CLEAN DEVELOPMENT MECHANISM

**CDM-MP61-A08**

# Draft Large-scale Consolidated Methodology

# ACM0008: Abatement of methane from coal mines

Version 08.0 - Draft

Sectoral scope(s): 08 and 10



United Nations
Framework Convention on
Climate Change

# COVER NOTE

## 1. Procedural background

1. The Methodologies Panel (Meth Panel), at its 58th meeting, agreed to revise approved methodology ACM0008 "Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation".

## 2. Purpose

2. The revision aims to improve the consistency of the approved methodology with existing standards.

3. The purpose of the call for public input aims to facilitate the work of the Meth Panel on the revision of the methodology taking into account feedback/comments received through wider consultation process.

## 3. Key issues and proposed solutions

4. The draft revision:

(a) Takes into account comments from the United Nations Economic Commission for Europe (UNECE) Group of Experts on Coal Mine Methane (CMM);

(b) Expands the applicability to project activities at abandoned mines;

(c) Simplifies and streamlines the procedure for the baseline scenario identification, baseline emission calculation, project emission calculation, leakage calculation.



## 4. Impacts

5. The revision of the methodology, if approved, will improve its consistency with other standards, expand its applicability and streamline it.

## 5. Proposed work and timelines

6. The Meth Panel, at its 61st meeting, agreed on the draft revision of the methodology. After receiving public inputs on the document, the Meth Panel will continue working on the revision of the approved methodology, at its 62nd meeting, for recommendation to the Board at a future meeting of the Board

## 6. Recommendations to the Board

7. Not applicable (call for public input).

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# 1. Introduction

1. The following table describes the key elements of the methodology:

**Table 1. Methodology key elements**

| | |
|---|---|
| **Typical projects** | Capture and destruction and/or use of coal bed methane, coal mine methane or ventilation air methane from new, existing or abandoned coal mines |
| **Type of GHG emissions mitigation action** | GHG destruction:<br>Destruction of methane emissions and displacement of more-GHG-intensive service |

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. This methodology applies to project activities that aim for methane use and/or destruction, methane that was extracted/obtained from a working or abandoned coal mine.

## 2.2. Applicability

3. This methodology applies to project activities that aim for methane use and/or destruction, methane that was extracted/obtained from a working or abandoned coal mine, where the baseline is the partial or total release of methane and the project activities include any of the following methods to treat the methane captured:

    (a) The methane is destroyed without energy production, for example through flaring;

    (b) The methane is used to produce energy. This may include electricity, heat, vehicle fuel, etc.

4. Emission reductions may or may not be claimed for displacing or avoiding energy from other sources;

5. Methane used in the project activities shall be extracted using the following techniques:

    (a) Surface drainage boreholes to capture coal bed methane (CBM) or methane from open cast mines;

    (b) Underground boreholes in the mine, surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas, to capture coal mine methane (CMM);

    (c) Mine ventilation system to dilute and remove ventilation air methane (VAM);

    (d) Surface drainage boreholes in the case of sealed abandoned mines or ventilation system in the case of ventilated mines to capture abandoned mine methane (AMM).

6. The remaining share of the methane, to be diluted for safety reason, may still be vented.

7. In the case of open cast mines, in addition to conditions listed above, project activities should meet the following requirements:

   (a) The mines should have had a working mining concession for at least three years prior to the start of project;

   (b) Only pre-mining drainage from wells placed within the area to be mined are eligible for crediting;

   (c) For the calculation of emission reductions, all provisions for CBM should be followed for the open cast mine methane.

8. The methodology **does not apply** to project activities with any of the following features:

   (a) Capture/use of virgin coal bed methane, e.g. methane extracted from coal seams without a valid coal mining concession;

   (b) Use $CO_2$ or any other fluid/gas to enhance CBM drainage before mining takes place;

   (c) Methane extraction from abandoned mines that are flooded due to regulation;

9. The methodology does not apply to project activity that involves use and/or destruction of CBM or open cast methane if the baseline scenario identification resulted in partial use and/or destruction of CBM or open cast methane.

10. Emission reductions due to the use and/or destruction of CBM or open cast mine methane cannot be claimed if surface drainage to capture CBM or methane from open cast mines is used within the project boundaries prior to the implementation of the project activity.



### 2.3. Entry into force

11. Not applicable (call for public input).

## 3. Normative references

12. This consolidated baseline and monitoring methodology is based on elements from the following proposed new methodologies:

   (a) “NM0066: Baseline methodology for grid-connected coalmine methane power generation at an active coal mine with existing methane extraction and partial utilization,” submitted by Hegang Coal Industry Group Limited;

   (b) “NM0075: Baseline methodology for coal mine methane (CMM) utilization and destruction at a working coal mine”, prepared by IT Power;

   (c) “NM0093: Baseline methodology for methane utilization and destruction project activities at working coal mines where both coal mine methane (drained from within the mine) and coal bed methane (drained from the surface within the coal mining concession area) is used and/or destroyed”, prepared by Westlake Associates, Ltd and Asian Development Bank;

(d) “NM0094: “Baseline methodology for coal mine methane recovery and utilization at active coal mines”, prepared by Millennium Capital Services, Co.;

(e) “NM0102: Generalised baseline methodology for coal mine methane (CMM) power generation”, prepared by the Prototype Carbon Fund.

13. This methodology also refers to the latest approved version of the following tool(s):

(a) “Combined tool to identify the baseline scenario and demonstrate additionality”;

(b) “Tool to calculate the emission factor for an electricity system”;

(c) “Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion”;

(d) “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”;

(e) The methodological tool “Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period”;

(f) “Tool to determine project emissions from flaring gases containing methane”.

14. For more information regarding the proposed new methodologies and the tools, as well as their consideration by the CDM Executive Board (the Board), please refer to <http://cdm.unfccc.int/goto/MPappmeth>.

### 3.1. Selected approach from paragraph 48 of the CDM modalities and procedures



15. “Existing actual or historical emissions, as applicable”.

## 4. Definitions

16. The definitions contained in the Glossary of CDM terms shall apply.

17. For the purpose of this methodology, the following definitions apply:

(a) **Abandoned mine** - a mine where all mining activity including mine development and coal production have ceased, mine personnel are not present in the mine workings and mine ventilation fans are no longer operative;

(b) **Abandoned mine methane (AMM) –** methane emitted from an abandoned mine;

(c) **Area of coal to be mined** - the area(s) lying within the planned limit of the surface mine containing coal reserves that are blocked out for mining in a surface mine plan, and is contractually secured for mining. In underground mining, the area of coal to be mined can be characterized by the existence of one or more longwall panels;

(d) **Coal bed methane (CBM)** – a generic term for the methane-rich gas naturally occurring in coal seams typically comprising 80 per cent to 95 per cent methane with lower proportions of ethane, propane, nitrogen, and carbon dioxide;

(e) **Coal mine methane (CMM) –** methane component of gases captured at a working coal mine by underground methane drainage techniques. Any gas captured underground, whether drained in advance of or after mining, and any gas drained from surface goaf wells is included in this definition;

(f) **Flameless oxidation** - technology for flameless destruction of methane with or without utilization of thermal energy and/or with or without a catalyst;

(g) **Goaf** - broken, permeable ground where coal has been extracted by longwall coal mining and the roof has been allowed to collapse, thus fracturing and de-stressing strata above and, to a lesser extent, below the seam being worked;

(h) **Mining activities -** working of an area, or panel, of coal that has been developed and equipped to facilitate coal extraction and is shown on a mining plan;

(i) **Methane** - for this methodology it is referred as the gas extracted because of mining activities and fell into the one of the following categories:

(i) Coal bed methane (CBM);

(ii) Coal mine methane (CMM);

(iii) Ventilation air methane (VAM);

(iv) Abandoned mine methane (AMM);

(j) **Pre-drainage (pre-mine drainage)** – extraction of CMM from coal ahead of mining;

(k) **Post-drainage (post-mine drainage)** – extraction of CMM released as a consequence of mining;



(l) **Reference conditions** - reference conditions are defined as $0^oC$ (273.15 K, 32ºF) and 1 atm (101.325 kN/m2, 101.325 kPa, 14.69 psia, 29.92 in Hg, 760 torr);

(m) **Ventilation air methane (VAM) –** methane emitted from coal seams that enters the ventilation air and is exhausted from the ventilation shaft at a low concentration, typically in the range of 0.1 per cent to 1.0 per ceny by volume.

