A6.4-SB004-AA-A10–APPENDIX 3

Draft Methodology

Electrification of rural communities using renewable energy

Version 01.0

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1. Introduction

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

Table 1. Methodology key elements

Typical activity(ies)	Communities which did not have electricity prior to project implementation are supplied with electricity from renewable based systems (e.g. solar home systems, renewable mini grid)
Type of GHG emissions mitigation action	Renewable energy: Displacement of fossil fuel use

2. Scope, applicability and entry into force

2.1. Scope

2. This methodology covers electrification of a community achieved through installation of renewable electricity generation systems that displace fossil fuel use, such as in fuel-based lighting systems, stand-alone power generators, and fossil fuel based mini-grids. ~~The two categories of applicable project activities are:~~

~~(a) Implementation of individual, renewable energy systems such as roof top solar photovoltaic systems;~~

~~(b) Installation or extension of an isolated mini-grid which distributes electricity generated only from renewable energy systems.~~

2.2. Applicability

Annex 4 to the report of the third meeting of the Supervisory Body (SB03) of the mechanism established by Article 6, paragraph 4, of the Paris Agreement (hereinafter referred to as the Article 6.4 Mechanism), i.e. "Information Note: Status of current work on the application of the requirements referred to in chapter V B (Methodologies) of the rules, modalities and procedure" (hereafter referred to as Requirements**),** captured the status of the work undertaken by the Supervisory Body related to the request of the CMA in decision 3/CMA.3, paragraph 6(d), to develop recommendations on the application of the requirements referred to in chapter V B (Methodologies) of the rules, modalities and procedures while stating it is not final, may not reflect all the views expressed and forms a basis for further work on this matter by the Supervisory Body. 'Draft requirements' in annex 4 above are included below:

Encouraging ambition over time

12. Paragraph 33 of the rules, modalities and procedures (RMP) for the Article 6.4 Mechanism states that 'Mechanism methodologies shall encourage ambition over time'.

13. This requirement shall be implemented through the application of approaches to be elaborated in accordance with further guidance and procedures to be developed by the Supervisory Body, which are relevant and applicable to the implementation of other elements of para 33 of the RMP.

14. These approaches shall include approaches based on:

(a) increasing the stringency of the baselines over time or;

(b) the implementation of replicable and scalable mitigation activities.

15. Developing Baseline Contraction Factors (BCFs) to periodically adjust the baseline downwards, is one way of implementing more stringent baselines over time. BCFs could be developed by the Supervisory Body at the request of the host Party or could be developed by host Party and approved by the Supervisory Body. A procedure [will][could] be established to guide the development of BCFs including the process for consultation with the host Parties.

16. Approaches to include progressively more efficient and less greenhouse gas (GHG) intensive technologies in programmes, or activities which expand the user base of project technologies or greater penetration among potential end users, or expansion of geographical sectoral coverage, are potential ways of supporting replicability and scalability of mitigation activities.

17. The Supervisory Body shall develop further guidance on the applicability and/or procedures on the implementation of these approaches.

Contribution to equitable sharing of mitigation benefits

34. Paragraph 33 of the RMP states that the 'Mechanism methodologies shall contribute to the equitable sharing of mitigation benefits between the participating Parties'.

35. Mechanism methodologies may specify application of [an approach based on increasing the stringency of the baselines over time under paragraph 14 (a)] [approaches identified under paragraphs 14 to 17] so as to ensure that activity will contribute to equitable sharing of mitigation benefits.

36. Mechanism methodologies shall require the activity participants to describe the measures taken to contribute to the delivery of mitigation benefits to the participating Parties in the project design documents.

37. This requirement may also be operationalized through the DNAs, acknowledging that it is their full right to demand an equitable share of benefits as a pre-condition for the approval of activity(ies) and/or authorization of A6.4ERs to achieve their nationally determined contributions (NDCs). Activity participants shall follow any guidance from the DNAs in this regard.

