions per tonne of ROM coal extracted from the mine during the year.

6. Emissions from decommissioned underground mines

Greenhouse gas emissions may occur following the closure of underground coal mines. This may include leakage to the atmosphere through fractured gas bearing strata, open vents and seals over daily to decadal timescales. However, emissions will be reduced by flooding of the mine, which prevents desorption of gases from the remaining gas bearing strata in the decommissioned mine.

Division 3.2.4 (sections 3.30 to 3.40) of the NGER Measurement Determination provide the requirements for estimating these emissions allowing Methods 1 and 4 to estimate the emissions.

Note: From the 2018–19 reporting years onwards, Method 1 in section 3.32 of the Measurement Determination estimates emissions based on whole months since the mine became a decommissioned mine.

6.1 Definition of a decommissioned underground mine

In determining whether a mine is a decommissioned underground mine, the timing for the applicability of Division 3.2.4 of the NGER Measurement Determination is important. Prior to this timing, estimating emissions from decommissioned underground mines is not applicable. The timing is determined as follows:

1. Meet the definition for **'**decommissioned underground mine' in 1.03 of the NGER Regulations:

   decommissioned underground mine means an underground coal mine where the following activities have ceased to occur and are not expected to occur in the future:

   - coal production
   - active mine ventilation, including the operation of ventilation fans at the mine.

   Accordingly, coal production and any active mine ventilation must have stopped, and not be expected to occur in the future. The CER expects that the decommissioned underground mines source is included in energy and emissions reports when a facility meets the above definition.

   In practice:

   - Few mines will have active pre-drainage of gas in coal seams after terminating coal production, unless it serves a safety purpose, or if the drainage of coal mine waste gas serves an economic purpose – for example, as gas used for an ACCU Scheme project.
   - Many mines may continue with active mine ventilation for some time after coal production terminates. This may include only occasional mine ventilation for people to enter the mine for inspection during 'care and maintenance' prior to decommissioning.

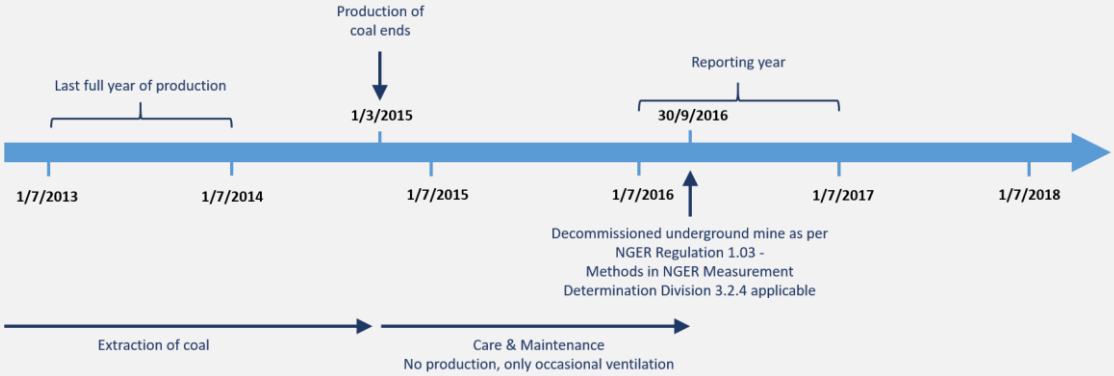
2. Maximum 19 years and 11 months after meeting the definition – the mine must have been closed less than 20 years for the Division to be applicable.

Example 8 – Determining the timing for decommissioned mine emissions

A gassy underground mine terminated coal production on 1 March 2015. A period to 30 September 2016 of care and maintenance followed, with no coal production but occasional mine ventilation. The mine performs no gas drainage.

The following timeline can be set out:

Figure 4 – Example for determining timing for decommissioned mine emissions.



Date for being decommissioned underground mine: by 30 September 2016 coal production and mine ventilation have ceased to occur, and none is expected to occur in the future. The mine meets the definition for a decommissioned underground mine in 1.03 of the NGER Regulations by this date.

Date for decommissioned mine emissions applicable: estimating decommissioned underground mine emissions is applicable 1 October 2016.

End of decommissioned mine emissions applicable: the last whole month before the mine has been decommissioned for 20 years will be August 2036. The last reporting year for reporting decommissioned underground mine emissions will be the 2036–37 reporting year. Decommissioned underground mine emissions must be estimated for 19 years and 11 months from the date the mine was decommissioned.

6.2 Estimating emissions during care and maintenance

The period after coal production has terminated until the mine meets the definition for a decommissioned underground mine may also cause fugitive release of emissions and may vary considerably in length from time to time. However, no bespoke methodology for estimating these emissions exists.

During this period, the estimation methodology that applies include:

- estimating the fugitive release using Method 4 under section 3.6 of the NGER Measurement Determination. See chapter 3 of this guideline for the general requirements for this approach
- per subsection 3.4(7) of the NGER Measurement Determination, if the emissions are incidental, another method may be used that is consistent with the principles in section 1.13 of the NGER Measurement Determination - see chapter 2 of this guideline. However, all emissions must be estimated including incidental emissions.

During care and maintenance, significant emissions may occur if (or when) active ventilation occurs. These emissions may need to be estimated as during coal extraction - see chapter 3.2 of this guideline. If active ventilation occurs occasionally, the emissions may have to be estimated during these events. It should be noted that emissions from occasional ventilation are likely highest at the start of the ventilation period – this is due to any accumulation of gas leaked into the roadways during ventilation down time.

If all goaf areas are sealed, the emissions from venting may be significantly less than during coal extraction. This is due to ventilation displacing air in mine roadways and tunnels only.

Emissions during times when active mine ventilation does not occur may be minor. During these times, whilst leakage of gases may occur, the air and gases in the mine will not be actively displaced. Additionally, if ventilation emissions are measured using ventilation surveys, Method 4 may not be practically possible for emissions estimation. An incidental emissions estimation methodology may be the only practical approach unless additional monitoring equipment is installed.