# 5. Baseline methodology

## 5.1. Project boundary

18. The spatial extent of the project boundary comprises:

(a) The coal mine from where the methane is extracted;

(b) All equipment installed and used for the extraction, compression, and storage of methane and transport to an off-site user;[1]

(c) Facilities that are installed and used as part of the project activity for flaring, flameless oxidation, captive power and heat generation;

(d) Power plants connected to the electricity grid, where the project activity exports power to the grid, as per the definition of project electricity system and connected

[1] If equipment existed in the baseline the project participant shall include it and explain the effect of this inclusion in the investment analysis of the project activity and in the baseline calculations.

electricity system given in the latest version of the “Tool to calculate the emission factor for an electricity system”.

19. Table 2 illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

**Table 2. Emission sources included in or excluded from the project boundary**

| **Source** | | **Gas** | **Included** | **Justification/Explanation** |
|---|---|---|---|---|
| **Baseline** | Methane emissions as a result of venting | $CH_4$ | Yes | Main emission source. However, certain sources of methane may not be included, as noted in the applicability conditions.<br><br>Recovery of methane from coal seams will be taken into account only when the particular seams are mined through or disturbed by the mining activity |
| | Emissions from destruction of methane in the baseline | $CO_2$ | Yes | Considers any flaring or energy use in the baseline scenario |
| | | $CH_4$ | No | Excluded for simplification |
| | | $N_2O$ | No | Excluded for simplification |
| | Electricity generation (electricity provided to the grid and/or to the captive user), heat and vehicle fuel use | $CO_2$ | Yes | Only included if the project activity is to replace electricity from the grid, heat generation and vehicle fuel use |
| | | $CH_4$ | No | Excluded for simplification |
| | | $N_2O$ | No | Excluded for simplification |
| **Project activity** | Emissions of methane as a result of continued venting | $CH_4$ | No | Only the change in CMM/CBM/VAM emissions release will be taken into account, by monitoring the methane used or destroyed by the project activity |
| | On-site fuel consumption due to the project activity, including transport of the gas | $CO_2$ | Yes | If additional equipment such as compressors or fans are required on top of what is required for purely drainage, energy consumption from such equipment should be accounted for |
| | | $CH_4$ | No | Excluded for simplification. This emission source is assumed to be very small |
| | | $N_2O$ | No | Excluded for simplification. This emission source is assumed to be very small |
| | Emissions from methane destruction | $CO_2$ | Yes | From the combustion of methane in a flare, flameless oxidation, or heat/power generation |

| Source | | Gas | Included | Justification/Explanation |
|---|---|---|---|---|
| | Emissions of unburned methane | $CH_4$ | Yes | Small amounts of methane will be vented because of maintenances or safety reason or released accidentally |
| | Fugitive methane emissions from on-site equipment | $CH_4$ | No | Excluded for simplification. This emission source is assumed to be very small |

### 5.1.1. Identification of the baseline scenario and demonstration of additionality

20. Project participants shall apply the latest approved version of the “Combined tool to identify the baseline scenario and demonstrate additionality” with the following additional guidance to identify the baseline scenario:

### 5.1.2. Guidance for the identification of alternatives

21. The baseline scenario alternatives should include all technically feasible options to handle methane to comply with safety regulations. These alternatives may include, inter alia:

    (a) Extraction of methane prior to the mining (CBM/open cast);

    (b) Extraction of methane during and after the mining (CMM);

    (c) Extraction of methane through ventilation during the mining;

    (d) Extraction of methane from the abandoned mine;

    (e) Possible combinations of options (a) to (d) with the relative shares of gas specified.



22. The baseline scenario alternatives should include all technically feasible options to deal with methane. These options could include:

    (a) Venting of methane;

    (b) Flaring of methane;

    (c) Use of methane for energy production, e.g. electricity generation, heat generation, vehicle fuel, etc.

    (d) Possible combinations of options (a) to (c) with the relative shares of gas specified.

23. On the basis of the options that are technically feasible and comply with all requirements, project participants should construct coherent and comprehensive baseline scenario alternative(s). One of these alternative(s) shall be the CDM project activity not being registered as a CDM project.

24. The baseline scenario alternatives should clearly identify what share or volumes of potential methane would be managed according to the different technology options, and what share or volumes of methane would be used for which end-uses, where appropriate (including flaring and flameless oxidation if applicable). The baseline

scenario alternatives should also identify whether the power used at the coal mine would be from the grid, captive power, or a combination of the two.

## 5.2. Baseline emissions

25. Baseline emissions would have occurred because:

(a) Methane eligible for crediting would have been either destroyed or vented in a baseline, and

(b) Useful energy that is produced due to the project activity would have been produced using baseline technologies and fuels.

26. Baseline emissions are determined in two steps:

(a) Step A. Determination of methane eligible for crediting;

(b) Step B. Determination of baseline emissions. The following sources are applicable:

(i) Emissions from the destruction[2] of methane;

(ii) Emissions from the release of methane into the atmosphere;

(iii) Emissions from the production of power, heat or other forms of energy.

### 5.2.1. Step A. Determination of methane eligible for crediting



27. All captured methane within the project boundaries shall be directly monitored as part of the project activity. The amount of methane that would be captured and used in the baseline shall be defined either as an absolute amount, or as a share of the amount captured in the project activity. In each case, these assumptions must be justified by the project participants.

### 5.2.2. The eligible methane from open cast mines shall be determined using provisions for CBM

#### 5.2.2.1. Eligible CMM

28. All captured CMM is eligible for crediting.

#### 5.2.2.2. Eligible VAM

29. All captured VAM is eligible for crediting.

#### 5.2.2.3. Eligible CBM including methane from open cast mines

30. Captured CBM is only considered eligible for crediting once it would have been emitted in the baseline scenario. The approach to quantify the eligible CBM is to identify the zone of influence of CBM wells, and when these are impacted by mining activities.

[2] Burning or oxidation.

#### 5.2.2.3.1. Identify relevant wells

31. The first step is to identify the drilling plan and the wells that will be intersected by mining and are within an existing valid coal mining concession.

32. The location of CBM wells in relation to the mine concession area and mining plan during the initial crediting period is estimated using the latest mine plan information, and a map should be included in the CDM-PDD. Indicative mining maps showing relevant CBM wells and their zones of influence is shown in Figures 1 and 2, with the area of coal to be mined shaded in blue. Figure 1 depicts an underground coal mine plan and the pre-mine drainage boreholes, while Figure 2 depicts a surface coal mine and its pre-mine drainage boreholes.

Note: Wells that extract virgin coal bed methane, i.e. from areas that will not be mined and are in an area for which no existing valid coal mining concession exists, are out of the boundary of both the baseline and the project. Any activity intending to extract and use such virgin coal bed methane should refer to another methodology.

