CLEAN DEVELOPMENT MECHANISM

**CDM-MP67-A18**

# Information note

# Simplification of monitoring in methodologies

Version 01.0

United Nations
Framework Convention on
Climate Change

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# 1. Procedural background

1. CMP 9 reiterated its encouragement to the EB, as contained in decision 5/CMP.8, to continue its work on the simplification and streamlining of methodologies, with the aim of reducing transaction costs for all project activities and programmes of activities, especially those in regions underrepresented in the clean development mechanism.

2. The Board at EB 78 agreed to the work on simplification in monitoring in small-scale and large-scale methodologies.

3. The Methodologies Panel (MP) has been working on this mandate since MP64, developing a generic and comprehensive approach to streamline monitoring procedures, prioritising parameters and tools/methodologies where difficulty with monitoring has been reported.

# 2. Purpose

4. This document aims to outline the general method adopted by the MP to analyse the monitoring requirements in tools and methodologies and to present the analysis undertaken for streamlining the requirements for monitoring of:

   (a) Electricity generation/consumption; and

   (b) Biogas concentration/flow.

# 3. Key issues and proposed solutions

## 3.1. Summary of the work conducted

5. The Secretariat and MP agreed on a general method as outlined in Section 3.2 and conducted a research which identified the methodologies. Methodologies with high registration rates but low issuance rates were also considered (see Appendix 1). This work resulted in prioritizing of three groups of parameters:

   (a) Electricity generation and consumption;

   (b) Flow and concentration of Biogas;

   (c) Flow and concentration of Wastewater.

6. MP concluded the first phase of analysis resulting in recommended revisions of:

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

   (b) “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”.

7. The work pertaining to wastewater projects is still on-going. Future work will also include prioritising other parameter types (e.g., quantify of biomass and fossil fuels) for simplifications and streamlining.

### 3.2. Method for analysis

8. Separate analysis was carried out on monitoring parameters of three different project types, i.e., electricity, waste water and biogas. The analysis conducted includes the following generic steps:

   (a) Review and listing of monitoring parameters in the related methodologies including information on:

      (i) Whether monitoring is done *ex post* or *ex ante*;

      (ii) Whether default values have been specified;

      (iii) Guidance on measurement including measuring devices, location of measuring equipment;

      (iv) QA/QC requirements;

      (v) Any monitoring campaign included;

   (b) Review of requirements in other standards for similar monitoring parameters (e.g.. the EU Emissions Trading System (EU ETS), guidelines by U.S. Department of Energy (DOE), Gold standard protocol, Verified Carbon Standard (VCS) standard, standards from California Air Resources Board (ARB), California Climate Action Registry (CAR), California Air Resources Board (ACR) and Australia standard from Carbon Farming Initiative (CFI)) was done;

   (c) Literature search (e.g., those researching existing CDM approaches and proposing alternative ones) was carried out;

   (d) Review of data from CDM registered projects (e.g., monitoring reports) was carried out, to identify opportunities to derive default values, simplifications, reduced monitoring frequency and use of sampling approach.

   (e) Extensive review of post-registration change requests (including accepted and rejected ones) to identify options to reduce burden on the project proponents (PPs) to undertake non-substantial changes to monitoring plans was carried out;

   (f) Review of validation/verification reports including Forward Action Request (FARs)/Corrective Action Request (CARs) to identify possible solutions for frequent difficulties faced by PPs.

### 3.3. Analysis of electricity monitoring

9. The relevant CDM methodologies were identified and reviewed. The list of methodologies and the summary of the information gathered is given in Appendix 2.

10. The following initial observations were made based on the above review:

   (a) There is a scope to improve the consistency of guidance across methodologies about parameters for monitoring of electricity in terms of source of data, measurement procedure, monitoring frequency and QA/QC information;

(b) There is also a need to explore the feasibility to further reduce the number of parameters which are monitored only for CDM purposes, and are not required for the project's regular operation;

(c) Some methodologies require the monitoring of electricity at the household level (e.g. AM0046) and include a specific guidance which may not be suitable to be streamlined with requirements in other methodologies that are not for household applications;

(d) There are methodologies using older monitoring tables that need to be updated to the latest format that provide more detailed guidance (e.g. AM0007);

(e) Electricity consumption or generation in general are project and technology specific, and may not be readily replaced by default values or indirect measurements. These could be suggested only for specific technologies in specific methodologies.

11. Non-CDM standards referred to in paragraph 8(b) above were reviewed to identify if any good practices in electricity monitoring have been indicated. Most of these standards referred don't provide specific guidelines for electricity monitoring. Electricity metering guidelines from a national electricity authority were also reviewed. The findings are detailed in Appendix 3.

12. Review of 113 Post-registration changes (PRCs) relating to electricity monitoring was conducted. Appendix 4 illustrates the findings and depicts the reasons for which PRCs are raised and their frequency. The analysis mostly illustrates the need for consistent and accurate monitoring tables for electricity monitoring, but also shows the need for guidance for missing data.

### 3.4. Recommendations for of electricity monitoring

13. The MP recommends a revision of "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" to include monitoring guidance for parameters, including expansion of the scope to cover emissions from electricity generation.

14. A procedure for cases of missing data due to meter failure or other reasons is recommended in the draft revision of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

15. In case of parameters related to emissions from electricity consumption, following improvements are proposed for future work:

(a) Revision of the methodologies that include guidance related to these parameters (e.g., ACM0001 version 15) to refer the tool and remove the guidance from the methodology. The methodologies listed in in Appendix 2 will be a basis for this work;

(b) To include tiered approach i.e., different stringencies depending on the parameter's significance for the emission reductions calculation (e.g. consumption may be a minor share and generation is more important).

### 3.5. Analysis of biogas monitoring

16. The relevant standards were identified and reviewed. The list of standards and the summary of the information gathered is given in Appendix 5.

17. There is scope to improve the consistency of information and requirements for the same/similar parameters including notation, data unit, description, source of data, measurement procedure, monitoring frequency and QA/QC procedures in methodologies.

18. Comparison of different standards regarding monitoring frequency, operation hours and missing data was done. The comparison data is given in Appendix 6.

19. 51 relevant PRCs have been analysed, identifying four common requests categories:

    (a) Replacement of a meter with a higher accuracy equipment;

    (b) Removal of a redundant meter;

    (c) The total flow equals to the flow to different destruction devices;

    (d) Missing data due to delay in meter installation or its failure.

20. Of these, (a) and (b) are addressed in the Project Standard (PS) and/or methodology. Items 19 (c) and (d) could be further elaborated and streamlined, to address the 9 PRCs which regard these categories out of the identified 51 PRCs.

21. A review of monitored and verified data from CDM projects was used to analyse the feasibility of simplifications in the monitoring requirements of methane content and biogas flow, for short time periods depending on the available data. This exercise was repeated for three sectors:

    (a) For landfills: 238 projects pertaining to ACM0001 Flaring or use of landfill gas (LFG) are registered. For these:

        (i) The consistency of guidance with regard to data handling procedures can be improved;

        (ii) Average of methane content in the LFG vary from 30.1% to 57.2%;

        (iii) Standard deviation of methane contents in the LFG vary from 1.3% to 6.0% of the LFG, which are 2.2% to 19.8% of the average;

        (iv) Standard deviation of the LFG flow varies from 24% to 42% of the average.

    (b) For manure projects: 11 projects pertaining to ACM0010 GHG emission reduction from manure management systems are registered. Only 2 projects have detailed monitoring data. For these:

        (i) The consistency of guidance with regard to data handling procedures can be improved;

        (ii) Average of methane content in the biogas vary from 61.5% to 65.1%;

        (iii) Standard deviation of methane content varies from 0.0% to 2.7% of the biogas, which are 0.0% to 4.4% of the average;

(iv) Standard deviation of biogas flow varies from 17% to 24% of the average.