Note: for use of an incidental emissions estimation method, the incidental thresholds in 4.27(5) of the NGER Regulations must be observed – that is, the incidental fugitive emissions must not exceed 3 kt CO_2-e; and total incidental emissions from the facility must not exceed 12 kt CO_2-e.

6.3 Estimating fugitive emissions from decommissioned underground mines

Methods 1 and 4 are the only methods available for estimating fugitive emissions from decommissioned underground mines in accordance with subsection 3.31 (2) of NGER Measurement Determination.

Method 4 – direct emissions monitoring

Per section 3.37 of the NGER Measurement Determination, Method 4 is the same as Method 4 under section 3.6 of the NGER Measurement Determination – see chapter 3 of this guideline for the general requirements for this approach. However, if Method 4 is applied for a decommissioned underground mine, some additional monitoring equipment may be required, for example, measuring flow using ventilation surveys are not applicable.

Method 1 – default emission factor

Sections 3.32 to 3.36 of the NGER Measurement Determination provides Method 1 for estimating methane emissions from decommissioned underground mines. Estimating emissions using Method 1 is automated in EERS.

Per section 3.32 of the NGER Measurement Determination, Method 1 is estimated using the following equation:

$E_{dm} = E_{tdm} \times EF_{dm} \times (1 - F_{dm})$

Where:

E_{dm} is the fugitive emissions of CH_4 from the decommissioned mined during the year measured in CO_2-e tonnes

E_{tdm} is the emissions from the mine for the last 12-month period before the mine became a decommissioned underground coal mine, measured in t CO_2-e and estimated under section 3.6 of the NGER Measurement Determination, see chapter 3.1 of this guideline

Note: The E_{tdm} variable should reflect the GWP value of methane applicable to the reporting year, not the year when the mine was decommissioned.

EF_{dm} is the emissions factor for the decommissioned mine for the year of estimation calculated under section 3.33

F_{dm} is the proportion (between 0 and 1) of the decommissioned mine flooded at the end of the financial year, as estimated under section 3.34.

However, if, under subsection 3.32(1) of the NGER Measurement Determination, the estimated emissions in t CO_2-e for the mine during the year is less than $0.02 \times E_{tdm}$, the estimated emissions for the mine during the year is taken to be $0.02 \times E_{tdm}$.

- Emissions from the mine for the last 12-month period before the mine became a decommissioned underground coal mine (E_{tdm})

  These are the fugitive emissions from extraction of coal in the 12-month period before the mine became a decommissioned mine. Per example 8 above, it would be the emissions for the period from 1 October 2015 to 30 September 2016.

  The emissions should be estimated in t CO_2-e per section 3.6 of the NGER Measurement Determination (Method 4) – see chapter 3.1 of this guideline.

  For mines recently decommissioned it would be expected that the emissions for the preceding 12 months were estimated using Method 4 for NGER reporting, and therefore be expected to be applied for estimating emissions from decommissioned mines.

- Emission factor for the decommissioned underground mine (EF_{dm})

  The emission factor for Method 1 is derived from an emission decay curve, describing the decline in fugitive methane emissions over time following mine closure. Hyperbolic curves have been found to function best in portraying the rapid decline in emissions in the first few years, followed by a slow decline over time of the remaining emissions. Australian-specific emission decay curves have been developed and been utilised for both gassy and non-gassy mines.

  The following describes the formula for calculating the emissions factor as per the NGER Measurement Determination. There is a requirement to calculate it as the integral under the curve of the formula for the period between T and T-N.

  The equation for calculating the emissions factor each year is provided in section 3.33 of the NGER Measurement Determination. It is a function of:

  - the number of whole months since decommissioning, per definition in 1.03 of the NGER Regulations - see chapter 6.1 of this guideline. This determines the factor *T* in the equation in section 3.33 of the NGER Measurement Determination. In example 8, it is the number of whole months from 30 September 2016.

- note that if decommissioning occurs on the first day of a month, that month is not counted as a whole month for this purpose

» N is factor dependent on T.

N is equal to T if T is less than 12, or 12 if T is greater than 12.

T is the number of whole months since the mine became a decommissioned underground coal mine, at the end of the reporting year

» whether the mine is a gassy or non-gassy mine, per definition in section 1.8 of the NGER Measurement Determination - see section 5.1 above. This determines the factors *A*, *b* and *C* of the equation in section 3.33 of the NGER Measurement Determination, as follows:

A is $\frac{0.23}{12}$ for a gassy or $\frac{0.35}{12}$ for a non-gassy mine

b is –1.45 for a gassy or –1.01 for a non-gassy mine

C is 0.024 for a gassy or 0.088 for a non-gassy mine.

Determining whether the mine is gassy or non-gassy should be based on measurement performed during coal extraction, that is, measuring it during care and maintenance is not allowed.

- EF_{dm} can then be calculated as: the integral under the curve, $\frac{(1+\mathrm{A}\times\mathrm{T})^{\mathrm{b}}-\mathrm{C}}{12}$, for the period between T and T–N.

Note: for the 2018 – 19 reporting year, an amendment was made to the NGER Measurement Determination for the estimation of emissions from decommissioned underground coal mines using Method 1 under section 3.32 (enabled by the National Greenhouse and Energy Reporting (Measurement) Amendment (2018 Update) Determination 2018) [15]. The intention of the amendment was to enable a more accurate estimation of emissions from mines which are decommissioned part way through a reporting year by:

- nominating a decommissioned starting month part way through a reporting year
- estimating annual emissions going forward in time using an emission factor based on the number of months since decommissioning, rather than years.

However, the amendment to section 3.33 of the NGER Measurement Determination incorrectly results in the overestimation of emissions through the inflation of the emissions factor.