**Figure 1** **Indicative figure showing underground mining plan, relevant CBM wells and their zones of influence**

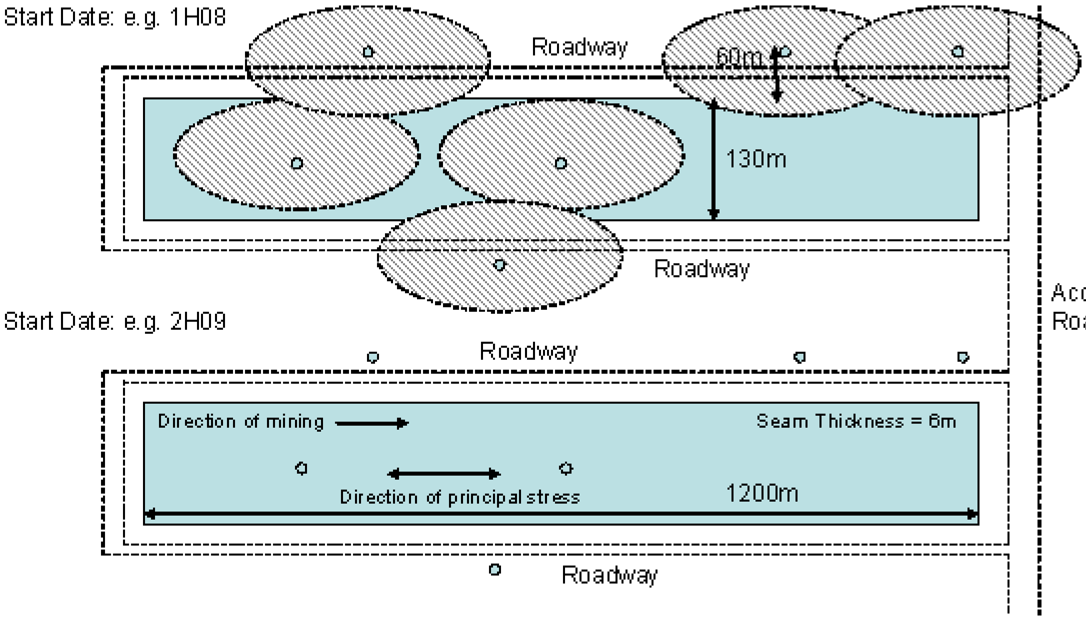
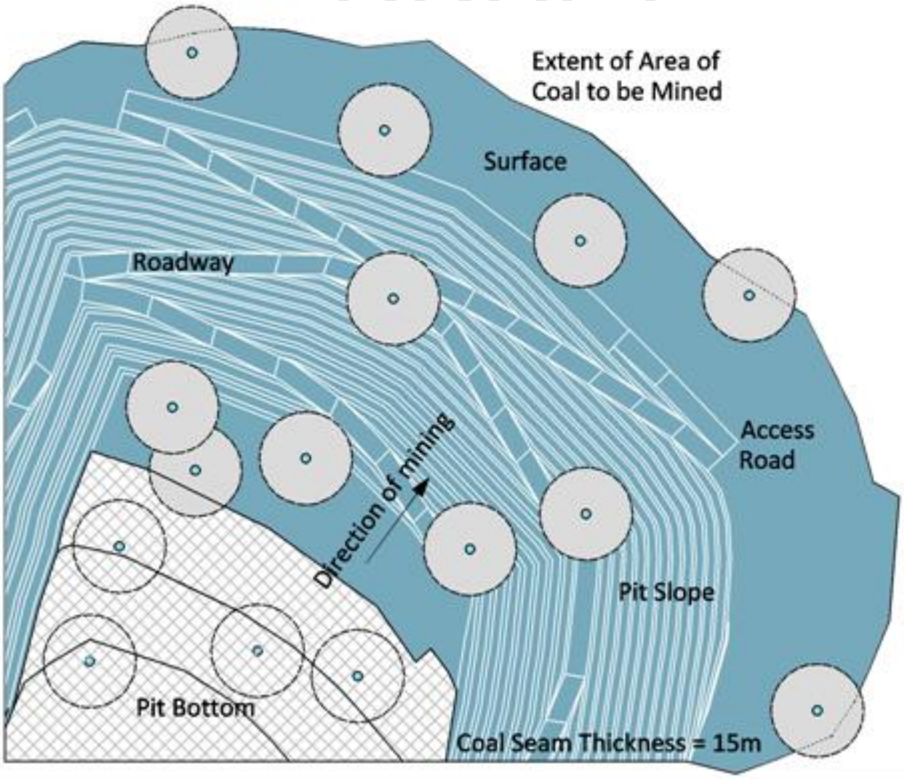



**Figure 2.** **Indicative figure showing surface mining plan, relevant CBM wells and their zones of influence**





### 5.2.2.3.2. Estimation of the Zone of Influence of a CBM Well and eligible methane

33. This procedure estimates the overlap between a cylindrical gas drainage zone around a production well with the zone of disturbance around an area of coal to be mined, from which gas is emitted.

34. A generalised zone or radius of influence, *R*, for a particular well can be estimated at any time during the pre-drainage process based on either:

(a) On the cumulative flow measured at the well $V_{w;}$ or

(b) On the total cumulative gas drained from all the wells measured at the centralised monitoring station $V_c$.

35. Idealised uniform degassing is assumed within a cylindrical zone centred on the borehole and a constant production flow.

36. Radius of influence based on the cumulative flow at an individual well should be determined as follows:

$$R = \left(\frac{V_w}{\pi \times T \times \rho_{coal} \times g_{coal}}\right)^{0.5} \quad \text{Equation (1)}$$

Where:

| | | |
|---|---|---|
| $R$ | = | Cumulative radius of zone of influence (m) |
| $V_w$ | = | Cumulative flow measured at an individual well ($m^3$) |
| $T$ | = | Total thickness of coal in section accessed by well (m) |
| $\rho_{coal}$ | = | Density of locally mined coal ($t/m^3$) |
| $g_{coal}$ | = | Gas content of the coal ($m^3$ $CH_4$/t) |
| $w$ | = | CBM well that will be intersected by mining |



37. Radius of influence based on the cumulative flow from a number of wells should be determined as follows:

$$R = \left(n \times \frac{V_a}{(\pi \times T \times \rho_{coal} \times g_{coal})}\right)^{0.5} \quad \text{Equation (2)}$$

Where:

| | | |
|---|---|---|
| $R$ | = | Cumulative radius of zone of influence (m) |
| $n$ | = | Number of days the selected well is operational |
| $V_a$ | = | Average flow per day across all wells ($m^3$/d) |
| $T$ | = | Total thickness of coal in section accessed by well (m) |

| | | |
|---|---|---|
| $\rho_{coal}$ | = | Density of locally mined coal ($t/m^3$) |
| $g_{coal}$ | = | Gas content of the coal ($t\ CH_4/t$) |
| $w$ | = | CBM well that will be intersected by mining |

and

$$V_a = V_c/N = \frac{\sum V_w}{N}$$ Equation (3)

Where:

| | | |
|---|---|---|
| $V_a$ | = | Average flow per day ($m^3/d$) |
| $V_c$ | = | Total cumulative gas drained from all the wells measured at the centralised monitoring station ($m^3$) |
| $V_w$ | = | Cumulative flow measured at an individual well ($m^3$) |
| $N$ | = | Sum of days that all wells have been operational (days) |
| $w$ | = | CBM well that will be intersected by mining |

38. <u>Example</u>: taking the density of coal as 1.4 tonne per $m^3$, the gas in coal to be 12 $m^3$ per tonne, the thickness of the section to be 40 metres and the flow rate to be 2400$m^3$/day, then the radius of zone of influence will increase by 20 m per year. Therefore, if the number pre-drainage years are ‘n’ the corresponding radius of zone of influence will be n x 20 m. The CDM-PDD should elaborate the project specific values for the zone of influence.