(c) For wastewater projects: 28 projects pertaining to ACM0014 Large-scale consolidated methodology treatment of wastewater. 3 projects are chosen for data analysis. For these:

(i) The consistency of guidance with regard to data handling procedures can be improved;

(ii) Average of methane content in the biogas vary from 55.45% to 57.1%;

(iii) Standard deviation of methane content varies from 1.3% to 2.7% of the biogas, which are 2.2% to 4.3% of the average;

(iv) Standard deviation of biogas flow varies from 10% to 21% of the average.

### 3.6. Recommendations for biogas monitoring

22. The “Tool to determine the mass flow of a greenhouse gas in a gaseous stream” should be revised to incorporate the following:

(a) Additional guideline for missing data of either flow or methane content;

(b) Additional guideline for allowing reduced number of meters for multiple use of biogas;

(c) Allowing for sampling for methane concentration.

23. Consequently, other standards referring to the tool should be aligned with the tool with respect to for parameter notation, data unit and description and source of data.

# 4. Impacts

24. The work undertaken to streamline monitoring requirements and the draft proposed revision of the standards would reduce monitoring effort for PPs.

# 5. Subsequent work and timelines

25. Further work is envisioned to improve monitoring provisions for additional parameters, besides the on-going work on improving the provisions for wastewater related standards.

# Appendix 1. Research for prioritization of parameter groups

1. The following CDM pipeline analysis was used to identify and prioritize parameter groups which are prone to result in monitoring related difficulties.

**Table. Title [Caption]**

| | Year of approval | Total projects | Under validation / unknown | Registered | Rejected / withdrawn | Issued CER | Registered / total | Issued / total projects | Issued / registered | Actually issued / expected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AM0002 | 2003 | 1 | 0 | 1 | 0 | 1 | 100.00% | 100.00% | 100.00% | 8.13% | withdrawn and consolidated into ACM0001 |
| ACM0016 | 2009 | 18 | 6 | 9 | 3 | 2 | 50.00% | 11.11% | 22.22% | 18.79% | Low rate of actual / expected |
| AM0059 | 2007 | 4 | 0 | 4 | 0 | 1 | 100.00% | 25.00% | 25.00% | 28.31% | Low rate of actual / expected |
| AMS-II.G. | 2008 | 45 | 13 | 32 | 0 | 2 | 71.11% | 4.44% | 6.25% | 28.78% | Low rate of issuance, actual / expected |
| AM0011 | 2004 | 10 | 4 | 6 | 0 | 6 | 60.00% | 60.00% | 100.00% | 28.95% | withdrawn and consolidated into ACM0001 |
| AM0027 | 2005 | 1 | 0 | 1 | 0 | 1 | 100.00% | 100.00% | 100.00% | 29.42% | Low rate of actual / expected |
| ACM0013 | 2007 | 55 | 45 | 6 | 4 | 1 | 10.91% | 1.82% | 16.67% | 30.93% | Low rate of registration, low rate of issuance, actual / expected |
| AM0016 | 2004 | 40 | 0 | 40 | 0 | 39 | 100.00% | 97.50% | 97.50% | 33.13% | withdrawn and consolidated into ACM0010 |
| AM0055 | 2007 | 7 | 2 | 5 | 0 | 3 | 71.43% | 42.86% | 60.00% | 34.19% | |
| AM0010 | 2004 | 2 | 0 | 2 | 0 | 2 | 100.00% | 100.00% | 100.00% | 36.11% | withdrawn and consolidated into ACM0001 |
| AM0031 | 2006 | 15 | 5 | 10 | 0 | 3 | 66.67% | 20.00% | 30.00% | 37.44% | |
| AMS-III.F. | 2002 | 108 | 51 | 56 | 1 | 11 | 51.85% | 10.19% | 19.64% | 39.60% | Low rate of issuance |
| AR-ACM0001 | 2008 | 11 | 4 | 7 | 0 | 2 | 63.64% | 18.18% | 28.57% | 39.80% | withdrawn and consolidated into AR-ACM0003 |
| AMS-II.J. | 2008 | 52 | 15 | 37 | 0 | 4 | 71.15% | 7.69% | 10.81% | 41.19% | Low rate of issuance |
| ACM0003 | 2005 | 48 | 14 | 33 | 1 | 9 | 68.75% | 18.75% | 27.27% | 45.37% | |
| AM0018 | 2004 | 19 | 8 | 11 | 0 | 7 | 57.89% | 36.84% | 63.64% | 46.10% | |
| AM0014 | 2004 | 19 | 13 | 6 | 0 | 3 | 31.58% | 15.79% | 50.00% | 48.07% | |
| ACM0018 | 2010 | 82 | 26 | 55 | 1 | 2 | 67.07% | 2.44% | 3.64% | 49.44% | Spun off from ACM0006, Low rate of issuance |

| | Year of approval | Total projects | Under validation / unknown | Registered | Rejected / withdrawn | Issued CER | Registered / total | Issued / total projects | Issued / registered | Actually issued / expected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AM0033 | 2006 | 6 | 1 | 5 | 0 | 2 | 83.33% | 33.33% | 40.00% | 49.79% | withdrawn (similar to ACM0015) |
| AM0013 | 2004 | 16 | 8 | 8 | 0 | 6 | 50.00% | 37.50% | 75.00% | 50.57% | withdrawn and consolidated into ACM0014 |
| AMS-III.D. | 2002 | 323 | 135 | 181 | 7 | 51 | 56.04% | 15.79% | 28.18% | 52.06% | |
| AR-AMS0001 | 2005 | 29 | 12 | 17 | 0 | 4 | 58.62% | 13.79% | 23.53% | 52.44% | withdrawn and consolidated into AR-AMS0007 |
| ACM0001 | 2004 | 364 | 132 | 226 | 6 | 99 | 62.09% | 27.20% | 43.81% | 52.76% | |
| AM0006 | 2004 | 9 | 4 | 4 | 1 | 2 | 44.44% | 22.22% | 50.00% | 53.45% | withdrawn and consolidated into ACM0010 |
| AM0072 | 2008 | 2 | 0 | 2 | 0 | 1 | 100.00% | 50.00% | 50.00% | 54.69% | |
| AM0003 | 2004 | 4 | 0 | 4 | 0 | 3 | 100.00% | 75.00% | 75.00% | 57.87% | withdrawn and consolidated into ACM0001 |
| AM0058 | 2007 | 18 | 7 | 11 | 0 | 4 | 61.11% | 22.22% | 36.36% | 59.20% | |
| ACM0008 | 2005 | 174 | 85 | 83 | 6 | 36 | 47.70% | 20.69% | 43.37% | 59.95% | |
| AM0029 | 2006 | 111 | 53 | 54 | 4 | 28 | 48.65% | 25.23% | 51.85% | 61.03% | |
| AM0078 | 2009 | 4 | 0 | 4 | 0 | 2 | 100.00% | 50.00% | 50.00% | 61.34% | |
| ACM0005 | 2005 | 76 | 50 | 16 | 10 | 10 | 21.05% | 13.16% | 62.50% | 62.09% | |
| AMS-I.C. | 2002 | 700 | 378 | 303 | 19 | 79 | 43.29% | 11.29% | 26.07% | 62.91% | |
| ACM0012 | 2007 | 424 | 262 | 136 | 26 | 44 | 32.08% | 10.38% | 32.35% | 62.94% | |
| AM0004 | 2004 | 2 | 0 | 2 | 0 | 2 | 100.00% | 100.00% | 100.00% | 66.06% | withdrawn (similar to ACM0006) |
| AMS-III.H. | 2006 | 398 | 153 | 235 | 10 | 69 | 59.05% | 17.34% | 29.36% | 66.58% | |
| AMS-III.Q. | 2007 | 141 | 93 | 41 | 7 | 7 | 29.08% | 4.96% | 17.07% | 67.01% | Low rate of issuance |
| AM0025 | 2005 | 142 | 72 | 66 | 4 | 10 | 46.48% | 7.04% | 15.15% | 67.92% | withdrawn and consolidated into ACM0022, low rate of issuance |
| AMS-II.B. | 2002 | 28 | 16 | 11 | 1 | 5 | 39.29% | 17.86% | 45.45% | 67.94% | |
| ACM0009 | 2006 | 21 | 14 | 5 | 2 | 3 | 23.81% | 14.29% | 60.00% | 68.07% | |
| AM0030 | 2006 | 6 | 2 | 3 | 1 | 1 | 50.00% | 16.67% | 33.33% | 68.56% | |
| AM0036 | 2006 | 25 | 15 | 8 | 2 | 2 | 32.00% | 8.00% | 25.00% | 70.13% | |
| AM0009 | 2004 | 52 | 27 | 22 | 3 | 5 | 42.31% | 9.62% | 22.73% | 70.35% | |
| AM0024 | 2005 | 41 | 24 | 11 | 6 | 5 | 26.83% | 12.20% | 45.45% | 71.12% | withdrawn and consolidated into ACM0012 |
| AMS-I.A. | 2002 | 54 | 20 | 33 | 1 | 7 | 61.11% | 12.96% | 21.21% | 71.76% | |
| AM0034 | 2006 | 56 | 4 | 52 | 0 | 35 | 92.86% | 62.50% | 67.31% | 72.95% | withdrawn and consolidated into ACM0019 |
| AMS-III.G. | 2006 | 72 | 33 | 39 | 0 | 9 | 54.17% | 12.50% | 23.08% | 73.44% | |
| ACM0004 | 2005 | 227 | 98 | 112 | 17 | 93 | 49.34% | 40.97% | 83.04% | 75.23% | withdrawn and consolidated into ACM0012 |
| ACM0006 | 2005 | 423 | 254 | 147 | 22 | 62 | 34.75% | 14.66% | 42.18% | 75.90% | ACM0018 is an offshoot |