For the 2018–19, 2019–20 and 2020–21 reporting years, the CER and the Department of Climate Change, Energy, the Environment and Water will interpret the calculation of $\boldsymbol{EF_{dm}}$ under section 3.33 of the NGER Measurement Determination as follows:

[15] https://www.legislation.gov.au/F2018L00923/latest/text

$\boldsymbol{EF_{dm}}$ is the integral under the curve of:

$$(\mathbf{1} + \boldsymbol{A} \times \boldsymbol{T})^{\boldsymbol{b}} - \boldsymbol{C},$$

divided by N.

The National Greenhouse and Energy Reporting (Measurement) Amendment (2022 Update) Determination 2022[16] provided a further change to this formula. From the 2021–22 reporting year onwards, the CER and the Department will interpret the calculation of $\boldsymbol{EF_{dm}}$ under section 3.33 of the NGER Measurement Determination as described in the National FG:

$\boldsymbol{EF_{dm}}$ is the integral under the curve, for the period between *T* and *T-N,* of:

$$\frac{(\mathbf{1} + \boldsymbol{A} \times \boldsymbol{T})^{\boldsymbol{b}} - \boldsymbol{C}}{\mathbf{12}}$$

- Proportion of mine void flooded (F_{dm})

  Emissions from decommissioned mines are reduced as a mine fills with water. This progressive filling reduces the gas desorption from the coal remaining in the closed mine. The variables required to estimate the portion of the mine flooded at a point in time are the size of the void volume and the water inflow rate into the closed mine. Sections 3.34 to 3.36 of the NGER Measurement Determination provides requirements for how to measure these variables, using the following parameters:

  - the size of mine void volume (M_{vv}). – measured in m^3 per industry practice; or standard factor based on total ROM coal extracted from the mine during the life of the mine.
  - water flow into the mine (M_{WI}) over the years, based on the number of years since decommissioning per definition in 1.0 of the NGER Regulations – see chapter 6.1 of this guideline

    M_{WI} is measured based on flow rates per an appropriate standard; or per water flow rates (in m^3 per year) for different regions of New South Wales and for Queensland mines.

    The number of whole months since the mine became a decommissioned underground coal mine at the end of the reporting year (*months)* is then applied to M_{WI} to calculate total water in m^3 that has flowed into the mine at the end of the year since the time of decommissioning.

  F_{dm} can then be calculated as: $F_{dm} = \frac{M_{WI}}{M_{VV}} \times \frac{months}{12}$

  - this yields a proportion. If the calculation exceeds a proportion of 1, it must be set at 1.

[16] https://www.legislation.gov.au/F2022L00815/latest/text

Emissions from on-site combustion or flaring of coal mine waste gas

Combustion or flaring of coal mine waste gas can also occur at decommissioned underground mines – this would be post-drainage of coal mine waste gas in goaf. As set out in section 3.38 to 3.40 in the NGER Measurement Determination, the estimation methodology is the same as for coal mine waste gas flared or combusted from operating underground mines (see chapter 4.2) – except for Method 2 being not available for methane flaring emissions from decommissioned underground mines as per sub-section 3.31(4)(b) of the NGER Measurement Determination.

7. Fugitive emissions from open-cut coal mining

Fugitive emissions from open cut coal mining primarily relate to in-situ methane and carbon dioxide in gas bearing strata being released as the coal is extracted. As it is in open pits, it is released directly into the air. Methods 1, 2 and 3 are allowed estimation methods.

7.1 Method 1 – State-based emission factor for methane

Method 1, outlined in section 3.20 of the NGER Measurement Determination, estimates methane emissions only. Carbon dioxide emissions are not estimated by this method. Some safeguard facilities may not be able to use Method 1 and are required to use Method 2 or 3 under the Safeguard Mechanism. Please refer to chapter 7.2 of this guideline for more on the applicable methods for safeguard facilities.

Method 1 is a simple method with only one variable (Q) to be determined, that of ROM coal extracted from the mine during the year measured in tonnes - see chapter 5.2 of this guideline for more on ROM coal.

The emission factor (EF) to apply depends on the state or territory that the mine operates in and is specified in section 3.20 of the NGER Measurement Determination.

Example 9 – Method 1: State-based emission factor for methane

A facility constituted by an open cut coal mine in NSW extracts 2,554,000 t of ROM coal during the year. The reporter elects to use Method 1 (Section 3.20) to estimate fugitive emissions of methane. Emissions are estimated as follows:

$$\mathbf{E_j = Q \times EF_j}$$

where:

E_j is the fugitive emissions of methane (j) that result from the extraction of coal from the mine during the year, measured in t CO_2-e.

Q is the quantity of ROM coal extracted from the mine during the year, measured in tonnes. In this example, the quantity is 2,554,000 t of ROM coal.

EF_j is the emission factor for **methane** (j), measured in t CO_2-e per tonne of ROM coal extracted from the mine, which is specified for a mine in each State. In this case, for an open cut mine in NSW, the emission factor is 0.061 t CO_2-e per tonne of ROM coal extracted.

Therefore, the estimate of methane emissions in t CO_2-e:

E_j = (2,554,000 x 0.061)

Estimated emissions of methane = 155,794 t CO_2-e

7.2 Restrictions on use of Method 1 for open-cut coal mines covered by the Safeguard Mechanism

The NGER (Measurement) Amendment (2024 Update) Determination 2024[17] introduced a staggered phase-out of Method 1 for estimating fugitive methane emissions from **open-cut coal mines covered by the Safeguard Mechanism**.

The transition from Method 1 is phased in two 'tranches'. Tranche 1 commenced on 1 July 2025 and applies to facilities that extracted more than 10 million tonnes of ROM coal in 2022–23. For these facilities, Method 1 cannot be used to estimate fugitive emissions of methane from the extraction of coal from 2025–26.

Tranche 2 commences on 1 July 2026 and prohibits use of Method 1 for *all* remaining Safeguard facilities from 2026–27.