#### 5.2.2.3.3. Area of overlap

39. Once the zone of influence for a well in a given year overlaps the area of coal to be mined, then the gas or part of it from the well is considered to be eligible CBM. To estimate portion of CBM that would have been released because of mining activities, a geometric approach in the horizontal plane and the vertical plane is used where the area of overlap between the defined zones of influence for each well and the area of coal to be mined (“*Area of Overlap*”) is used as well as the de-stressing zone above and below the seam to be mined.

40. <u>Horizontal plane</u>: The ratio of the Area of Overlap to the total area of the zones of influence of the wells considered is calculated and used to identify the appropriate share of gas counted as eligible CBM.

$$ES_h = \frac{\sum_w AO_w}{\sum_w AT_w}$$ Equation (4)

Where:

| | | |
|---|---|---|
| $ES_h$ | = | Eligible share of CBM based on the horizontal plane overlap for well *w* (%) |
| $AO_w$ | = | Area of overlap of well w with the area of coal to be mined ($m^2$) |

| | | |
|---|---|---|
| $AT_w$ | = | Total zone of influence of well *w* ($m^2$) |
| $w$ | = | CBM well that will be intersected by mining |

41. Vertical plane: The de-stressing zone typically extends upwards 140 m and downwards 40 metres. If cased boreholes are used and the seams are fractured within the de-stressing zone, then all the gas entering the CBM well is gas that would have appeared as methane in ventilation air and CMM during and after mining. If other seams outside of the de-stressed zone are fractured, then this gas must be excluded from the eligible CBM. The eligible share is defined as follows:

$$ES_v = \frac{t}{T} \qquad \text{Equation (5)}$$

Where:

| | | |
|---|---|---|
| $ES_v$ | = | Eligible share of CBM based on the vertical plane overlap for well *w* (%) |
| $t$ | = | Thickness of coal which lies within the longwall emission zone (m) |
| $T$ | = | Total thickness of coal in section accessed by well (m) |

42. The value for $ES_v$ would be 1 for cased boreholes where fraccing is only done in the seams of relevance. A mine cross section should be included in the PDD together and supporting documentation on the well drilling process should be supplied to the DOE to justify the ratio of *t/T*.



43. Summarising the eligible contribution of CBM in the horizontal and vertical planes gives the final ratio of eligible CBM:

$$ES_{t,w} = ES_h \times ES_v \qquad \text{Equation (6)}$$

Where:

| | | |
|---|---|---|
| $ES_{t,w}$ | = | Total eligible share of CBM for each well *w* (%) |
| $ES_h$ | = | Eligible share of CBM based on the horizontal plane overlap for well *w* (%) |
| $ES_v$ | = | Eligible share of CBM based on the vertical plane overlap for well *w* (%) |

44. If any CBM wells that were planned to be intersected by mining, or their zones of influence overlap with mining, are not reached by the mining activities, then corresponding methane extracted should not be taken into account in the emission reduction calculation.

#### 5.2.2.3.4. $CO_2$ emissions from use or destruction of CBM

45. Although only the eligible CBM should be accounted for to calculate the baseline emissions in year *y,* the total amount of the $CO_2e$ resulting from the use or the

destruction of all the CBM extracted should be included in project emissions in the year these emissions occur.

46. The CDM-PDD should contain the relevant project specific data in order to calculate an ex ante estimate of the above.

#### 5.2.2.3.5. Adjustments for baseline emissions

47. No emission reductions from CBM destruction can be claimed until the mining activity enters the zone of influence of the well. At that time the emission reductions from the share of aggregate eligible pre-drainage methane can be claimed. Amount of CBM that is eligible in year y is calculated using the following procedure:

48. For a well where mining reaches the zone of influence in year *y* the amount of eligible CBM is determined as a sum of annual amounts of CBM captured from a well from the first year of the crediting period to the year *y*.

$$CBM_{e,y} = \sum_{z} \sum_{d}^{y} (V_{z,d} \times ES_{t,w}) \qquad \text{Equation (7)}$$

Where:

| | | |
|---|---|---|
| $CBM_{e,y}$ | = | Eligible CBM captured from wells where mining has reached the zone of influence in year *y* (t $CH_4$) |
| $ES_{t,w}$ | = | Total eligible share of CBM for each well *w* (%) |
| $V_{z,d}$ | = | Amount of CBM captured from well $z$ in year *d* (t $CH_4$) |
| $z$ | = | CBM well where mining reached the zone of influence in year *y* |
| $d$ | = | Year of crediting period, starting from the first |



49. Example: at a mine in which five CBM wells had been drilled, if mining entered the zone of influence of all five wells in year 4, then in years 1 to 3 the eligible CBM would be zero. In year 4 it would be the cumulative volume for the previous three years plus the volume extracted in year 4.

50. The total eligible amount of CBM that can be claimed from one single CBM well is aggregated amount of methane captured from the CBM well from the first year the well is operated till the moment it is mined through. Once a CBM well has been mined through at an underground mine, then the well acts in the same manner as conventional underground post-drainage of CMM and therefore all of the methane that is drained through this type of well is eligible, irrespective of whether the well is drilled off-centre to the longwall panel and some of the area of influence is outside the area of the longwall panel.

#### 5.2.2.4. Eligible AMM

51. The amount of methane extracted by the project activity from the abandoned mine is different from that which would have been released in the absence of the project. Methane emissions from abandoned mines without any extraction activities fit a

hyperbolic model of decline.[3] To determine the amount of AMM that would have been released in the baseline a modelling approach is to be used. The following procedure shall be applied:

#### 5.2.2.4.1. Determine the baseline amount of AMM

52. The amount of AMM that would have been released in a year in the absence of the project activity should be determined using the equation below.

$$AMM_{DC,y} = AMM_s \times \rho \times 365 \times (1 + b \times D_i \times t)^{-\frac{1}{b}}$$ Equation (8)

Where:

| | | |
|---|---|---|
| $AMM_{DC,y}$ | = | The amount of AMM that would have been released in the absence of the project activity (t $CH_4$) |
| $AMM_s$ | = | The daily flow rate of methane from abandoned mine after closure ($m^3$/day) |
| $S$ | = | The ratio of fully venting flow for a sealed mine |
| $b$ | = | The hyperbolic exponent |
| $D_i$ | = | The initial decline rate (1/yr) |
| $t$ | = | Time elapsed from the date of abandonment (years) |
| $\rho$ | = | Density of methane. Set as 0.67 (t/$m^3$) |



#### 5.2.2.4.2. Determine the hyperbolic exponent and the initial decline rate

53. The hyperbolic exponent (*b*) and the initial decline rate (*$D_i$*) should be determined either by using option I - measured rate data, or by option II - country specific data. Option I is the preferred approach. If measured data is not available then coefficients taken from a coal basin or coal rank specific model should be used.

**(a) Option I**

54. Derive hyperbolic emission rate decline curve coefficients using measured data.

55. The monitored data should be used to develop a correlation between barometric pressure and methane emission flow rate. Annual average barometric pressure at the site should then be used to estimate the annual average emission flow rate. This flow rate should then be plotted against the time since mine closure in years in order to derive the hyperbolic emission rate decline curves by fitting the data to a curve in the form of equation (8) above.

**(b) Option II**

56. Obtain hyperbolic decline curve coefficients from published data sources such as information used during the development of the national greenhouse gas inventory for the project's country of origin. Project developers are required to use coal basin specific

[3] <http://www.epa.gov/cmop/docs/amm_final_report.pdf> Section 4.2.

decline curves, unless there is only one representative coal basin in a particular country. In this case, a country specific decline curve is sufficient.