| | Year of approval | Total projects | Under validation / unknown | Registered | Rejected / withdrawn | Issued CER | Registered / total | Issued / total projects | Issued / registered | Actually issued / expected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AMS-I.E. | 2008 | 27 | 7 | 20 | 0 | 6 | 74.07% | 22.22% | 30.00% | 75.90% | |
| AMS-I.D. | 2002 | 3,188 | 1,115 | 2,011 | 62 | 651 | 63.08% | 20.42% | 32.37% | 76.06% | |
| AMS-II.D. | 2002 | 238 | 169 | 56 | 13 | 26 | 23.53% | 10.92% | 46.43% | 76.78% | |
| AMS-III.B. | 2002 | 96 | 60 | 23 | 13 | 10 | 23.96% | 10.42% | 43.48% | 77.77% | |
| AR-AM0004 | 2006 | 11 | 3 | 8 | 0 | 4 | 72.73% | 36.36% | 50.00% | 77.88% | withdrawn and consolidated into AR-ACM0003 |
| AM0035 | 2006 | 7 | 5 | 2 | 0 | 1 | 28.57% | 14.29% | 50.00% | 79.06% | |
| AMS-I.F. | 2010 | 83 | 38 | 45 | 0 | 4 | 54.22% | 4.82% | 8.89% | 79.18% | Low rate of issuance |
| AMS-III.C. | 2002 | 19 | 13 | 6 | 0 | 1 | 31.58% | 5.26% | 16.67% | 79.56% | Low rate of issuance |
| AMS-II.C. | 2002 | 38 | 24 | 13 | 1 | 4 | 34.21% | 10.53% | 30.77% | 79.83% | |
| ACM0002 | 2004 | 4,095 | 830 | 3,164 | 101 | 1,035 | 77.26% | 25.27% | 32.71% | 81.23% | |
| AR-AM0001 | 2005 | 7 | 5 | 2 | 0 | 2 | 28.57% | 28.57% | 100.00% | 81.92% | withdrawn and consolidated into AR-ACM0002(->AR-ACM0003) |
| AM0045 | 2006 | 7 | 5 | 1 | 1 | 1 | 14.29% | 14.29% | 100.00% | 82.60% | |
| ACM0007 | 2005 | 35 | 19 | 14 | 2 | 3 | 40.00% | 8.57% | 21.43% | 84.38% | |
| AM0032 | 2006 | 2 | 0 | 2 | 0 | 1 | 100.00% | 50.00% | 50.00% | 84.68% | withdrawn and consolidated into ACM0012 |
| AMS-III.I. | 2006 | 10 | 4 | 6 | 0 | 3 | 60.00% | 30.00% | 50.00% | 84.69% | |
| AM0065 | 2008 | 3 | 0 | 3 | 0 | 3 | 100.00% | 100.00% | 100.00% | 86.53% | |
| AM0015 | 2004 | 32 | 11 | 21 | 0 | 20 | 65.63% | 62.50% | 95.24% | 88.29% | withdrawn (similar to ACM0006) |
| AMS-III.AD. | 2009 | 1 | 0 | 1 | 0 | 1 | 100.00% | 100.00% | 100.00% | 90.81% | |
| AM0023 | 2005 | 14 | 1 | 13 | 0 | 5 | 92.86% | 35.71% | 38.46% | 93.72% | |
| AM0028 | 2006 | 30 | 6 | 24 | 0 | 16 | 80.00% | 53.33% | 66.67% | 94.34% | |
| AM0005 | 2004 | 9 | 6 | 3 | 0 | 3 | 33.33% | 33.33% | 100.00% | 94.37% | withdrawn and consolidated into ACM0001 |
| ACM0014 | 2007 | 51 | 23 | 27 | 1 | 3 | 52.94% | 5.88% | 11.11% | 97.35% | Low rate of issuance |
| ACM0011 | 2007 | 6 | 4 | 2 | 0 | 1 | 33.33% | 16.67% | 50.00% | 97.61% | |
| ACM0010 | 2006 | 37 | 19 | 16 | 2 | 9 | 43.24% | 24.32% | 56.25% | 101.85% | |
| ACM0019 | 2011 | 27 | 2 | 25 | 0 | 2 | 92.59% | 7.41% | 8.00% | 105.73% | Low rate of issuance |
| AM0001 | 2003 | 21 | 1 | 19 | 1 | 19 | 90.48% | 90.48% | 100.00% | 105.84% | |
| AR-AM0002 | 2006 | 4 | 2 | 2 | 0 | 2 | 50.00% | 50.00% | 100.00% | 106.95% | withdrawn and consolidated into AR-ACM0003 |
| AM0026 | 2005 | 11 | 4 | 6 | 1 | 4 | 54.55% | 36.36% | 66.67% | 113.24% | Specific to Chile |
| AMS-III.E. | 2002 | 46 | 30 | 16 | 0 | 3 | 34.78% | 6.52% | 18.75% | 113.98% | Low rate of issuance |
| AM0021 | 2005 | 4 | 0 | 4 | 0 | 4 | 100.00% | 100.00% | 100.00% | 120.95% | |
| AR- | 2006 | 13 | 8 | 5 | 0 | 3 | 38.46% | 23.08% | 60.00% | 132.49% | withdrawn and consolidated into |