For more information, please contact the CER by email cer-nger-reporting@cer.gov.au.

[17] https://www.legislation.gov.au/F2024L00823/asmade/text

7.3 Method 2 and 3 – Mine specific in-situ gas modelling

Method 2 and 3 for estimating fugitive emissions from the extraction of coal from open cut mines requires:

a) the development of a 'geological' model of the coal reserve

b) a 'gas assignment' model.

The geological and gas models are combined to generate a 'mine specific' model of where and how much methane and carbon dioxide is contained in the area to be mined. Best practice is for these models to be developed using core samples that were collected before the area has been mined. This model should be used to estimate the fugitive emissions of methane and carbon dioxide each year when extracting coal. The requirements are outlined in sections 3.21 to 3.26 of the NGER Measurement Determination.

The CER initiated a thematic audit program that concluded in October 2025 to assess the compliance of facilities using Method 2 and 3. The findings of the audits, including any identified exceptions to compliance, are available here: NGER thematic audit program – Higher methods for open cut coal mining.[18]

Use ACARP Guidelines to model the in-situ gas in place

Higher order methods enable more accurate estimation of fugitive emissions from open cut coal extraction compared to the use of Method 1. The higher order methods require the use of the Guidelines for the implementation of NGER Method 2 or 3 for Open Cut Coal Mine Fugitive GHG Emissions Reporting[19] (ACARP Guidelines). These guidelines provide clear requirements and guidance for:

- the overall modelling approach, including requirements of the 'Estimator', the professional that should lead the modelling
- requirements for in-situ gas sampling and testing, including minimum requirements for sampling and how to document sufficient and unbiased gas samples to enable modelling
- requirements for analysis and modelling of in-situ gas in gas bearing strata based on the available and obtained gas samples.

Below are key aspects for applying the ACARP Guidelines:

- Apply the NGER Measurement Determination and ACARP Guidelines in full – the ACARP Guidelines are consistent with (and referred to) within the requirements of the NGER Measurement Determination. Where there is a discrepancy between the 2 documents, the NGER Measurement Determination prevails. The modelling approach using the ACARP Guidelines should be checked for compliance with the requirements of the NGER Measurement Determination.
- Document use of qualified Estimator and peer reviewer – the ACARP Guidelines draw heavily on using an expert 'Estimator' that diligently documents an unbiased representative gas model. It should be evidenced that the Estimator (either an individual or a team) used meets the professional and qualification requirements set out in the ACARP Guidelines. The process and supporting data for the modelling should also undergo a documented independent peer review by an appropriate professional.
- Perform representative gas sampling and testing – the following are key aspects to observe when performing gas sampling:
  - » Determine domains – based on historical data and interpretation of new gas samples, (gas) domains should be established, whether one or several. Section 1.08 of the NGER Measurement

[18] https://cer.gov.au/document_page/nger-thematic-audit-program-higher-methods-open-cut-coal-mining
[19] https://www.acarp.com.au/abstracts.aspx?repId=C20005

Determination, a domain means an area, volume or coal seam in which the variability of gas content and variability of gas composition in the open cut mine has a consistent relationship with other geological, geophysical or special parameters located in the area, volume or coal seam. This enables modelling for each domain.

  - Obtain representative gas sampling – at least 3 boreholes to sample the gas bearing strata in each domain must be undertaken. At least one of these boreholes must be a 'Type borehole' that obtains gas samples that can characterise the vertical variability of a deposit. Samples must be taken to a depth of at least 20 metres (m) below the planned pit floor, to enable appropriate estimate of fugitive release below the pit floor.
  - The location and spacing of boreholes should be determined by analysing existing historical data. Additional boreholes and sampling may be required in an iterative process confirming data sufficiency to enable the gas modelling.
  - Avoid errors in gas sampling and testing – gas sampling and lab testing processes can be prone to error. Avoiding compromising the integrity of gas samples and the testing process is important. This particularly requires the parties performing the borehole gas sampling collection and lab testing to ensure that gas samples are not contaminated (for example, with ambient air) and are analysed using appropriate standards.
  - Third parties are often used for gas sampling and testing. It should be documented that the Estimator is satisfied that the competence and approach taken by those performing the required sampling and testing meets appropriate standards. Additionally, the documented analysis of gas data obtained from the lab is important, to eliminate false gas data (for example, due to contamination).

- Develop unbiased model to estimate in-situ gas in place – an appropriate and unbiased model to estimate in-situ gas in place should be developed using the sample data.
  - Avoid modelling bias – several gas modelling approaches are allowed, including simple models so long as the modelling is unbiased (which should be tested and documented).
  - Apply gas model to all gas bearing strata in geology – the gas model should be applied to the full geological ply model so that all known and spatially continuous coal seams (and carbonaceous bands) are modelled, including those that may have been classified as uneconomic for mining.
  - Include fugitive release below the pit floor – the gas model should enable estimation of the expected fugitive release from below the pit floor, per section 3.23 of the NGER Measurement Determination.
  - Establish and model appropriate 'low gas zone' – per section 3.25C of the NGER Measurement Determination. The horizon of the low gas zone should be appropriately established and applied to the gas modelling.

> Note: The in-situ gas model will usually cover a multi-year planned mining area, based on the 'life of mine' plan at the time of modelling. If mining is to extend into further coal seams not modelled, new modelling will be required.

Any additional modelling should be carried out using the ACARP Guidelines and the requirements of the NGER Measurement Determination in full, including using an appropriate Estimator. This modelling may require new boreholes for gas sampling and testing, unless the new or updated modelling can demonstrate that existing gas samples provide sufficient basis to model the in-situ gas in the extended mining area.

Annual emissions estimation

The gas in place model typically covers a multi-year mining area. Accordingly, each year's emissions estimate should be extrapolated from this model based on the exact areas mined in the previous financial year. The mined area can be determined using standard state mine surveying requirements. Estimates for annual emissions of methane and carbon dioxide should be reported separately.