##### 5.2.2.4.3. Determine the amount of AMM eligible for crediting

57. The amount of AMM that is eligible for crediting during the crediting year should be determined as a minimum value between the aggregated amount of AMM that is captured by the project activity and the aggregated amount of AMM that would have been released in the absence of the project activity from the first year of the crediting period. The amount of AMM that is eligible from the first year of the crediting period till the year y-1 and has been claimed in the previous monitoring period shall be subtracted from the total.

$$AMM_y = min\left\{\sum_i \sum_1^y AMM_{PJ,i,y}, \sum_1^y AMM_{DC,y}\right\} - \sum_1^{y-1} AMM_y$$ Equation (9)

Where:

| | | |
|---|---|---|
| $AMM_y$ | = | The amount of AMM that is eligible for crediting during the crediting year *y* (t $CH_4$) |
| $AMM_{PJ,i,y}$ | = | AMM captured, sent to and destroyed by use *i* in the project activity in year *y* (t $CH_4$) |
| $AMM_{DC,y}$ | = | The amount of AMM that would have been released in the absence of the project activity (t $CH_4$) |



#### 5.2.3. Step B. Determination of baseline emissions

58. Baseline emissions would have occurred due to methane destruction, methane venting and use of other fossil fuels that are displaced by methane under the project activity. Baseline emissions due to venting should be discounted in case host country has regulations in place that are restricting the release of methane into the atmosphere.

$$BE_y = BE_{MD,y} + BE_{MR,y} + BE_{Use,y}$$ Equation (10)

Where:

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions in year *y* (t $CO_2$e) |
| $BE_{MD,y}$ | = | Baseline emissions from destruction of methane in the baseline scenario in year *y* (t $CO_2$e) |
| $BE_{MR,y}$ | = | Baseline emissions from release of methane into the atmosphere in year *y* that is avoided by the project activity (t $CO_2$e) |
| $BE_{Use,y}$ | = | Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year *y* (t $CO_2$e) |

#### 5.2.3.1. Methane destruction in the baseline

59. Depending on the baseline scenario, part of methane may be destroyed through flaring, flameless oxidation, power generation, heat generation, supply to gas grid to various combustion end uses. Baseline emissions should account for the $CO_2$ emissions resulting from the destruction of that methane.

$$BE_{MD,y} = CEF_{CH4} \times \sum_{i}\sum_{s} MT_{BL,s,i,y} \qquad \text{Equation (11)}$$

Where:

| | | |
|---|---|---|
| $BE_{MD,y}$ | = | Baseline emissions from destruction of methane in the baseline scenario in year *y* ($tCO_2e$) |
| $i$ | = | Use of methane (flaring, power generation, heat generation, supply to gas grid to various combustion end uses) |
| $s$ | = | Source of methane that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y.* This may include eligible CBM, CMM, VAM, eligible AMM and eligible open cast methane |
| $MT_{BL,s,i,y}$ | = | Methane from source s that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y* (t $CH_4$) |
| $CEF_{CH4}$ | = | Carbon emission factor for combusted methane. Set as 2.75 (t $CO_2e$/t $CH_4$) |



60. The amount of methane that would has been used (i.e. flaring, power generation, heat generation, etc.) during the crediting period(s) shall be identified either as an absolute amount, or as a share of the amount captured in the project activity. In each case, these assumptions must be justified by the project participants.

#### 5.2.3.2. Methane venting in the baseline

61. The amount of methane that would have been emitted to the atmosphere in the baseline scenario shall be determined as follows:

$$BE_{MRy} = \sum_{i}\sum_{s}(MT_{PJ,s,i,y} - MT_{BL,s,i,y}) \times GWP_{CH4} \qquad \text{Equation (12)}$$

Where:

| | | |
|---|---|---|
| $BE_{MRy}$ | = | Baseline emissions from release of methane into the atmosphere in year *y* that is avoided by the project activity (t $CO_2e$) |
| $MT_{PJ,s,i,y}$ | = | Methane from source s captured, sent to and destroyed by use *i* in the project activity in year *y* (t $CH_4$) |
| $MT_{BL,s,i,y}$ | = | Methane from source s that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y* (t $CH_4$) |

| | | |
|---|---|---|
| $i$ | = | Use of methane (flaring, power generation, etc.) |
| $s$ | = | Source of methane that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y.* This may include eligible CBM, CMM, VAM, eligible AMM and eligible open cast methane |
| $GWP_{CH4}$ | = | Global warming potential of methane (t $CO_2$e/t $CH_4$) |

62. The methane that would have been captured, sent to and destroyed by use *i* in the baseline scenario shall not be less than a maximum average annual amount of methane that have been captured, sent to and destroyed over the three historical years prior to the implementation of the project activity.

63. The methane that is vented in the project scenario is not accounted in the project emissions or in the baseline emissions, since it is vented in both scenarios.

#### 5.2.3.3. Baseline emissions from various end use energy types displaced by project

64. The baseline emissions from displacement of power/heat generation and vehicle fuels are given by the following equation:

$$BE_{Use,y} = \sum_{k} (EG_{use,k,y} \times EF_{k,y})$$ Equation (13)



Where:

| | | |
|---|---|---|
| $BE_{Use,y}$ | = | Baseline emissions from energy displaced by the project activity in year *y* (t $CO_2$) |
| $EG_{use,k,y}$ | = | Energy of type *k* displaced by the project activity in year *y* (energy unit) |
| $EF_{k,y}$ | = | Baseline emissions factor for energy type k production in year *y* (t $CO_2$/energy unit) |
| $k$ | = | Energy type displaced by the project activity |

### 5.2.4. Baseline emissions factor for energy type *k*

#### 5.2.4.1. Power generation

65. If the baseline scenario includes power generation that would be replaced by the project activity, the emission factor for displaced electricity is calculated as per the latest version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.

#### 5.2.4.2. Heat generation emissions factor

66. If the baseline scenario includes heat generation (either existing or new) that is replaced by the project activity, the emissions factor for displaced heat generation is calculated as follows:

$$EF_{H,y} = EF_{co2,r,y} \times \eta_{H,y}$$ Equation (14)

With:

$$\eta_{H,y} = \frac{\eta_{H,PJ,y}}{\eta_{H,BL,y}}$$ Equation (15)

Where:

| | | |
|---|---|---|
| $EF_{H,y}$ | = | $CO_2$ emission factor of heat generation unit in year *y* (t $CO_2$/GJ) |
| $EF_{co2,r,y}$ | = | Average $CO_2$ emission factor of fuel type *r* used in heat generation unit in year *y* (t $CO_2$/GJ) |
| $\eta_{H,y}$ | = | Efficiency ratio of heat generation unit in year *y* (ratio) |
| $\eta_{H,PJ,y}$ | = | Average net efficiency of the project heat generation unit in year *y* (ratio) |
| $\eta_{H,BL,y}$ | = | Average net efficiency of the baseline heat generation unit in year *y* (ratio) |
| *r* | = | Fuel used in a heat generation unit in year *y* |

67. To estimate baseline heat generation efficiency, project participants may choose between the following two options:

(a) Apply the latest version of the “Tool to determine the baseline efficiency of thermal or electric energy generation systems”;

(b) Assume a boiler efficiency of 100 per cent;

(c) As a conservative approach.