| | Year of approval | Total projects | Under validation / unknown | Registered | Rejected / withdrawn | Issued CER | Registered / total | Issued / total projects | Issued / registered | Actually issued / expected | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AM0005 | | | | | | | | | | | AR-ACM0003 |
| AR-AM0003 | 2006 | 4 | 0 | 4 | 0 | 2 | 100.00% | 50.00% | 50.00% | 202.31% | withdrawn and consolidated into AR-ACM0001(->AR-ACM0003) |
| AM0041 | 2006 | 3 | 0 | 3 | 0 | 1 | 100.00% | 33.33% | 33.33% | 251.58% | withdrawn and consolidated into ACM0021 |
| AMS-III.R. | 2007 | 39 | 5 | 34 | 0 | 1 | 87.18% | 2.56% | 2.94% | #DIV/0! | Low rate of issuance |
| AMS-II.E. | 2002 | 58 | 37 | 13 | 8 | 1 | 22.41% | 1.72% | 7.69% | #DIV/0! | Low rate of issuance |
| AM0038 | 2006 | 2 | 1 | 1 | 0 | 1 | 50.00% | 50.00% | 100.00% | #DIV/0! | |
| AMS-III.O. | 2007 | 2 | 1 | 1 | 0 | 1 | 50.00% | 50.00% | 100.00% | #DIV/0! | |
| AMS-III.K. | 2006 | 1 | 0 | 1 | 0 | 1 | 100.00% | 100.00% | 100.00% | #DIV/0! | |

# Appendix 2. Data gathered pertaining electricity metering in CDM methodologies

1. In addition to the “Tool to calculate the emission factor for an electricity system”, the following methodologies were identified as relevant, and the various monitoring requirements compared. As the number of methodologies involved is substantial, only select methodologies were analysed in detail.

**Table 1. List of methodologies with electricity parameters**

| Methodology/ version number | Monitored parameters | | Not monitored Parameters |
|---|---|---|---|
| | **Number of parameters (electricity generation)** | **Number of parameters (electricity consumption)** | **Number of parameters (electricity generation or consumption)** |
| AM0014 / Version 05.0 | 1 | 0 | 1 (EG-HIST) |
| AM0018 / Version 03.0 | 0 | 1 | 1 (EC-HIST) |
| AM0029 / Version 03.0 | 1 | 0 | 0 |
| AM0036 / Version 04.0 | 0 | 1 | 0 |
| AM0037 / Version 02.1 | 0 | 1 | 2 (EC-HIST) |
| AM0038 / Version 03.0 | 0 | 1 | 1 (EC-HIST) |
| AM0042/ Version 02.1 | 1 | 1 | 0 |
| AM0045 / Version 02 | 3 (2 parameters - based on secondary data)* | 0 | 1 (EG-HIST) |
| AM0046 / Version 02.0 | 0 | 6 | 0 |
| AM0048 / Version 04.0 | 1 | 0 | 0 |
| AM0049 / Version 03.0 | 2 | 0 | 0 |
| AM0050 / Version 03.0.0 | 0 | 0 | 1 (EC-HIST) |
| AM0052/ Version 02.0 | 1 | 0 | 0 |
| AM0058 / Version 03.1 | 1 | 0 | 2 (EG-HIST) |
| AM0059 / Version 01.1 | 1 | 2 | 0 |
| AM0060 / Version 1.1 | 0 | 1 (No monitoring table) | 0 |
| ACM0001 / Version 15.0 | 1 | 1 | 0 |
| ACM0002 / Version 16.0 | 3 | 0 | 1 (EG-HIST) |
| AM0014 / Version 05.0 | 1 | 0 | 1 (EG-HIST) |

* Out of three, two parameters includes monitoring procedure as “based on secondary data”.
EC-HIST: Electricity consumption – based on historical data.
EG-HIST: Electricity generation – based on historical data.

**Table 2. List of methodologies referring to the tool to calculate the emission factor for an electricity system**

| Methodology referring to tool | With guidance (related to parameters in the tool) | Without guidance (related to parameters in the tool) |
|---|---|---|
| AM0001 / Version 06.0.0 | | X |
| AM0009 / Version 07.0 | | X |
| AM0018 / Version 03.0.0 | | X |
| AM0021 / Version 03 | | X |
| AM0031 / Version 05.0.0 | | X |
| AM0037 / Version 02.1 | X (partially) | X (some parameters) |
| AM0050 / Version 03.0.0 | | X |
| AM0053 / Version 04.0.0 | | X |
| AM0055 / Version 02.1.0 | | X |
| AM0057 / Version 03.0.1 | | X |
| AM0059 / Version 01.1 | | X |

**Note: With guidance (related to parameters in the tool):** The methodology refers to the tool and also provides monitoring guidance for the parameters required by the tool.

**Note: Without guidance (related to parameters in the tool):** The methodology refers to the tool, but does not provide monitoring guidance for the parameters required by the tool.

**Table 3. Detail analysis of relevant methodologies**

| Meth | MP | Unit | Source of data | Measurement Procedures | QA/QC requirements | Frequency of measurement | Measurement Procedures |
|---|---|---|---|---|---|---|---|
| AM0029 | $LE_{LNG,CO2,y}$ | | | | | | |
| ACM0001 | $EG_{EC,y}$ | MWh | Electricity meter | Sources of consumption shall include, where applicable, electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or other applications (boilers, power generators), for the compression of the LFG into the natural gas network, etc. | Electricity meter will be subject to regular (in accordance with stipulation of the meter supplier) maintenance and testing to ensure accuracy. The readings will be double checked by the electricity distribution company | Continuous | Sources of consumption shall include, where applicable, electricity consumed for the operation of the LFG capture system, for any processing and upgrading of the LFG, for transportation of the LFG to the flare or other applications (boilers, power generators), for the compression of the LFG into the natural gas network, etc. |
| ACM0005 | $PELE_{grid,CLNK,y}$ | MWh | the project plant/unit that has been added under the project activity | Use electricity meter | | Monthly | Use electricity meter |
| | $PELE_{sg,CLNK,y}$ | MWh | On-site measurements in plant records | Use electricity meter | | Monthly | Use electricity meter |
| | $PELE_{grid,BC,y}$ | MWh | On-site measurements in plant records | Use electricity meter | | Monthly | Use electricity meter |
| | $PELE_{sg,BC,y}$ | MWh | On-site measurements in plant records | Use electricity meter | | Monthly | Use electricity meter |
| | $PELE_{grid,ADD,y}$ | MWh | On-site measurements in plant records | | | | |

| Meth | MP | Unit | Source of data | Measurement Procedures | QA/QC requirements | Frequency of measurement | Measurement Procedures |
|---|---|---|---|---|---|---|---|
| | $PELE_{sg,ADD,y}$ | MWh | On-site measurements in plant records | Use electricity meter | | Monthly | Use electricity meter |
| ACM0006 | $EL_{PJ,imp,y}$ | MWh | On-site measurements | | | Data monitored continuously and aggregated as appropriate, to calculate | |
| | $EL_{PJ,aux,y}$ | MWh | emissions reductions | The consistency of metered electricity generation should be cross-checked | | | The consistency of metered electricity generation should be cross-checked |
| ACM0012 | $EG_{PJ,i,j,y}$ | MWh | with receipts from electricity purchases | | | | |
| ACM0018 | $EG_{PJ,aux,y}$ | MWh | On-site measurements | | | Data monitored continuously and aggregated as appropriate, to calculate | |

# Appendix 3. Results for review of non-CDM standards pertaining electricity metering

1. EU–ETS: It does not provide specific guidance about electricity measurement. It has guidance about data handling and uncertainty assessment. Tiered approach for GHG accounting is provided. The classification is based on the materiality of the source of emission and the level of accuracy the project proponent wants to achieve through the monitoring plan. The projects are divided into different classes depending upon the total annual emissions. Not only does a project developer have the freedom to have a monitoring plan with maximum permissible uncertainty level, it also gives them a freedom to switch to a higher or lower level in case of changes. A, B,C are the categories of project according to their yearly emissions, where emissions from A>B>C.