All gas bearing strata mined should be included. A straight reconciliation to ROM coal may not be possible, but a documented sense-check to ROM coal extracted during the year and the corresponding coal seams mined per the model is recommended.

> For any areas classified as a low gas zone, a default gas content of 0.00023 tonnes of carbon dioxide per tonnes of gas bearing strata must be assigned to all gas bearing strata located in the low gas zone. No estimation of methane should be made for a low gas zone.

In addition to estimating the emissions from the extraction of gas bearing strata, emissions of gas released from gas bearing strata within 20 m down from the pit-floor also need to be included. Emissions below the pit-floor occur as the downward-pressure on gas bearing strata is reduced by extraction of overburden and gas bearing strata above.

> When estimating emissions from gas released below the pit floor, the term 'pit floor' is the deepest level at which removal of overburden and gas bearing strata took place at that location at the end of the reporting year. The pit floor could be at different levels in a mine depending on the pattern of extraction employed at the mine.
>
> At the end of the reporting period, emissions from gas bearing strata within twenty metres down from the pit floor are presumed to occur. This is regardless of the duration of time in which the gas bearing strata has been within twenty metres down from the pit floor.

The proportion of gas content released below the pit floor is estimated in accordance with section 3.23 of the NGER Measurement Determination. Section 3.23 allows the reporter to determine the β_z factor when the gas bearing strata is not at or above the pit floor. Reporters have a choice of determining β_z in relation to the depth:

$$\beta_Z = 1 - \frac{x-h}{dh};$$

In these cases, β_z will be a value between 0 and 1.

Alternatively, reporters may elect to estimate that β_z is 0.5. β_z being equal to 0.5 is equivalent to accepting that 50% of the gas contained in the gas bearing strata has been released.

The estimation of the proportion of gas released from gas bearing strata below the pit floor in one reporting year will have implications on estimated emissions in future reporting years. Gas that has been estimated as being released from gas bearing strata below the pit floor should be excluded from future estimations.

For example, if gas bearing strata is estimated to have released 50% of its gas in the previous 2 reporting years is extracted in this reporting year, it could be estimated to release only the remaining gas contained.

Table 9 – Reporting year and gas estimated as being released as a percentage of the total quantity of gas contained according to the gas model.

Reporting year	βz	Gas estimated as being released as a percentage of the total quantity of gas contained according to the gas model
2016–17 (within 20 m down from the pit floor)	0.5	50%
2017–18 (within 20 m down from the pit floor)	0.5	25%
2018–19 (extracted)	1	25%

> Records of how below pit floor emissions were estimated should be kept, ensuring accurate estimations can be made in future reporting years.

It is recommended that the Estimator (or Estimator team) be involved in the annual emissions estimation process. The ACARP Guidelines implicitly assume this to be the case – refer the checklist in Appendix 1 of the ACARP Guidelines.

Method 3 – additional sampling requirements

As per section 3.26 of the NGER Measurement Determination, Method 3 is the same as Method 2, except for additional requirements to use an appropriate standard for gas sampling. These standards may include the specifically mentioned Australian standards. Using the default specified in the ACARP Guidelines does not qualify as 'an appropriate standard' for the purpose of achieving Method 3.

7.4 Venting or flaring emissions at open cut coal mines

Venting or flaring of in-situ gas can also occur from open cut coal mines. This will be from surface in seam drainage. Such gas drainage from open cut coal mines is less common than for underground coal mines. The likelihood of significant in-situ gas in place prior to coal extraction is lower where targeted coal seams are closer to the surface.

Where these emissions occur, the requirements for estimating the emissions are equivalent to the approach required for underground coal mines, except that Method 2 is not available for estimating methane emissions from flaring. If PEM is used, it must be performed in accordance with the requirements in Part 1.3 of the NGER Measurement Determination.

See chapter 3.3 of this guideline for estimating venting emissions, and chapter 4.2 of this guideline for estimating combustion and flaring emissions.

Note: if venting or flaring emissions occur at an open cut coal mine that uses Methods 2 or 3 to estimate fugitive emissions from extraction of coal, a correction to emissions estimated per the in-situ gas modelling may be required. The requirements for this are included in section 3.22 of the NGER Measurement Determination.

8. Energy production

Reporters are required to report energy production from the operation of the facility where applicable. See the Reporting energy production and consumption[20] guideline for more information.

Brief guidance for reporting energy production from key coal mine specific energy production sources is provided below. Typical reportable energy production from coal mines include:

- production of 'saleable coal on a washed basis' – see chapter 8.1 of this guideline
- coal mine waste gas captured for combustion where applicable – see chapter 4.1 of this guideline
- on-site electricity generation where applicable – see chapter 8.2 of this guideline.

In general, energy production must be reported in accordance with section 6.3 of the NGER Measurement Determination:

$$Z_i = Q_i \times EC_i$$

Where:

Z_i is the energy content of fuel/energy commodity type (i) produced during the year in gigajoules (GJ).

Q_i is the quantity of fuel/energy commodity type (i) produced during the year in either mass or volume units.

EC_i is the energy content factor of fuel/energy commodity type (i) produced during the year in GJ per quantity unit.

8.1 Energy production: 'saleable coal on a washed basis' (Q)

The purpose of extracting coal from a mine is to produce a valuable energy commodity. Accordingly, production of the final coal product is a significant reportable energy production under NGER. Its energy value usually dwarfs all other on-site energy production. Coal mines are required to report 'saleable coal on a washed basis' energy produced from coal mined within their facility's boundaries.

Determining Q: 'saleable coal on a washed basis' energy production

The key variable, Q, is 'saleable coal on a washed basis', per subsection 6.2(2) of the NGER Measurement Determination. This is considered to be coal that is ready for final consumption.