### 5.2.4.3. Vehicle fuel use emissions factor

68. If the baseline scenario includes vehicle operation that will be fuelled by methane produced by the project activity, the emission factor for displaced vehicle fuel use is calculated as follows:

$$EF_{VE,v,y} = EF_{co2,v,q,y} \times \eta_{VE,y}$$ Equation (16)

Where:

| | | |
|---|---|---|
| $EF_{VE,v,y}$ | = | $CO_2$ emission factor of vehicle *v* in year *y* (t $CO_2$/GJ) |
| $EF_{CO2,v,q,y}$ | = | Average $CO_2$ emission factor of fuel type q used in vehicle *v* in year *y* (t $CO_2$/GJ) |
| $\eta_{VE,y}$ | = | Efficiency ratio of vehicle in year *y* (ratio) |
| *v* | = | Vehicle in year *y* |

69. In case, vehicles would have been fuelled by the compressed natural gas in the baseline, the efficiency ratio ($\eta_{VE,y}$) is assumed to be one. Otherwise it is assumed that efficiency losses due to switch from gasoline to methane is about ten per cent and therefore the efficiency ratio ($\eta_{VE,y}$) is assumed to be 0.9.

## 5.3. Project emissions

70. Project emissions comprise the following sources:

(a) Emissions from the energy use to capture and use methane;

(b) Emissions from destruction of captured methane through production of various energy types and/or flaring and/or flameless oxidation;

(c) Emissions from the un-combusted methane.

71. Project emissions are defined by the following equation:

$$PE_y = PE_{ME,y} + PE_{MD,y} + PE_{UM,y}$$ Equation (17)

Where:

| | | |
|---|---|---|
| $PE_y$ | = | Project emissions in year *y* (t $CO_2$e) |
| $PE_{ME,y}$ | = | Project emissions from energy use to capture and use methane (t $CO_2$e) |
| $PE_{MD,y}$ | = | Project emissions from destruction of captured methane (t $CO_2$e) |
| $PE_{UM,y}$ | = | Project emissions from un-combusted methane (t $CO_2$e) |



### 5.3.1. Project emissions from the energy use to capture and to use methane

#### 5.3.1.1. Additional energy may be used due to the project activity (e.g. for the capture, transport, compression and use or destruction of methane). Emissions from this energy use should be accounted as project emissions:

(a) Emissions due to electricity consumption should be determined using the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" should be used;

(b) Emissions due to additional fossil fuel consumption, including heat consumption should be determined the latest version of the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" shall be used.

### 5.3.2. Project emissions from destruction of captured methane

72. When the captured methane is burned in a flare, power plant, or oxidized in a flameless oxidation unit, combustion emissions are released.

$$PE_{MD,y} = \sum_i MD_{i,y} \times CEF_{CH4}$$ Equation (18)

Where:

| | | |
|---|---|---|
| $PE_{MD}$ | = | Project emissions from methane destroyed (t $CO_2e$) |
| $MD_{i,y}$ | = | Methane destroyed through use *i* (t $CH_4$) |
| *i* | = | Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses) |
| $CEF_{CH4}$ | = | Carbon emission factor for combusted methane. Set as 2.75 (t $CO_2$/t $CH_4$) |

73. In each end-use, the amount of methane destroyed depends on the efficiency of combustion of each end use and should be determined as follows.

$$MD_{i,y} = MM_{i,y} \times Eff_{i,y}$$ Equation (19)

Where:

| | | |
|---|---|---|
| $MD_{i,y}$ | = | Methane destroyed through use *i* in year *y* (t $CH_4$) |
| $MM_{i,y}$ | = | Methane measured sent to use *i* in year *y* (t $CH_4$) |
| $Eff_{i,y}$ | = | Efficiency of methane destruction in use *i* in year *y* (%) |

74. The efficiency of the flameless oxidation process shall be determined as follows:



$$Eff_{OX,y} = 1 - \frac{PC_{CH4,exhaust,y} \times D_{CH4,corr_{exh},y}}{PC_{CH4,VAM,y} \times D_{CH4,corr_{inflow},y}}$$ Equation (20)

Where:

| | | |
|---|---|---|
| $Eff_{OX,y}$ | = | Efficiency of the flameless oxidation process in year *y* (%) |
| $PC_{CH4,exhaust,y}$ | = | Annual average concentration of methane in the VAM exiting the flameless oxidation unit in year *y* ($m^3/m^3$) |
| $D_{CH4,corr_{exh},y}$ | = | Annual average density of methane corrected for pressure and temperature in the exhaust gases corrected to reference conditions (t $CH_4/m^3$) |
| $PC_{CH4,VAM,y}$ | = | Annual average concentration of methane in the VAM entering the flameless oxidation unit ($m^3/m^3$) |
| $D_{CH4,corr_{inflow},y}$ | = | Annual average density of methane entering the flameless oxidation unit corrected to reference conditions (t$CH_4/m^3$) |

75. For ex ante projections, the efficiency of destruction of methane in the VAM may be assumed to be 90 per cent.

### 5.3.3. Project emissions from un-combusted methane

76. Not all of the methane sent to the flare, to the flameless oxidizer or used to generate power and heat will be combusted, so a small amount will be released to the atmosphere. These emissions are calculated as follows:

$$PE_{UM,y} = GWP_{CH4} \times \sum_{i} MM_{i,y} \times \left(1 - Eff_{i,y}\right)$$ Equation (21)

Where:

| | | |
|---|---|---|
| $PE_{UM,y}$ | = | Project emissions from un-combusted methane (t $CO_2$e) |
| $GWP_{CH4}$ | = | Global warming potential of methane (t $CO_2$e/t $CH_4$) |
| $i$ | = | Use of methane (power generation, heat generation, supply to gas grid to various combustion end uses) |
| $MM_{i,y}$ | = | Methane measured sent to use *i* in year y (t $CH_4$) |
| $Eff_{i,y}$ | = | Efficiency of methane destruction in use *i* in year *y* (%) |

## 5.4. Leakage

77. Leakage may occur if the project activity prevents methane from being used to meet baseline thermal energy demand, whether as a result of physical constraints on delivery, or price changes.

78. Where regulations require that local thermal demand is met before all other uses this leakage can be ignored.

79. If displacement does occur, the project activity may cause increased emissions outside the project boundary associated with meeting thermal energy demand with coal as a fuel. The leakage shall be accounted if the amount of thermal energy generated using methane is less than average thermal energy demand based on the recent three years records. Leakage shall be calculated as follows:



$$LE_y = \max\left\{0, (TH_{hist} - TH_y) \times EF_{coal}\right\}$$ Equation (22)

Where:

| | | |
|---|---|---|
| $LE_y$ | = | Leakage due to displacement of baseline thermal energy uses of methane in year *y* (t $CO_2$e) |
| $TH_{hist}$ | = | Average historical thermal energy demand (GJ) |
| $TH_y$ | = | Thermal demand met by project activity in year *y* (GJ) |
| $EF_{coal}$ | = | Emission factor of coal (t $CO_2$e/GJ) |

## 5.5. Emission reductions

80. The emission reduction $ER_y$ by the project activity during a given year *y* is the difference between the baseline emissions ($BE_y$) and project emissions ($PE_y$), as follows:

$$ER_y = BE_y - PE_y - LE_y$$ Equation (23)

Where:

| | | |
|---|---|---|
| $ER_y$ | = | Emissions reductions of the project activity during the year *y* (t $CO_2$e) |
| $BE_y$ | = | Baseline emissions during the year *y* (t $CO_2$e) |
| $PE_y$ | = | Project emissions during the year *y* (t $CO_2$e) |
| $LE_y$ | = | Leakage emissions in year *y* (t $CO_2$e) |

81. Note that, because emissions reductions from CBM are only credited when the seam is mined through, there could be cases where CBM drainage commenced before the start of the crediting period.

## 5.6. Changes required for methodology implementation in 2nd and 3rd crediting periods

82. Refer to the tool “Assessment of the validity of the original/current baseline and to update of the baseline at the renewal of the crediting period”.