Alignment with the long-term temperature goals of the Paris Agreement

> *41. Paragraph 33 of the RMP states that 'Mechanism methodologies shall align with the long-term temperature goal of the Paris Agreement.'*
>
> *42. Mechanism methodologies shall require demonstration that the activity is aligned with long-term temperature goals of the Paris Agreement.*
>
> *43. Mechanism methodologies may require the application of 'approaches' identified under paragraph 14 to 17 so as to ensure that activity aligns with the long-term temperature goal of the Paris Agreement.*
>
> *44. The Supervisory Body will develop further guidance on how this requirement will be demonstrated.*

3. Application of this methodology shall:

    (a) Encourage ambition over time;

    (b) Contribute to the equitable sharing of mitigation benefits between the participating Parties; and

    (c) Require that activity aligns with the long-term temperature goal of the Paris Agreement.

4. The requirement in paragraph 3 above shall be met using approaches based on:

    (a) Increasing the stringency of the baselines over time;

    (b) The implementation of replicable and scalable mitigation activities.

5. With regard to 4 (b) above, implementation of replicable and scalable mitigation activities should be demonstrated by referring to:

    (a) Plans for progressive deployment of more efficient and less GHG intensive technologies in programmes or activities; or

    (b) Activities that expand the user base of activity technologies or increase penetration of the activity technologies among potential end users over time; or

    (c) The expansion of geographical sectoral coverage.

6. An option to apply Baseline Contraction Factors (BCFs) to periodically adjust the baseline downwards to implement more stringent baselines over time is included in this methodology.[1] If the host Party has provided BCFs, those BCFs shall be applied when choosing this option. If the host Party has not provided BCFs and the Supervisory Body has published applicable BCFs or interim BCFs, the BCFs published by the Supervisory Body shall be applied by the activity participant when using this option.

7. The activity participants shall describe in the activity design documents the measures taken to contribute to the delivery of mitigation benefits to participating Parties. In this regard, the activity participants shall follow any guidance from the DNAs of the host Party(ies).

[1] Activity participants may propose alternative approaches for the consideration of the Supervisory Body.

Rationale for changes

There was support at SB03 for grouping elements of RMP requirements when providing options for meeting those requirements; although, details of the groupings were not given. Paragraph 3 above lists three such requirements from RMP and paragraph 4 above provides two broad options to meet those requirements. Paragraph 5 elaborates the process for increasing baseline stringency over time. Paragraph 6 above details the options for showing replicable and scalable activities.

Irrespective of the guidance and provisions in paragraphs 4-6, the baseline approach under this methodology results in more conservative estimation of emission reductions as compared to methods now prevalent (e.g. under the clean development mechanism (CDM)). The baseline approache includes conservative default values for emission factor for electricity supplied.

8. The emission reductions achieved using this methodology shall be real, transparent, conservative and credible, representing actual tonnes of GHG emissions reduced. This requirement shall be met by:

(a) Basing the estimation of emission reductions on up-to-date scientific information that is clearly and consistently referenced using a standard citation method;

(b) Including transparent descriptions of the source of the data used and the assumptions made;

(c) Including all the underlying steps followed in deriving the estimates of the results, where necessary including equations; and

(d) Ensuring emission reductions are not overestimated, for instance, where applicable, by requiring the accounting of uncertainty associated with modelled and surveyed data.

Rationale for changes

The above changes are self explanatory.

Draft Requirements

Aligning with NDC of each participating Party, if applicable and LT-LEDs, if it has submitted one [and the long-term goals of the Paris Agreemnt]

38. Paragraph 33 of the RMP states that ‘mechanism methodologies shall, in respect of each participating Party, contribute to reducing emission levels in the host Party, and align with its NDC, if applicable, its long-term low GHG emission development strategy, if it has submitted one and the long-term goals of the Paris Agreement’

39. Mechanism methodologies shall require demonstration that the activity aligns with the latest NDC of the host Party (if applicable) or [encourages] [enables] increasing ambition in the NDCs, and aligns with the LT-LEDs (if it has submitted one) [and the long-term goals of the Paris Agreement].

40. The Supervisory Body will develop further guidance on how this requirement will be demonstrated.

9. Activity participants shall demonstrate to each participating Party that the activity contributes to reducing emission levels in the host Party, and aligns with the host Party’s NDC, the Party’s long-term low-GHG emission development strategy if it has submitted

one, and the long-term goals of the Paris Agreement. In this regard, the host Party's communications, including in relation to participation requirements under the Article 6.4 Mechanism, may be referenced.