- After extraction, ROM coal may require processing and preparation before it is ready for final consumption and therefore considered to be 'saleable coal on a washed basis' (Q). This can include 'washing' of coal using a flocculent to remove impurities.
- If ROM coal is ready for final consumption and does not require 'washing', it is considered to be 'saleable coal on a washed basis'. In this case, 'saleable coal on a washed basis' (Q) may be the same quantity (in tonnes) as the ROM coal.

Coal mine facilities that produce 'saleable coal on a washed basis' can use industry practice to measure energy production (Q). This typically includes regular stockpile surveys to reconcile 'saleable coal on a washed basis' production with other controlled factors, such as sold or railed coal, and ROM coal. For

[20] https://cer.gov.au/document_page/reporting-energy-production-and-consumption-guideline

example, it may be possible to estimate the quantity of energy production (Q) from the amount of 'saleable coal on a washed basis' in tonnes added to the saleable coal stockpile during the year.

Energy production should be reported for the facility that mined the coal[21], even if the coal is processed and prepared (including 'washing') at another facility to make 'saleable coal on a washed basis'. In this case the coal mine facility should report both the ROM coal, and the estimated quantity of 'saleable coal on a washed basis' (Q) made outside of the facility (the reported amount of ROM coal should be higher than the reported amount of 'saleable coal on a washed basis' (Q) that was produced from that ROM coal). The reporter can estimate these amounts using techniques consistent with industry practice.

Coal product that is sold, loaded, shipped, delivered or railed out from the coal mine facility is only considered to be 'saleable coal on a washed basis' (Q) if it is the coal product that is ready for final consumption and does not require subsequent processing and preparation (which can include 'washing').

The quantity (Q) of 'saleable coal on a washed basis' to be reported is the production for the reporting year.

The approach used to determine the energy production quantity (Q) should align with the general principles described in section 1.13 of the NGER Measurement Determination, being transparency, comparability, accuracy and completeness. Application of the above principles supports the principle of comparability, in that estimation approaches are comparable within the industry sector.

Determining EC: Energy content of 'saleable coal on a washed basis' production

The energy content factor can be determined in one of 2 ways:

- default energy content factor for NGER specified coal products
- mine specific energy content factor using analysis of calorific value of 'saleable coal on a washed basis' produced.

Default energy content factor

The simplest way to determine an appropriate energy content factor for the produced 'saleable coal on a washed basis' is by using the default energy content factors for solid fuels provided in the NGER Measurement Determination. To do this, the 'saleable coal on a washed basis' production should be matched to a solid fuel energy commodity specified in Part 1 of Schedule 1 of the NGER Measurement Determination, see also Table 10 below.

Table 10 – Default energy content factors for 'saleable coal on a washed basis' production.

Coal product (fuel)	Energy content factor in GJ/t
Bituminous coal	27.0
Sub-bituminous coal	21.0
Anthracite	29.0

[21] This is consistent with regulation 2.25 of the Regulations, which states that energy production is constituted by 'extraction or capture from natural sources'.

Coal product (fuel)	Energy content factor in GJ/t
Brown coal	10.2
Coking coal	30.0

It is expected that coal mines know what coal they produce, as different coal products have different commercial value on the market. Accordingly, it is expected that coal mines can document the choice of energy commodity applied to its 'saleable coal on a washed basis' production.

If more than one coal product is produced from the mine, the 'saleable coal on a washed basis' production should be divided appropriately between the different coal products produced and reported separately using the appropriate energy content factor for each coal product produced.

Mine specific energy content factor

Energy content can also be determined by analysing the calorific value of 'saleable coal on a washed basis' samples monthly in accordance with AS 1038.5-1998 (as stipulated in Schedule 2 of the NGER Measurement Determination). Whilst coal mines generally know the energy content of its coal production, it can only use the mine specific energy content factor if the analysis is done in accordance with the specified standard.

8.2 Electricity production

Coal mines may have on-site electricity production, typically as back-up generators or from own combustion of coal mine waste gas captured from gas drainage.

Where on-site electricity production occurs, it must be reported as energy production if above the reporting threshold. As per 4.19 and 4.20 of the NGER Regulations, the applicable reporting threshold is where the generating capacity of the unit is greater than 0.5 megawatts (MW) and the unit generates greater than 100,000 kilowatt hours (kWh) of electricity in the reporting year. The threshold applies to each generating unit, not the combined capacity of the generating facility, as shown in the example below.

Example 10 – Electricity production

Table 11 – A coal mine has 2 generating units, with the following annual generation:

Unit	Capacity (MW)	Annual generation (kWh)
1	0.6	90,000
2	0.4	120,000
Total	1.0	210,000

The coal mine does not have to report electricity production, since neither unit is above both reporting thresholds. If, the following year, unit 1 generates greater than 100,000 kWh, it would have to be reported as electricity production.

Where coal mines have generators with a generating capacity over 0.5 MW, the annual generation should be monitored and documented to determine whether the reporting threshold is reached.

Per subsection 6.3(2) of the NGER Measurement Determination, the amount of electricity produced should be evidenced by invoices, contractual arrangements or industry metering records. If the electricity production on a mine site is for own use, invoices and contractual arrangements are not applicable. In that case, metering of generated electricity of units with a generating capacity over 0.5 MW is required.

9. Other NGER data

In this section, guidance on some coal mining specific observations for other NGER data is provided. It is not an exhaustive or complete consideration of all the different types of energy and emissions data required from coal mines and deals only briefly with typical specific coal mine matters.

9.1 Liquid fuel combustion emissions

All on-site fuel consumption must be reported, if above the set reporting thresholds (1 kL for combusted liquid fuels other than petroleum-based oils and greases). Where fuel is combusted, resultant emissions should be estimated and reported. Coal mines typically have many different types of fuel consumption, but typically only one significant source – that of diesel combustion used to drive on-site mining equipment including haul trucks in open cut coal mining.