**Table 1.**

| **Greenhouse gas** | **Minimum Tier level required** | | |
|---|---|---|---|
| | A | B | C |
| **$CO_2$ emission sources** | 2 | 2 | 3 |
| **$N_2O$ emission sources** | 2 | 2 | 3 |

**Table 2.**

| **Maximum possible uncertainty for each tier** | | | | |
|---|---|---|---|---|
| | **Tier 1** | **Tier 2** | **Tier 3** | **Tier 4** |
| **$CO_2$ emission sources** | ±10% | ±7.5% | ±5% | ±2.5% |
| **$N_2O$ emission sources** | ±10% | ±7.5% | ±5% | N.A |
| **$CO_2$ transfer** | ±10% | ±7.5% | ±5% | ±2.5% |

2. Guidelines from the US Department of Energy: Electricity monitoring guidance has been provided by the DOE under the federal energy management program. The focus is on creating a monitoring plan for commercial and residential buildings which can be used to analyse energy consumption patterns. Some of the desired features for an electricity meter and the monitoring plan are listed below:

   (a) Data storage and time-stamp capabilities – meters can record and store energy, demand, and diagnostics in a time-series record with user-selectable intervals (for energy efficiency projects, home );

   (b) Diagnostic capabilities – Span the electrical horizon from voltage and current diagnostics, harmonic distortion and power factor studies to voltage level and phase symmetry.

(c) Two-way communications – Meters typically have abilities to both send and receive signals which allow remote access to change meter configurations (e.g., data intervals);

(d) Flexible data intervals – for diagnostic purposes, these meters have flexible recording intervals, usually down to at least 1 minute. This allows facility staff to isolate suspect events in a much refined window;

(e) Multiple modes of communication – most meters have capabilities from traditional phone modem to networked connections and wireless options. In addition, some meters allow for multiple communication options and include an ability to be a communications hub for other devices such as gas or water metering devices;

(f) Recording Interval: For larger commercial buildings and industrial/processing facilities, utilities collect, store, and determine billing amounts based on a 15-minute interval.

(g) Data Collection:

(i) Daily (if not hourly) data collection and processing is recommended for the following reasons:

a. Daily collection (with review) assures that any communication and/or metering issues are identified within that 24-hour period, thus minimizing the loss of data beyond that window;

b. A daily data window is a convenient to perform various processing and benchmarking routines for which energy/facility managers can review and make decisions. For hourly data retrieval (recommended where possible), these data can be aggregated-up to present the daily statistics and benchmarks;

c. Data quality checks (data receipt, within range, and complete) are easily implemented within the daily window. For systems reporting hourly data, it is recommended that these checks be implemented at the reporting interval (i.e., hourly).

(h) Data Loss:

(i) Whether by communications issues, metering equipment malfunction, or data processing error, data loss is an inevitable outcome for any monitoring/reporting system. The first objective upon recognition of data loss is to understand and correct the cause. This may involve staff from a variety of trades and expertise from software/IT to electricians;

(ii) Once identified and corrected, the focus shifts to understanding the magnitude of data loss and any corrective action necessary to the data set. In general, there are two methods (ASHRAE 2002) to handle missing data;

(iii) Substitution: This method requires additional information or data specific to the lost points. Missing data can be substituted with rational fixed values, calculated average values, or values interpolated from known points;

(iv) Omission: If missing data is more significant than substitution procedures will reasonably accommodate, these points and the resulting analysis can be omitted. While data gaps can be challenging, large data-set substitution may introduce unintended biases and other inaccuracies far undesirable than the data.

3. Indian National Electricity Authorities: The electricity authorities provide a detailed guidance on the location, accuracy and calibration frequency of the electricity meters.

# Appendix 4. Results for PRC review pertaining electricity metering

**Table. Identified causes for PRCs**

| Revision of Monitoring Plan | Type of issue | Diagnosis | Total |
|---|---|---|---|
| Change of source | from measurement to calculation (for co-firing) | Allowed in newer version of methodology | 1 |
| | from measurement to calculation (for net, proportioning, multiple meters) | To clarify that PRC is not needed | 16 |
| Change of measurement equipment or procedure | Change of meter type/make/number etc. (e.g., analog to electrical, check meter to bi-directional meter) | Info in Monitoring Plan is too specific , beyond requirements of monitoring methodology | 5 |
| | Include / change meter location, measurement frequency, data storage frequency, cross-checking | Info in Monitoring Plan is too specific , beyond requirements of monitoring methodology, but required by Project Standard | 18 |
| | Include / change accuracy, calibration frequency, include QA/QC | Info in Monitoring Plan is too specific , beyond requirements of monitoring methodology, but required by Project Standard | 35 |
| Include/exclude parameters | Capacity change of the plant | out of scope | 1 |
| | Include parameters because of design change | out of scope | 4 |
| | Include/remove parameters | out of scope | 7 |
| | Additional parameters were included as new sources of emissions were identified | out of scope | 1 |
| Data Acquisition, handling/processing | Meter Failure/ Data was not recorded temporarily. | Assess whether to provide guidance for such cases. | 3 |
| | Meter is Missing | Assess whether to provide guidance for such cases. | 1 |
| | Data handling for accuracy issues | Assess whether to provide guidance for such cases. | 3 |
| Application of Appendix -I of Project Standard | "(1) temporarily not monitored, a lower accuracy level | | |

| Revision of Monitoring Plan | Type of issue | Diagnosis | Total |
|---|---|---|---|
| (2) Change of calibration frequency not within PP's control, Change of accuracy/type/model/location of meter(s) as per PPA" | According to App I of PS: (1) discounting (2) not adjustment is needed | 16 | |
| Editorial changes | | out of scope | 2 |

4. Issues leading to the PRCs can be classified into following four broad classes.

(a) Revision of Monitoring Plan;

(b) Data Acquisition and handling process;

(c) Application of the Appendix-I of the Project standard;

(d) Editorial changes.

5. These are further subdivided into different categories. Following conclusions can be drawn from the analysis:

(a) Most of the PRC's are raised because of a change from the registered monitoring plan in terms of the QA/QC requirements, location of the meters, or change in the source of data from measurement to calculation (net metering and apportioning). A small proportion of PRC's under this category are a consequence of inclusion or exclusion of parameters;

(b) A significant number of PRC's that are raised have been subsequently addressed through provisions in the Appendix-I of the Project standard. These include change in type of meter when installation of meters is not in the scope of the PP and is regulated by the PPA;

(c) A small number of PRC's are raised because of inadequate information provided in the data acquisition/ handling/ processing plan. Lack of a concrete plan in case of missing data, lower accuracy of meters results in PRC's being raised;

(d) A small number of PRC's are related to the editorial changes, which are made to make the monitoring plan consistent with the requirements.

6. Based on these observations, a few questions were raised which might help in building framework to address these issues.