Rationale for changes The above changes are self explanatory.

10. This methodology is applicable to:

Greenfield individual, renewable energy system projects or mini-grid activities. ~~This methodology is applicable to electrification of a community achieved through the installation of renewable electricity generation systems that displace fossil fuel use, such as in fuel-based lighting systems, stand-alone power generators, and fossil fuel based mini-grids.~~

11. The two categories of applicable activities are:

(a) Implementation of individual, renewable energy systems such as ~~roof top~~ solar photovoltaic systems;

(b) Installation ~~or extension~~ of an isolated mini-grid which distributes electricity generated only from renewable energy systems.

~~(c) and/or~~

~~(d) Rehabilitation (or refurbishment) of individual, renewable energy systems if it can be demonstrated that the baseline system(s) are not part of another CDM mechanism activity and are non-operational and require a substantial investment~~[2] ~~for them to be rehabilitated to or above the original electricity generation capacity. Options for demonstrating compliance with this condition include providing documentation that:~~

~~(i) The existing system has not generated electricity, or that alternative fuels (e.g. kerosene) have been used, for at least six months prior to activity design document or component programme activity design document (CPA-DD) submittal; and/or~~

~~(ii) Substantial investments are required to rehabilitate the existing systems, e.g. investments greater than half of the cost to install a new system with the same electricity generation capacity.~~

12. This methodology is applicable in situations where consumers that were not connected to a national/regional grid prior to project implementation are supplied with electricity from the project activity. It is also applicable to situations where a fraction of consumers that are supplied with electricity from a fossil fuel based mini-grid prior to the implementation of the project are now supplied with electricity from the project activity.

13. At least 75 per cent (by number) of the consumers connected to the project renewable electricity generation system(s) shall be households.

[2] On-going or deferred maintenance is not eligible under this.

14. Project equipment shall comply with applicable international standards[3] or comparable national, regional or local standards/guidelines and the activity design document shall indicate the standard(s) applied.

15. The methodology is applicable to renewable electricity generation systems intended for permanent installation and is not applicable to portable systems, such as portable electricity generating systems or LED lanterns. ~~The aggregate installed capacity of the renewable energy generating systems shall not exceed 15 MW~~

16. For projects involving the installation of hydro power plants with reservoirs the requirements prescribed under revised ACM0002 ~~“AMS-I.D.: Grid connected renewable electricity generation”~~ shall be followed.

3. Definitions

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

(a) **Renewable mini grid system** - ~~small-scale~~ power system ~~with a total capacity not exceeding 15 MW (i.e. the sum of installed capacities of all electricity generating units connected to the mini-grid is equal to or less than 15 MW)~~ which is not connected to a national or a regional grid;

(b) **Individual, renewable electricity generation system** - renewable-based electricity generation system that supplies electricity to a single consumer (e.g. a home) and that are not interconnected with other facilities or generation systems, i.e. stand-alone systems;

~~(c) **Rehabilitation (or refurbishment)** - Investment to restore existing individual, renewable electricity generation systems that are not generating electricity in their current condition. This may involve repairs, renovations or replacement of broken, missing or worn out equipment, but specifically excludes actions only involving on-going or deferred maintenance. The primary objective of rehabilitation or refurbishment is to restore the performance of the system. Rehabilitation may also lead to increase in efficiency performance of individual, renewable electricity generation systems;~~

(d) **Consumer(s)** - they are end-user(s)/facility(ies) that may include households; public buildings; and/or small, medium and micro enterprises (SMMEs). Electricity uses may include interior lighting, street lighting, refrigeration, or agricultural water pumps.

4. Baseline methodology

4.1. Project boundary

18. The spatial extent of the project boundary includes the project renewable electricity generation systems, any project distribution (grid) systems, and the physical sites of the consumers served by the ~~project~~ activity.

[3] For example, IEC 62124 PV stand-alone systems, design verification or another PVGAP recommended standard to verify system design and performance of stand-alone photovoltaic systems including functionality, the battery autonomy and solar fraction.