Emissions from diesel combustion

At open cut coal mines, diesel combustion is often the biggest source of emissions due to the operation of haul trucks. This is primarily reported as stationary energy because the moving mining equipment is not road registered. For information about the methods and measurement criteria available for diesel and other fuels, see the Methods and measurement criteria[22] guideline.

A few key comments regarding reporting emissions for this source:

- BBB measurement criterion usually not applicable – this is because diesel (and other fuel) is typically acquired by the facility through a commercial transaction. BBB measurement criterion is only available if acquisition of the fuel does not involve a commercial transaction. Situations where industry practice is used to apportion fuels to different uses, or where a contractor acquired the fuel through a commercial transaction to conduct activities within the facility, are all considered to have involved commercial transactions, and therefore BBB must not be applied.
- AAA measurement criterion usually not available – this is due to the technical requirement of measuring at the point of combustion at ambient temperatures using measurement equipment calibrated to a measurement requirement.

  A fuel management system is not considered to be direct measurement of fuel use at the point of combustion. Also, where a fuel management system exists, it may not meet the measurement requirements for AAA
- A or AA measurement criteria usually appropriate – mines should typically use measurement criteria A or AA to measure the diesel and other fuel consumed at the facility during the year. This is also data that is typically managed and controlled by the mine as part of purchasing at the mine, or centralised at the regional or head office.

  The data can be reconciled to accounts payable and/or stock surveys each year, and sense-checked to the dollar-value for fuel spend recorded during the year. Documenting these checks for the fuel use

[22] https://cer.gov.au/document_page/methods-and-measurement-criteria-guideline

reported in the annual NGER report is good practice. Note: Similar documented checks can often be applied to use of purchased electricity.

The mine can then use its on-site fuel management system to apportion the fuel proportionately to:

» the energy purpose, that is, whether used for electricity, transport or stationary purposes, per section 2.71 of the NGER Measurement Determination

» the applicable fuel items listed in Schedule 1 of the NGER Measurement Determination.

However, mines should observe the requirement in subsection 2.50(3) of the NGER Measurement Determination for commercial transactions. Once criteria AA or AAA measured at point of consumption have been used for a fuel acquired by commercial transaction for a given reporting year, the same criteria must be used in subsequent years.

- Method 1 usually applied – reporters need to determine if there is value in using higher order methods when estimating emissions from fuel combustion.
- Fuel use without combustion – if diesel is used as a flocculent in washing out impurities of the extracted coal in coal handling and preparation, it will have been consumed without combustion. Likewise, if diesel is used in explosive manufacture, it is considered non-combusted fuel use. Quantities used for these purposes should be excluded from the estimated fuel combustion emissions. However, the use of such fuels may result in reportable energy consumption.

  Non-combusted fuel use should be reported as non-combusted fuel use if exceeding the reporting threshold set in section 2.68 of the NGER Measurement Determination – for liquid fuel, the threshold is 15 kL per instance of a source.

  For additional information about the reporting of fuels consumed in the preparation and use of explosives see the Blended fuels, other fuel mixes, bitumen and explosives[23] guideline.

9.2 Emissions from purchased electricity

Scope 2 emissions must be reported if the amount of purchased electricity consumed from the operation of a facility during a year exceeds 20,000 kWh.

'Purchased electricity' can include acquisitions of electricity for any consideration (payment of money or otherwise). As such, the transfer of electricity between facilities without payment of money can still be classed as a 'purchase'. Where a facility consumes own generated electricity, it does not constitute a source of Scope 2 emissions but must be reported as energy consumption.

The calculation of Scope 2 emissions involves the use of the amount of electricity used and emission factors that are either designated in the NGER Measurement Determination or provided by the electricity supplier if sourced from a provider other than the main electricity grid for the state.

Note: The 'main electricity grid' is defined in subsection 7.2(4) of the NGER Measurement Determination. For Western Australia, this is the Southwest Interconnected System. For all other States and Territories, this is the electricity grid that provides electricity to the largest percentage of the State's or Territory's population.

[23] https://cer.gov.au/document_page/reporting-blended-fuels-other-fuel-mixes-bitumen-and-explosives-guideline

9.3 Other emissions sources

Other emissions sources are usually minor for coal mines. The emissions should be reported if they occur and are above reporting thresholds. Typical reportable emissions sources include:

- Waste emissions – mines can have different forms of on-site waste treatment:
  - » solid waste disposal emissions will usually not be reportable, even if an on-site landfill is operated (which can occur at remote mines in particular) unless the landfill emits more than 10,000 t CO_2-e from solid waste disposal in the landfill per section 5.2 of the NGER Measurement Determination.

    However, if on-site solid waste disposal occurs, the coal mine should determine and document annually whether it is below the reporting threshold. If it is not below the reporting threshold, solid waste disposal emissions must be reported per Part 5.2 of the NGER Measurement Determination[24].
  - » waste incineration emissions are reportable if occurring on-site; refer section 5.53 of the NGER Measurement Determination.
- emissions from sulphur hexafluoride (SF_6) – if an on-site reticulation system exists, some emissions from leakage of SF_6 may occur if switchgear or circuit breakers with SF_6 are applied. Part 4.5 of the NGER Measurement Determination must be used to estimate SF_6 emissions. There is no minimum reporting threshold for this emissions source. Method 1 in section 4.102 of the NGER Measurement Determination may be used, which requires a stock-take of SF_6 in on-site switchgear and circuit breakers.

Note: from the 2018–19 reporting year onwards, emissions from wastewater treatment (domestic or commercial) are not reportable for facilities whose primary activities are outside of ANZSIC code 281–Water supply, sewerage and drainage services (item 192 (Water supply, sewerage and drainage services - ANZSIC code 281), in Schedule 2 of the NGER Regulations).