## 5.7. Project activity under a programme of activities (PoA)

83. In addition to the requirements set out in the latest approved version of the “Standard for demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities”, the following shall be applied for the use of this methodology in a project activity under a programme of activities (PoAs).



84. The PoA may consist of one or several types of CPAs. CPAs are regarded to be of the same type if they are similar with regard to the demonstration of additionality, emission reduction calculations and monitoring. The CME shall describe in the CDM-PoA-DD for each type of CPAs separately:

   (a) Eligibility criteria for CPA inclusion used for each type of CPAs. In case of combination of the types of use of methane in one CPA, the eligibility criteria shall be defined for each type of use of methane separately;

   (b) Emission reduction calculations for each type of CPAs;

   (c) Monitoring provisions for each type of CPAs.

85. The CME shall describe transparently and justify in the CDM-PoA-DD which CPAs are regarded to be of the same type. CPAs are not regarded to be of the same type, if one of the following conditions is different:

   (a) The baseline scenario with regard to the use of the partial amount of methane (i.e. flaring, power generation, etc.) and the rest of methane is vented;

   (b) The project activity with regard to any of the following aspects of the use of methane:

      (i) Consumed on-site to meet heat energy demand;

      (ii) Injected to a gas pipeline;

      (iii) Flared;

(iv) Destructed in the flameless oxidizer;

(v) Used to produce electricity;

(vi) Combination of any above.

86. When defining eligibility criteria for CPA inclusion for a distinct type of CPAs, the CME shall consider relevant technical and economic parameters, such as:

(a) Ranges of overall projected extraction of methane;

(b) Ranges of net calorific value of the methane;

(c) Ranges of capital expenditure for methane infrastructure needed in the relevant scenario, such as gas capturing/destruction facilities, pipelines, etc.;

(d) Ranges of operational expenditure.

87. The eligibility criteria related to costs, revenues and investment climate shall be updated every two years in order to correctly reflect the technical and market circumstances of a CPA implementation.

88. In case the PoA contains several types of CPAs, the actual CPA-DD submitted for the purpose of registration of the PoA shall contain all information required as per the latest approved version of the “Guidelines for completing the component project activity design document form” for each type of actual CPA, to be validated by a DOE and submitted for the registration to the Board.



## 5.8. Data and parameters not monitored

89. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

**Data / Parameter table 1.**

| **Data / Parameter:** | **$TH_{hist}$** |
|---|---|
| Data unit: | GJ |
| Description: | Average historical thermal energy demand |
| Source of data: | - |
| Measurement procedures (if any): | - |
| QA/QC procedures: | - |
| Monitoring frequency: | - |
| Any comment: | Three most recent years prior to the implementation of the project activity shall be used |

**Data / Parameter table 2.**

| **Data / Parameter:** | **$MT_{BL,s,i,y}$** |
|---|---|
| Data unit: | t $CH_4$ |
| Description: | Methane from source s that would have been captured, sent to and destroyed by use *i* in the baseline scenario in the year *y* |

| | |
|---|---|
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | The amount shall be estimated ex ante and presented in the CDM-PDD |

**Data / Parameter table 3.**

| **Data / Parameter:** | **$AMM_s$** |
|---|---|
| Data unit: | $m^3$/day |
| Description: | The daily flow rate of methane from abandoned mine after closure |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 4.**

| **Data / Parameter:** | **b** |
|---|---|
| Data unit: | - |
| Description: | The hyperbolic exponent |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 5.**

| **Data / Parameter:** | **$D_i$** |
|---|---|
| Data unit: | 1/yr |
| Description: | The initial decline rate |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 6.**

| **Data / Parameter:** | $\mathbf{EF_{CO2,n,r,y}}$ |
|---|---|
| Data unit: | t $CO_2$/GJ |
| Description: | Average $CO_2$ emission factor of fuel type *r* used in heat generation unit *n* in year *y* |
| Source of data: | Baseline scenario |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | In case the CDM-PDD does not include exhaustive analysis of baseline alternatives for heat generation that is replaced by project activity or baseline heat generation does not belong to the project participant the baseline emission factor to be used is the emission factor for natural gas. The IPCC default value of 0.0543 t $CO_2$/GJ can be used |

**Data / Parameter table 7.**

| **Data / Parameter:** | $\mathbf{EF_{CO2,v,q,y}}$ |
|---|---|
| Data unit: | t $CO_2$/GJ |
| Description: | Average $CO_2$ emission factor of fuel type *q* used in vehicle *v* in year *y* |
| Source of data: | Baseline scenario |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |



# 6. Monitoring methodology

90. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted with calibrated measurement equipment according to relevant industry standards.

91. In addition, the monitoring provisions in the tools referred to in this methodology apply.

## 6.1. Methane collected and flared

92. The amount of methane actually flared will be determined by monitoring:

(a) The amount of methane gas collected, using a continuous flow meter and monitoring of temperature and pressure;

(b) The parameters used for determining the project emissions from flaring of the residual gas stream ($PE_{flare}$) or flameless oxidation of the VAM stream ($PE_{OX}$)

should be monitored as per the “Tool to determine project emissions from flaring gases containing methane”.

93. To determine the density of methane temperature (T) and pressure (P) are required.

## 6.2. Methane in ventilation air destroyed through flameless oxidation

94. The amount of methane entering the reaction chamber will be determined by monitoring the total inlet flow using a continuous flow meter and monitoring temperature and pressure to determine gas density. The share of VAM that is methane will be measured using a continuous analyser and for mine safety and regulatory reasons this is unlikely to exceed one per cent.

95. Project emissions from a VAM unit will be measured by continuous measurement of methane concentration, pressure and temperature of the exhaust gas stream.

## 6.3. Hyperbolic model of decline for AMM

96. To determine the hyperbolic exponent ($b$) and the initial decline rate ($D_i$) using measured data, two parameters must be monitored after the mine closure: local barometric pressure and mine methane emission flow rates corrected for temperature and pressure.

97. If the project begins operation within one year of the date of mine closure, these parameters should be monitored on an hourly or more frequent basis for the full duration of time between mine closure and project operation. If the project begins operations after one year past the date of mine closure, these parameters should be monitored for at least three periods spaced at least 4 months apart, each period having duration of at least 72 hours. The parameters should be monitored on an hourly or more frequent basis during those periods.



## 6.4. Data and parameters monitored

98. In addition to the parameters listed in the tables below, the provisions on data and parameters monitored in the tools referred to in this methodology apply.

**Data / Parameter table 1.**

| **Data / Parameter:** | $MT_{PJ,s,i,y}$ |
|---|---|
| Data unit: | t $CH_4$ |
| Description: | Methane from source s captured, sent to and destroyed by use *i* in the project activity in year *y* |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Continuous |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 2.**

| **Data / Parameter:** | **$GWP_{CH4}$** |
|---|---|
| Data unit: | t $CO_2$e/t $CH_4$ |
| Description: | Global warming potential of methane |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 3.**

| **Data / Parameter:** | **R** |
|---|---|
| Data unit: | m |
| Description: | Cumulative radius of zone of influence |
| Source of data: | c |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 4.**

| **Data / Parameter:** | **$V_w$** |
|---|---|
| Data unit: | $m^3$ |
| Description: | Cumulative flow measured at an individual well |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | Monitoring at each well should record gas flow, methane concentration, pressure, and temperature |

**Data / Parameter table 5.**

| **Data / Parameter:** | **T** |
|---|---|
| Data unit: | m coal |
| Description: | Thickness of all coal accessed by wells |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |

| | |
|---|---|
| QA/QC procedures: | - |
| Any comment: | Depth of fractures into respective seams and casing used should be recorded at time of drilling |