4.2. Additionality

Draft Requirements

Additionality

60. Paragraph 38 of the RMP states that 'Each mechanism methodology shall specify the approach to demonstrating the additionality of the activity. Additionality shall be demonstrated using a robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism, taking into account all relevant national policies, including legislation, and representing mitigation that exceeds any mitigation that is required by law or regulation, and taking a conservative approach that avoids locking in levels of emissions, technologies or carbon-intensive practices incompatible with paragraph 33 above'.

61. Paragraph 39 of the RMP states that 'The Supervisory Body may apply simplified approaches for demonstration of additionality for any least developed country or small island developing State at the request of that Party, in accordance with requirements developed by the Supervisory Body'.

62. Additionality assessment shall require that the activity participants take a conservative approach that avoids locking in levels of emissions, technologies or carbon-intensive practices incompatible with the requirements discussed under sections 2.3 to 2.11 above.

63. Mechanisms methodology shall require that additionality demonstration of the article 6.4 activity is established by showing that:

(a) Without the incentive from the mechanism, the activity would not be feasible; and

(b) The activity represents mitigation that exceeds any mitigation that is required by law or regulation.

64. The Supervisory Body may approve a list of technologies that are considered additional and termed as positive list of technologies. Mechanism methodologies should require that the activity participant demonstrate that that the proposed article 6.4 activity is part of the positive list of technologies established by the Supervisory Body in order to use the positive list for the demonstration of additionality.

65. The Supervisory Body will consider the technologies for which necessary conditions exist with a high degree of certainty in accordance with the requirements in paragraph 63, where relevant on a regional basis, considering special circumstances of LDCs/SIDS, as the basis for developing the positive list.

66. The Supervisory Body will develop further guidance on the demonstration of additionality and the positive list of technologies at a future meeting of the Supervisory Body, including simplified approaches for demonstration of additionality for any LDCs/SIDS.

19. Additionality of the activity shall be demonstrated using a robust assessment that shows the activity would not have occurred in the absence of the incentives from the mechanism, taking into account all relevant national policies, including legislation, and representing mitigation that exceeds any mitigation that is required by law or regulation.

20. The activity participants are required to take a conservative approach that avoids locking in levels of emissions, technologies or carbon-intensive practices incompatible with the requirements described in paragraphs 38–39 of the RMP.

21. If the Supervisory Body has established a positive list of technologies for additionality, the activity participant should demonstrate that the proposed activity is part of that positive list and use that option to demonstrate additionality.

22. Therefore, methodologies should require that additionality of article 6.4 activities be demonstrated by showing that:

(a) Without the incentive from the mechanism, the activity would not be feasible; and

(b) The activity represents mitigation that exceeds any mitigation that is required by law or regulation.

Rationale for changes

No specific technologies have been specified for the positive list currently. However a performance standard specifying an ambitious lighting service (e.g.77.2 lumens per watt for the efficient light bulb distributed by the activity) may be considered by the SB for specifying automatic additionality. For efficient lighting activities, JCM methodologies specified the luminous efficacy of the 'best available technology' for indoor light emitting diode (LED) lamps based on manufacturers' specifications with global presence (e.g. 77.2 lumens (lm)/watt (W) for LEDs between 10 to 20 W).

In terms of practice based methods, more recent work under the CDM in the area could be a useful reference. As a threshold for automatic additionality, based on the findings from Rogers' 1962 diffusion model, that a technology is considered to be in the innovation stage until reaching the 2.5 per cent diffusion level[4] was included in the recent revision of related tools and methodologies under the CDM[5]. A 2.5 per cent threshold for sales data (three years' sales average) and a 1.5 per cent threshold for stock data have been specified under the CDM considering that the sales data, when available, is more reliable than the stock data. In case of stock, the denominator is total number of existing technologies/products over the lifetime of the technologies/products, whereas the numerator represents new technologies/products for a much shorter duration (since the introduction of newer technologies/products). The use of sales data is preferable, and stock data should be used only if there is no sales data.