(a) What is the scope of the monitoring plan? Should these (e.g. calibration frequency, accuracy class, location) be specified in the monitoring plan? According to the modalities and procedures requirement :

(i) Project participants shall include, as part of the project design document, a monitoring plan that provides for;

(ii) The collection and archiving of all relevant data necessary for estimating or measuring anthropogenic emissions by sources of greenhouse gases occurring within the project boundary during the crediting period;

(iii) The collection and archiving of all relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases within the project boundary during the crediting period;

(iv) The identification of all potential sources of, and the collection and archiving of data on, increased anthropogenic emissions by sources of greenhouse gases outside the project boundary that are significant and reasonably attributable to the project activity during the crediting period;

(v) Quality assurance and control procedures for the monitoring process;

(vi) Procedures for the periodic calculation of the reductions of anthropogenic emissions by sources by the proposed CDM project activity, and for leakage effects (3/CMP.1, paragraph 53).

(b) What should be the requirements in PS vs methodologies/tools, conflicting and overlapping now? What is the scope of the monitoring requirements in methodologies and PS? For example, should these (e.g., calibration frequency, accuracy class, location) be specified in the methodologies or PS? The PS provides a list of requirement for the monitoring plan, Para 64 of PS: The monitoring plan shall include the following:

(i) Quality assurance and quality control (QA/QC) procedures;

(ii) Uncertainty levels, methods and the associated accuracy level of measuring instruments to be used for various parameters and variables;

(iii) Specifications of the calibration frequency for the measuring equipment. In cases where neither the selected methodology, nor the Board's guidance specify any requirements for calibration frequency for measuring equipment, project participants shall ensure that the equipment are calibrated either in accordance with the local/national standards, or as per the manufacture's specifications. If local/national standards or the manufacture's specifications are not available, international standards may be used;

(c) For electricity, can the requirement be only QA/QC through invoice?

(d) In projects where captive power or off-grid power is generated – Can the PP be referred to the grid requirements in the country for QA/QC requirements?

(e) Can calculation/apportioning from metered data be allowed within the methodologies?

(f) Can guidance provided to the PP for cases in which data is missing temporarily or accuracy class of the meter is lower than desired?

(g) How specific should the requirements be? E.g. Calibrate every 2 years, or calibration at least 2 years, calibrate according to national standards or manufacturer’s requirements or distribution companies.

# Appendix 5. Data gathered pertaining biogas metering in CDM methodologies

1. The following CDM standards were identified to be relevant for this work:

   (a) Methodological tool “Project and leakage emissions from anaerobic digesters”;

   (b) “Tool to determine the mass flow of a greenhouse gas in a gaseous stream”;

   (c) Methodological tool “Emissions from solid waste disposal sites”;

   (d) ACM0001 Flaring or use of landfill gas;

   (e) ACM0010 GHG emission reduction from manure management systems;

   (f) ACM0014 Large-scale consolidated methodology treatment of wastewater;

   (g) ACM0022 Alternative waste treatment process;

   (h) AM0073 GHG reduction through multi-site manure collection and treatment in a central plant;

   (i) AM0080 Mitigation of greenhouse gases emissions with treatment of wastewater in aerobic wastewater treatment plants.

2. Reviewing the identified standards, the methodologies could be divided into three categories in terms of biogas flow and methane content monitoring:

   (a) Determination of amount of CH4 is referred to the “Tool to determine the mass flow of a greenhouse gas in a gaseous stream (referred to as the Tool hereafter)”;

   (b) Determination of amount of CH4 is referred to the Tool. In addition, the methodology provided specific requirements in the form of monitoring table;

   (c) Determination of amount of CH4 is not referred to the Tool, but included in its monitoring table.

**Table. Biogas methodologies analysis**

| Methodology | Biogas flow | Methane content |
|---|---|---|
| ACM0022/Version 1.0.0 | Tool+, Table- | Tool+, Table- |
| ACM0001/Version 15 | Tool+, Table- | Tool+, Table- |
| ACM0010/Version 8 | Tool+, Table+ | Tool+, Table- |
| ACM0014/Version 6 | Tool+, Table+ | Tool+, Table+ |
| AM0080/Version1 | Tool-, Table+ | Tool-, Table+ |
| AM0073/Version 1 | Tool-, Table+ | Tool-, Table+ |
| ACM0022/Version 1.0.0 | Tool+, Table- | Tool+, Table- |

Notes: Tool+: determination of amount of $CH_4$ is referred to the Tool; otherwise, Tool- .
Table+: methodology has its own monitoring table; otherwise, Table-.

# Appendix 6. Results for review of non-CDM standards pertaining biogas metering

1. A detailed review and analysis of non-CDM standards/protocols was conducted. The following was reviewed:

   (a) Climate Action Reserve (CAR):

      (i) Mexico Landfill Project Protocol Version 1.1;

      (ii) U.S. Landfill Project Protocol Version 4.0;

      (iii) Mexico Livestock project protocol Version 2.0;

      (iv) U.S. Livestock Project Protocol Version 4.0;

      (v) Organic Waste Digestion Project Protocol.

   (b) American Carbon Registry(ACR):

      (i) Climate Leaders Greenhouse Gas Inventory Protocol Offset Project Methodology for Landfill Methane Collection and Combustion, Version 1.3.

   (c) California Environmental Protection Agency, Air Resources Board(ARB):

      (i) Livestock Projects Compliance Offset Protocol.

   (d) Climate Leader:

      (i) Climate Leaders Greenhouse Gas Inventory Protocol Offset Project Methodology Project Type: Managing Manure with Biogas Recovery Systems.

   (e) US Environmental Protection Agency(EPA):

      (i) Technical support document for industrial wastewater treatment: final rule for mandatory reporting of greenhouse gas.

**Table. Monitoring frequency, operation hours and Missing data in biogas standards**

| Monitoring requirements | CDM | CAR or ARB (Livestock) | ACR (Landfill) or Climate Leader (Manure) | EPA (Wastewater) |
|---|---|---|---|---|
| Monitoring frequency – biogas flow | •Continuous(from Tool)<br>•reported cumulatively on weekly basis, aggregated annually for calculations(from specific | Continuously measure and recorded at least once every 15 minutes or in an accumulated manner at least daily. Date to be aggregated monthly | Continuous metering or monthly sampling. However, Landfill gas flow to a combustion device must be measured and recorded on a | Continuously |

| Monitoring requirements | CDM | CAR or ARB (Livestock) | ACR (Landfill) or Climate Leader (Manure) | EPA (Wastewater) |
|---|---|---|---|---|
| | methodologies) | | continuous basis which is defined as collection and recording of flow data every 15 minutes, at minimum in ACR. | |
| Monitoring frequency – methane content | • Continuous (from Tool)<br>• Either with continuous analyser or alternatively with periodical measurement at [95/10 confidence/precision level] or [Take the higher bound of a confidence interval with 95% confidence level](from specific methodologies) | • Continuous/Weekly(from Mexico/U.S. Landfill Project Protocol in CAR)<br>• Continuous/Quarterly (from Mexico/U.S. Livestock Project Protocol& Organic Waste Digestion Project Protocol in CAR, and Livestock Protocol in ARB) | • At least weekly (from ACR)<br>• Continuous metering or monthly sampling(from Climate leader) | Either continuous or weekly monitoring of the biogas CH4 concentration.[1] |
| Operation hours (No differences between biogas flow and methane content) | The working hours of the power plant(s), boiler(s), air heater(s), glass melting furnace(s) and kiln(s) should be monitored, so that no emission reduction are claimed for methane destruction during non-working hours. (from ACM0001) | • Operational activity of the destruction devices shall be monitored and documented at least hourly to ensure actual methane destruction. GHG reductions will not be accounted for credited during periods in which the destruction device is not operational. (For flares, operation is defined as thermocouple readings above 500°F. For all other destruction devices, the means of demonstration shall be determined by the project developer and subject to verifier review.) | Not mentioned | Not mentioned |