**Data / Parameter table 6.**

| **Data / Parameter:** | $\rho_{coal}$ |
|---|---|
| Data unit: | $t/m^3$ |
| Description: | Density of locally mined coal |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | At start of each crediting period |
| QA/QC procedures: | - |
| Any comment: | Default value is 1.4 |

**Data / Parameter table 7.**

| **Data / Parameter:** | $g_{coal}$ |
|---|---|
| Data unit: | $m^3CH_4/t$ |
| Description: | Gas content of the coal |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | At start of each crediting period |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 8.**

| **Data / Parameter:** | **n** |
|---|---|
| Data unit: | Days |
| Description: | Number of days the selected well is operational |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 9.**

| **Data / Parameter:** | $V_a$ |
|---|---|
| Data unit: | $m^3/day$ |
| Description: | Average flow per day across all wells |
| Source of data: | - |

| | |
|---|---|
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 10.**

| **Data / Parameter:** | $V_c$ |
|---|---|
| Data unit: | $m^3$/day |
| Description: | Cumulative flow from all wells |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | Total flow from all boreholes measured at collection manifold using automatic remote monitoring of gas flow, methane concentration, pressure and temperature |

**Data / Parameter table 11.**

| **Data / Parameter:** | **N** |
|---|---|
| Data unit: | Days |
| Description: | Sum of days all wells operational |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | - |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 12.**

| **Data / Parameter:** | - |
|---|---|
| Data unit: | Coordinates |
| Description: | Position of wells relative to mining plan |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | Recorded in PDD ex ante. New drawing produced each year |

**Data / Parameter table 13.**

| **Data / Parameter:** | - |
|---|---|
| Data unit: | Coordinates |
| Description: | Well profile |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | Shows each well and zone of influence against latest mining plan |

**Data / Parameter table 14.**

| **Data / Parameter:** | - |
|---|---|
| Data unit: | m |
| Description: | Well depth |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | At time of drilling |
| QA/QC procedures: | - |
| Any comment: | Based on actual drilling records |



**Data / Parameter table 15.**

| **Data / Parameter:** | **T** |
|---|---|
| Data unit: | m |
| Description: | Total thickness of coal in section accessed by well |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | At start of each crediting period |
| QA/QC procedures: | - |
| Any comment: | From geology report and drilling records |

**Data / Parameter table 16.**

| **Data / Parameter:** | **t** |
|---|---|
| Data unit: | m |
| Description: | Thickness of coal which lies within the longwall emission zone |
| Source of data: | - |
| Measurement procedures (if any): | - |

| | |
|---|---|
| Monitoring frequency: | At start of each crediting period |
| QA/QC procedures: | - |
| Any comment: | From geology report and drilling records |

**Data / Parameter table 17.**

| **Data / Parameter:** | **$AO_w$** |
|---|---|
| Data unit: | $m^2$ |
| Description: | Area of overlap with are to be mined |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 18.**

| **Data / Parameter:** | **$AT_w$** |
|---|---|
| Data unit: | $m^2$ |
| Description: | Total zone of influence |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 19.**

| **Data / Parameter:** | **$V_c$** |
|---|---|
| Data unit: | $m^3$ |
| Description: | Total cumulative gas drained from all the wells measured at the centralised monitoring station |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 20.**

| **Data / Parameter:** | **$V_w$** |
|---|---|
| Data unit: | $tCH_4$ |
| Description: | Amount of CBM captured from well *w* in year *y* |

| | |
|---|---|
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 21.**

| **Data / Parameter:** | $\mathbf{V_{z,b}}$ |
|---|---|
| Data unit: | t $CH_4$ |
| Description: | Amount of CBM captured from well *z* in year *b* |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 22.**

| **Data / Parameter:** | $\mathbf{EG_{use,k,y}}$ |
|---|---|
| Data unit: | Energy unit |
| Description: | Energy of type *k* displaced by the project activity in year *y* |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | - |
| Any comment: | - |



**Data / Parameter table 23.**

| **Data / Parameter:** | $\mathbf{TH_y}$ |
|---|---|
| Data unit: | GJ |
| Description: | Thermal demand met by project activity in year *y* |
| Source of data: | - |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | - |
| Any comment: | - |

**Data / Parameter table 24.**

| **Data / Parameter:** | $\mathbf{PE_{UM}}$ |
|---|---|
| Data unit: | t $CO_2$e |
| Description: | Project emissions from un-combusted methane in year *y* |
| Source of data: | Facility records |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | - |
| Any comment: | This parameter includes amount of methane vented in year *y* because of: accidences, dilution for safety reason, releases during maintenances, etc. |

**Data / Parameter table 25.**

| **Data / Parameter:** | $\mathbf{Eff_{i,y}}$ |
|---|---|
| Data unit: | % |
| Description: | Efficiency of methane destruction in use *i* |
| Source of data: | Measurements |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | For the flaring process efficiency shall be determined applying the latest version of the “Tool to determine project emissions from flaring gases containing methane”.<br>For power and heat generation efficiency should be derived from the latest IPCC Report |



**Data / Parameter table 26.**

| **Data / Parameter:** | $\mathbf{EF_{coal}}$ |
|---|---|
| Data unit: | t $CO_2$e/GJ |
| Description: | Emission factor of coal |
| Source of data: | Measurements or default value |
| Measurement procedures (if any): | - |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | IPCC default value of 0.0983 can be used |

**Data / Parameter table 27.**

| **Data / Parameter:** | $\mathbf{\eta_{H,PJ,y}}$ |
|---|---|
| Data unit: | ratio |
| Description: | Average net efficiency of the project heat generation unit in year *y* |

| | |
|---|---|
| Source of data: | On site measurements |
| Measurement procedures (if any): | To estimate project heat generation efficiency, project participants shall apply any of the relevant national/international standards, e.g. ASME PTC-6 or IEC 60953-3, ASME PTC-4 or BS 845 or EN 12952-15 etc., preferably using direct methods |
| Monitoring frequency: | Annually |
| QA/QC procedures: | - |
| Any comment: | - |

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## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| Draft 08.0 | 22 October 2013 | MP 61, Annex 8<br>A call for public input will be issued on this draft revised methodology.<br>Revision to:<br>• Expand the applicability of the methodology to cover abandoned mine;<br>• Simplify and streamline the procedure for the baseline scenario identification, baseline emission calculation, project emission calculation, leakage calculation;<br>• Change the title from “ACM0008: Consolidated methodology for coal bed methane, coal mine methane and ventilation air methane capture and use for power (electrical or motive) and heat and/or destruction through flaring or flameless oxidation" to “ACM0008: Abatement of methane from coal mines”.<br>Due to the overall modification of the document, no highlights of the changes are provided. |
| 07 | 30 July 2010 | EB 55, Annex 12<br>Include open cast mining project activities and the possibility to measure $CMM_{PJ,y}$ and $PMM_{PJ,y}$ together when the common extraction system is located in the underground mine. |
| 06 | 25 March 2009 | EB 46, Annex 7<br>Revision to make provision for benchmark analysis as a part of investment analysis for the projects where no investment is required. |
| 05 | 26 September 2008 | EB 42, Annex 7<br>Revision to clarify that the methodology is applicable to project activities where methane is destructed using flameless oxidation without the use of a catalyst. |
| 04 | 02 November 2007 | EB 35, Annex 7<br>Include project activities that flare ventilation air methane using catalyst oxidation. |
| 03 | 22 December 2006 | EB 28, Annex 10<br>Adoption of methodological tool: “Tool to determine project emissions from flaring gases containing methane”. |

| | | |
|---|---|---|
| 02 | 28 July 2006 | EB 25, Annex 10<br>Insertion of new procedures to estimate efficiency of closed and open flares. |
| 01 | 28 November 2005 | EB 22, Annex 10<br>Initial adoption. |

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