The thresholds (i.e. 2.5 per cent (sales) and 1.5 per cent (stock) for automatic additionality are more suitable as thresholds for the proportion of the distributed type of technologies/products, but not for the proportion of facilities or plants. Therefore, these thresholds should be applied only to the methodologies where market penetration thresholds are defined for the distributed type of technologies/products.

4.3. Identification of the baseline scenario and baseline-as-usual (BAU) scenario

Draft Requirements

Being below business as usual

24. Paragraph 33 of the RMP states that the 'Mechanism methodologies shall be below 'business as usual''.

25. Mechanism methodologies shall require that the baseline selected following the approach described under section 2.15 shall be demonstrated as being below business-as-usual (BAU). For that purpose, the mechanism methodology shall require the identification of the BAU scenario(s) and provide an approach for the calculation of BAU emissions.

Recognizing suppressed demand

[4] See annex 9 of the report of the 83rd meeting of the Methodology Panel regarding Roger's theory of diffusion, available at https://cdm.unfccc.int/Panels/meth/index.html.

[5] See the report of the 115th meeting of the CDM Executive Board and associated annexes relating to methodological standards, available at https://cdm.unfccc.int/EB/index.html.

30. Paragraph 33 of the RMP states that the 'Mechanism methodologies shall recognize suppressed demand'.

31. Supervisory Body will recognise suppressed demand, where applicable, by considering that the baseline scenario is not the historical condition, but rather a situation where the baseline equipment or measure cannot realistically provide the level of service required of the Article 6.4 activity and alternative technology that provides the level of service comparable to Article 6.4 activity is assumed/assessed.

32. In context where the baseline equipment or measure cannot realistically provide the level of service of the Article 6.4 activity, the Supervisory Body will recognize alternative technology that provides the level of service comparable to Article 6.4 activity to be the baseline scenario rather than a historical situation.

33. The Supervisory Body will assess if suppressed demand is a plausible situation for a given context on a case-by-case basis and, where relevant, it will recognize suppressed demand by including benchmarks and default factors in specific methodologies that may not be below BAU. Mechanism methodologies may include such factors where relevant for use by activity participant, however activity participants shall not directly estimate supressed demand while applying a methodology.

Draft Requirements on baselines

54. Paragraph 36 of the RMP states that

'Each mechanism methodology shall require the application of one of the approach(es) below to setting the baseline, while taking into account any guidance by the Supervisory Body, and with justification for the appropriateness of the choices, including information on how the proposed baseline approach is consistent with paragraphs 33 and 35 above and recognizing that a host Party may determine a more ambitious level at its discretion:

A performance-based approach, taking into account:

(i) Best available technologies that represent an economically feasible and environmentally sound course of action, where appropriate;

(ii) An ambitious benchmark approach where the baseline is set at least at the average emission level of the best performing comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances;

(iii) An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 above'.

55. Paragraph 27 of RMP states that 'A host Party may specify to the Supervisory Body, prior to participating in the mechanism: (a) Baseline approaches and other methodological requirements.'

56. Mechanism methodologies shall justify the appropriateness of the choice(s) made in the methodology for setting the baseline while taking into account guidance on the performance-based approach in the RMP. For the approach based on existing actual or historical emissions, the mechanism methodology may apply [approaches identified under paragraph 14 to 17 as an option] [BCF(s) identified under paragraph 15 as one option] to adjust the existing actual or historical emissions downwards to ensure alignment with paragraph 33 of the RMP.

57. Mechanism methodology should include provisions to progressively increase the stringency of the baselines applied in the methodology, as applicable.

58. A host Party may determine a more ambitious baseline requirement at its discretion.

59. The Supervisory Body may undertake further assessment and develop further guidance in relation to the baselines at a future meeting of the Supervisory Body.

24. This methodology requires use of a performance-based approach to identify the baseline scenario unless the host Party has determined a more ambitious baseline level, which would take precedence. The baseline scenario shall be determined using:

    (a) Best available technologies that represent an economically feasible and environmentally sound course of action, where appropriate;

    (b) An ambitious benchmark approach where the baseline is set at least at the average emission level of the best-performing, comparable activities providing similar outputs and services in a defined scope in similar social, economic, environmental and technological circumstances;

    (c) An approach based on existing actual or historical emissions, adjusted downwards to ensure alignment with paragraph 33 of requirements referred to in chapter V.B (Methodologies) of the rules, modalities and procedures (RMP) of the Article 6.4 Mechanism.