9.4 Matters to be identified

NGER requires different 'matters to be identified' (MTBIs) in a facility's reporting. Some of this information is important to intended users of NGER reports. Diligence should be exercised in preparing and reporting complete and accurate MTBIs.

There are several specific MTBIs relating to coal mining specified in Part 1 of Schedule 4 of the NGER Measurement Determination, including:

- the location of the mine by State or Territory
- the tonnes of raw coal produced
- coal mine waste gas drained and diverted from venting at underground mines for on-site combustion (Q_{cap}), on-site flaring (Q_{flared}), or transferred off-site (Q_{tr}) – all converted into mass in t CO_2-e per gas type (being methane and carbon dioxide)
  - » open cut mines have the same requirement if gas drainage occurs and Methods 2 or 3 is used to estimate fugitive emissions from extraction of coal - if Method 1 is used, the MTBI only require the tonnes of coal mine waste gas flared to be reported.
- for decommissioned mines:
  - » whether a decommissioned underground mine is gassy or non-gassy

[24] See the agency's website at www.cer.gov.au for more information.

- the percentage of the mine void volume flooded
- the date that the mine was decommissioned - considered to be the date that the mine became a decommissioned underground mine (refer to section 6.1 of this Document)
- the tonnes of methane emissions (t CO_2-e) from the mine in the last 12-month period before the mine became a decommissioned underground coal mine.

Note: 'The tonnes of raw coal produced' is ROM Coal – an undefined term. For clarity, the CER considers it to imply the tonnes of ROM coal extracted from the mine during the year. It is an important parameter to include in NGER reports. For more on ROM coal, see chapter 5 of this guideline.

Other disclosure requirements

- Waste emissions – if waste emissions occur, several specific MTBIs are required, specified in Part 6 of Schedule 4 in the NGER Measurement Determination.
- Reporting about contractors – the activities of an on-site contractor under the operational control of the coal mine facility may result in emissions, energy consumption, or energy production levels that exceed one or more of the thresholds equivalent to the facility reporting thresholds, being 100 terajoules (TJ) of energy production or consumption, and 25,000 t CO_2-e of emissions. When one or more of these thresholds are met, additional information about the contractor must be included in the NGER report. The additional information is specified in regulation 4.30 of the NGER Regulations. The additional information is:
  - name of each contractor
  - identifying details of each contractor
  - total greenhouse gas emissions produced by each contractor's activity or activities
  - total energy produced by each contractor's activity or activities
  - total energy consumed by each contractor's activity or activities.

  Emissions, energy consumption and energy production from on-site contractors under the operational control of the coal mine facility must always be included in the emissions and energy totals in the NGER report for the coal mine facility. Reporting additional information for a contractor that meets one or more of the thresholds does not change the facility's emissions and energy totals, but rather attributes some of those emissions and energy quantities to the contractor. Coal mine facilities must determine whether they need to report additional information for contractors under their operational control.

  It is important to monitor both energy consumption and emissions from contractor fuel combustion as it is possible for the energy consumption threshold (100 TJ) to be reached whilst emissions are significantly below the emissions threshold (25,000 t CO_2-e).

  More information is available in the Contracts and leasing guideline[25].

[25] https://cer.gov.au/document_page/contracts-and-leasing-guideline

Example 11 – Reporting activities conducted by a contractor

Facility A consumes a total of 10,000 kL of diesel by combustion for stationary purposes. This quantity includes the diesel consumption of all contractors under the operational control of Facility A and was estimated using Method 1 and the default energy content factor.

Contractor B consumed 2,591 kL of diesel by combustion under the operational control of Facility A.

- Facility A must report the consumption by combustion of 10,000 kL of diesel, which is equivalent to 27,097 t CO2-e of emissions and 386,000 GJ of energy.
- Contractor B's diesel use is responsible for 7,021 t CO2-e of the emissions reported by Facility A. This value is below the emissions threshold of 25,000 t CO_2-e.
- Contractor B's diesel use is responsible for 100,013 GJ of the energy reported by Facility A. This value exceeds the contractor reporting threshold of 100 TJ of energy consumption.
- Facility A reports additional information, about Contractor B because they exceeded the 100 TJ energy consumption threshold. Specifically, Facility A reports Contractor B's name and identifying details, as well as totals of all emissions and energy attributed to Contractor B's activities within Facility A. This includes 7,021 t CO_2-e of emissions and 100,013 GJ of energy from diesel, along with emissions and energy quantities from any other activities undertaken by Contractor B.
- The additional information about Contractor B does not change Facility A reported totals for emissions and energy consumption.

9.5 Uncertainty

Uncertainty must be reported for a facility if the direct (Scope 1) emissions from the combustion of an energy type or for a source are 25,000 t CO_2-e or more in a reporting year. For coal mining facilities, this may include fuel combustion emissions and fugitive emissions. Uncertainty is not required to be aggregated to the facility and corporation or group levels.

Part 8.3 of the NGER Measurement Determination sets out how to assess uncertainty where Method 1 is used to estimate Scope 1 emissions. Part 8.4 of the NGER Measurement Determination sets out the requirements for assessing uncertainty where Method 2, 3 or 4 is used to estimate Scope 1 emissions.

See the Reporting uncertainty guideline[26] for more information.

[26] https://cer.gov.au/document_page/reporting-uncertainty-guideline

10. More information and references

More information

For more information, please contact CER:

Email: cer-nger-reporting@cer.gov.au

Phone: 1300 553 542 within Australia

Website: www.cer.gov.au

References

See our NGER Reporting Guides [27] for guidance on:

- defining a facility
- method and measurement criteria guideline
- reporting energy production and consumption
- reporting blended fuels, other fuel mixes, bitumen and explosives guideline
- reporting hydrofluorocarbons and sulphur hexafluoride gases
- petroleum-based oils and greases
- reporting uncertainty.

[27] https://cer.gov.au/schemes/national-greenhouse-and-energy-reporting-scheme/report-emissions-and-energy/nger-reporting-guides