[1] If a facility has equipment that continuously monitors the $CH_4$ concentration, the facility must use it. If a facility is not currently monitoring the biogas $CH_4$ concentration, they must use either installed or use portable equipment to monitor it weekly. Weekly monitoring provides an adequate number of samples to evaluate the variability and uncertainly associated with $CH_4$ generation

| Monitoring requirements | CDM | CAR or ARB (Livestock) | ACR (Landfill) or Climate Leader (Manure) | EPA (Wastewater) |
|---|---|---|---|---|
| | | • An exception to this requirement is made for destruction devices that receive less than 10% of the total biogas generated during the reporting period. Those devices do not need to be monitored for operational status.<br>•During the period of inoperability, the destruction efficiency of the device must be assumed to be zero. The monthly destruction efficiency (BDE) value shall be adjusted accordingly. | | |
| Missing date (No differences between biogas flow and methane content) | Not mentioned | In situations where the flow rate monitoring equipment is missing data, the Offset Project Operator or Authorized Project Designee shall apply the data substitution methodology provided in Appendix 1(Data substitution Guidelines). If for any reason the destruction device monitoring equipment is inoperable (for example, the thermal coupler on the flare or an engine), no emission reductions can be credited for the period of inoperability | Not mentioned | Not mentioned |

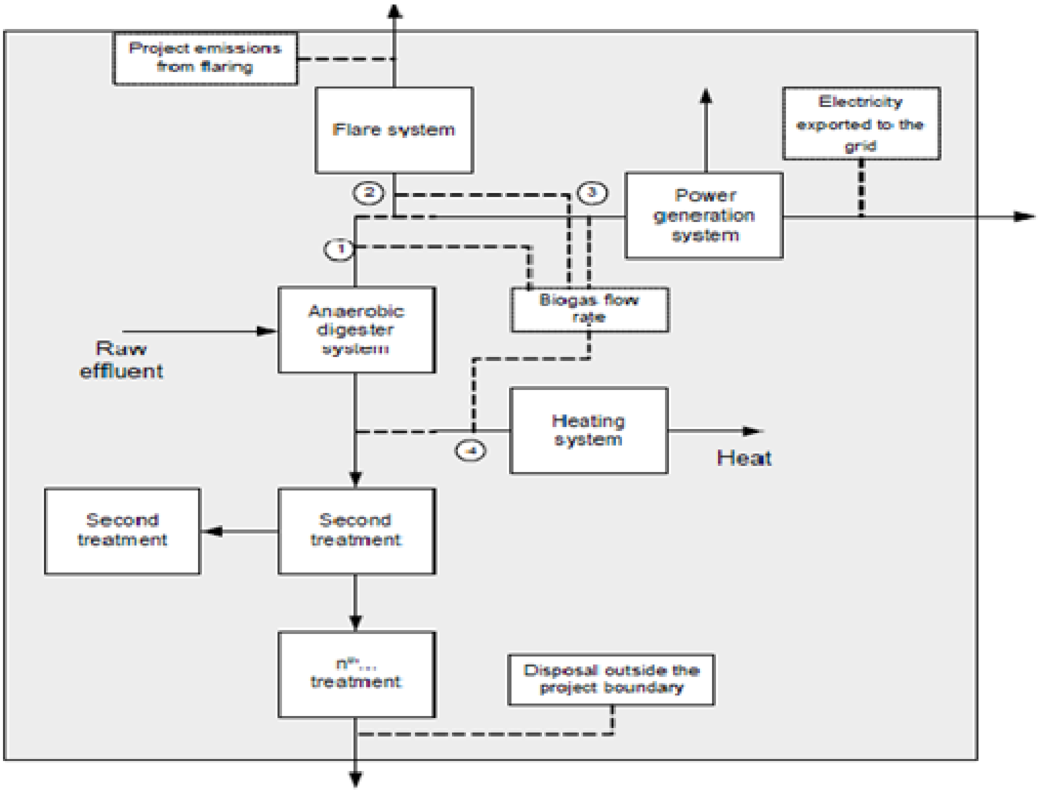
2. Comparison across different standards regarding monitoring procedure

(a) Measurement procedure for biogas flow:

(i) CDM:

a. In ACM0010, it indicates that the biogas flow will be measured at four points, as shown in the Figure 1, i.e., points when 1) entering power stations; 2) entering heating system; 3) leaving the anaerobic digester; and 4) entering into the flare.

**Figure 1. Measurement points in ACM0010**




(ii) CAR or ARB (Livestock):

a. The data should be adjusted for temperature and pressure in cases where the flow meter does not automatically correct to 0°C and 1atm;

b. CAR protocols also indicate the suggested arrangement of biogas flow meters and methane concentration metering equipment in Figure 2;

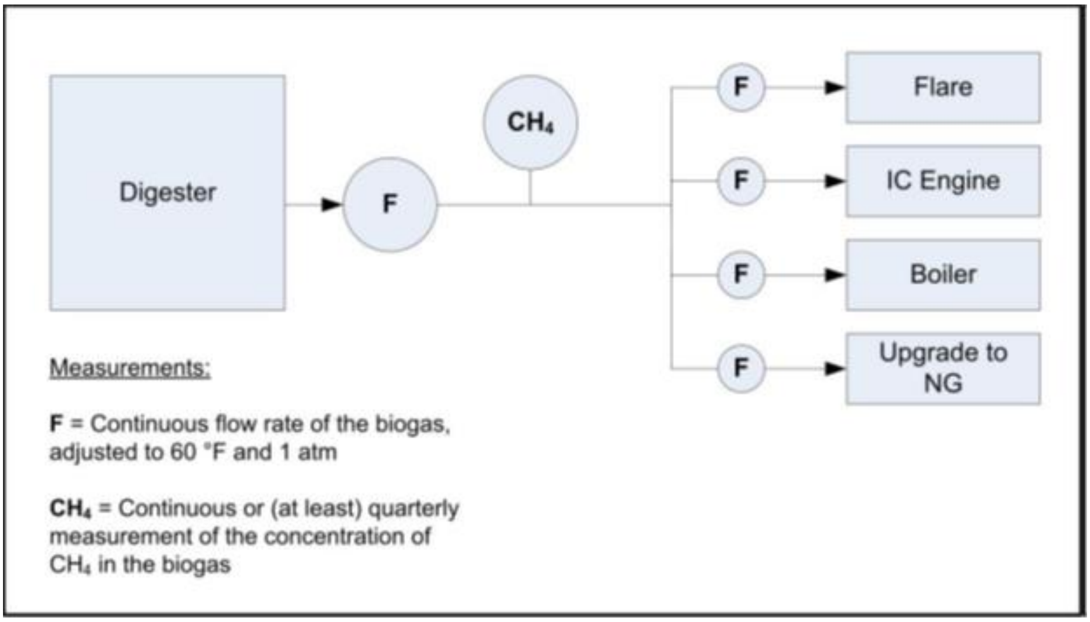
c. A single flow meter may be used to monitor the flow of gas to multiple destruction devices under certain conditions: If all destruction devices are of identical methane destruction efficiency and verified to be operational (i.e. there is recorded evidence of destruction), no additional steps are necessary for project registration. One example of this scenario would be a single meter used for a bank of multiple, identical engines that are in constant operation. If destruction devices are not of identical efficiency, then the destruction efficiency of the least efficient device shall be applied to the flow data for this meter. If there are any periods where the operational data show that one or more devices were not destroying methane, these periods are eligible for crediting, provided that the verifier can confirm all of the following conditions are met:

i. The destruction efficiency of the least destruction device in operation shall be used as the destruction efficiency for all destruction devices monitored by this meter; and

ii. All devices are either equipped with valves on the input gas line that close automatically if the device becomes non-operational(requiring no manual intervention), or designed in such manner that it is physically impossible for gas to pass through while the device is non-operational; and

iii. For any period where one or more destruction devices within this arrangement is not operational, it must be documented that the remaining operational devices have the capacity to destroy the maximum gas flow recorded during the period. For devices other than flares, it must be shown that the output corresponds to the flow of gas.

**Figure 2. Measurement point in CAR or ARB**




(iii) ACR (Landfill) or Climate Leader (Manure):

a. The gas flow meter must be installed as close to the gas combustion device as possible to measure the amount of gas reaching the device for monthly sampling;

b. Two procedures are used for date collection in monthly monitoring method;

c. Calibrate monitoring instrument in accordance with the manufacture's specification;

d. Collect four sets of date including flow rate(scfm), CH4 concentration(%), temperature(°R) and pressure(atm) from the inlet gas(before any treatment equipment using a monitoring meter specifically for CH4 gas);

e. For continuously metering, several direct measurement instruments may also use separate records to store and document data.

(iv) EPA(Waster Water):

a. A facility is required to determine temperature and pressure of the biogas weekly only if its gas flow meter is not equipped with automatic correction for temperature, pressure, or, if necessary, moisture content. A facility must measure moisture content weekly if the CH4 concentration is determined on a dry basis and biogas flow is determined on a wet basis, or vice-versa, and the flow meter does not automatically correct for moisture content;

b. A facility may measure flow rate using one of the methods specified below:

i. ASME MFC-3M-2004, Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi;

ii. ASME MFC-4M-1986 (Reaffirmed 1997), Measurement of Gas Flow by Turbine Meters;

iii. ASME MFC-6M-1998, Measurement of Fluid Flow in Pipes Using Vortex Flowmeters;

iv. ASME MFC-7M-1987 (Reaffirmed 1992), Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles;

v. ASME MFC-11M-2006 Measurement of Fluid Flow by Means of Coriolis Mass Flowmeters;

vi. ASME MFC-14M-2003 Measurement of Fluid Flow Using Small Bore Precision Orifice Meters; or

vii. ASME MFC-18M-2001 Measurement of Fluid Flow using Variable Area Meters; or

viii. Method 2A or 2D at 40 CFR part 60, appendix A-1.

c. A facility may measure biogas flow using a method other than those listed above; however, they must follow the manufacturer's instructions for the gas flow measurement device.

(b) Measurement procedure for methane content

(i) CAR or ARB(Livestock):

a. The measurement point is showed in Figure 2 above.

(ii) ACR (Landfill) or Climate Leader (Manure):

a. The two procedures for data collection in monthly monitoring method is the same as biogas flow.

(iii) EPA(Wastewater):

a. Facilities with biogas recovery from anaerobic processes must measure gas composition with a monitor capable of measuring the concentration of CH4 in the recovered biogas using either one of the methods specified below or as specified by the device manufacturer if they use another device.

i. Method 18 at 40 CFR part 60, Appendix A-6;

ii. ASTM D1945-03, Standard Test Method for Analysis of Natural Gas by Gas Chromatography;

iii. ASTM D1946-90 (Reapproved 2006), Standard Practice for Analysis of Reformed Gas by Gas Chromatography;

iv. GPA Standard 2261-00, Analysis for Natural Gas and Similar Gaseous Mixtures by Gas Chromatography;

v. UOP539-97 Refinery Gas Analysis by Gas Chromatography; or as an alternative to the gas chromatography methods, a facility may use total gaseous organic concentration analyzers and calculate the CH4 concentration.

3. Comparison across different standards regarding QA/QC procedure:

(a) CAR or ARB (Livestock)

(i) All gas flow meters or continuous methane analysers must be:

a. Cleaned and inspected according to a regular schedule as documented in the project's Monitoring Plan. Project developers and verifiers should consult with the manufacturer and installer of the metering equipment to determine the proper cleaning procedure and frequency to ensure that accuracy remains within the acceptable tolerance;

b. Field checked for calibration accuracy with the percent drift documented, using either a portable instrument(such as a pitot tube) or manufacturer specified guidance, at the end of but no more than two months prior to or after the end date of the reporting period (Instead of performing field checks, the project developer may instead have equipment calibrated by manufacturer or a certified calibration service per manufacturer's guidance, at the end of but no more than two months prior to the end date of the reporting period to meet this requirement.);

c. Calibrated by the manufacturer or a certified calibration service per manufacturer's guidance or every 5 years, whichever is more frequent.

(ii) Alternative for regulated meters: Projects that export biogas through a pipeline may have installed a custody transfer meter-or similar measurement device-for the measurement and analysis of biogas delivered to the pipeline. If the accuracy of this meter, and the maintenance and calibration necessary to maintain accuracy, are regulated by a government agency (including specific requirements for maintenance, inspection and/or calibration), then the project may prove adherence to those regulatory requirements in lieu of the QA/QC requirements listed above, The standard accuracy must be at least +/- 5%;

(iii) If the required calibration or calibration check is not performed and properly documented, no GHG credits may be generated for that reporting period. Flow meter calibrations shall be documented to show that the meter was calibrated to a range of flow rates consistent with the range of expected flow rates produced by the project biogas control system;

(iv) If the field check on a piece of equipment reveals accuracy outside a +/- 5% threshold, calibration by manufacturer or a certified service provider is required for that piece of equipment. However, if the field check indicates that the measurement accuracy of the meter has drifted, the project developer has the option to first record the as-found condition (percent drift) of the field check, then clean the equipment and conduct a second field check. If this second check indicates measurement accuracy within the acceptable threshold, no further calibration is required and the as-left condition of the meter shall be recorded to document calibration accuracy. This shall be considered a failed field check followed by a successful field check. If the second field check confirms accuracy outside of the +/- 5% threshold, calibration by manufacturer or a certified service provider is required for that piece of equipment;

(v) For calibrations or field checks that indicate the flow meter was outside the +/- 5% accuracy threshold, the project developer shall estimate total emission reductions using:

a. The metered values without correction, and

b. The metered values adjusted based on greatest calibration drift recorded at the time of calibration. The lower of the two emission reduction estimates shall be reported as the scaled emission reduction estimate.

(vi) These adjustments must be made for the entire period from the last successful field check until such time that the meter is shown to be measuring within the accuracy threshold;

(vii) If a portable instrument is used, the portable instrument should be maintained and calibrated per the manufacturer's specifications, and calibrated at least annually by the manufacturer, by a laboratory approved by the manufacturer, or at an ISO 17025 accredited laboratory. The portable instrument also must be field calibrated to a known sample gas prior to each use.

(b) ACR (Landfill) or Climate Leader (Manure):

(i) For monthly sampling, monitoring instrument should be calibrated in accordance with manufacturer's specification (applicable for both biogas flow and methane content).

(c) EPA (Wastewater):

(i) For biogas flow:

a. All temperature, pressure, and moisture content monitors must be calibrated using the procedures and frequencies specified by the device manufacturer. If the device manufacture does not provide calibration specifications, facilities may use an industry accepted or industry standard practice. All equipment must be maintained to the manufacturer’s specifications.

(ii) For methane content:

a. The gas composition monitors must be calibrated prior to the first reporting year and recalibrated either annually or at the minimum frequency specified by the manufacturer, whichever is more frequent.

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