25. Two parameters are required to be known to determine the baseline:

    (a) The amount of renewable electricity utilized by the consumers served by the project renewable electricity generation systems;

    (b) The number of consumers supplied with renewable electricity by the project activity.

26. The following are the baseline emission factors for each tranche of annual amount of renewable electricity consumed per consumer during the crediting period:

    (a) For the first 55 kWh of electricity supplied to the user by the project electricity generating system in a given year, a default emission factor of 2.72 kg CO_2/kWh (i.e. 2.72 t CO_2/MWh) may be used;

    (b) For the electricity supplied to the user by the project electricity generating system in a given year that is above 55 kWh, a default emission factor value of 0.7 kg CO_2/kWh shall be used.

27. Approaches in paragraph 24 recognise suppressed demand. Activity participants may propose other approaches to address suppressed demand, with due justification, for the consideration by the Supervisory Body.

5. This methodology requires the identification of the BAU scenario(s) and activity participants shall provide an approach for the calculation of BAU emissions. For the purpose of this methodology, the BAU scenario sees the community continuing to use fossil fuel in fuel-based lighting systems, stand-alone power generators, and fossil fuel based mini-grids for lighthing and other household uses.

Rationale for changes

Mechanism methodologies recognize suppressed demand where a minimum service level to meet basic human needs, such as lighting, cooking, safe drinking water and shelter, is unavailable to the end user of the service prior to the implementation of the activity. Suppressed demand may be addressed by considering that the baseline scenario is not the historical condition, but an alternative technology that provides a level of service comparable to the proposed Article 6.4 activity, where the baseline equipment or measure cannot realistically provide the level of service of the Article 6.4 activity.Under the CDM, in related methodologies, the basic level of service for lighting were assumed to be 55 kWh/year/household and other electricity use as 250 kWh/year/household based on a study by the International Energy Agency, the United Nations Development Programme and United Nations Industrial Development Organization in 2010 (IEA, 2010), titled “Energy Poverty: How to make modern energy access universal?”. Under the CDM, where kerosene usage for lighting was evident, it was assumed a high-pressure kerosene lamp (superior in efficiency compared to a wick kerosene lamp typically used in households, and hence more expensive) would provide similar or equivalent lighting as two lights consuming 55 kWh. Kerosene consumption of one high-pressure kerosene lamp and the corresponding emissions were determined, assuming that if a household’s income improves the household would move to a better technology available in the market than the basic wick kerosene lamp. Kerosene pressure lamps consume 0.08 litres of kerosene per hour (Mills, Evan, 2005. The Specter of Fuel-Based Lighting. Science 308:1263-1264**).** At standard density, using the net calorific value for kerosene and Intergovernmental Panel on Climate Change emission factor; at 5 hours of lighting per day, this amounts to 146 litres/year, or 0.375 t CO2/year/household. 55 kWh/year/household for lighting, as stated above, translated to 6.8 kg CO2/kWh. Thus a referene approach was used under the CDM for: (a) determining the minimum amount of electricity required for lighting per household per year under off grid conditions to meet the basic needs for lighting; and (b) determining amount of kerosene and corresponding emissions from a pressure kerosene lamp that would provide comparable lighting services determined under (a).

Under the proposed revision, the first part of the above reference approach (i.e. 55 kWh/household/year for lighting) is retained while the second part of using the consumption of pressure kerosene lamp is discarded in favour of a conservative performance benchmarking approach as per the RMP to consider the actual data on household kerosene usage for lighting. Table 1 below shows a wide range of kerosene consumption in households. The study by Lighting Africa (2010),[6] which was more comprehensive than other studies cited, estimated 150 kg CO_2/year/household based on a usage rate of 5 litre/month per bottom-of-pyramid household consumption of kerosene. The report stated that “our estimate draws on Lighting Africa market research on off-grid populations in five African countries and equates to the use of one kerosene wick lamp, or two relatively more efficient kerosene hurricane lamps for 3–4 hours daily”.

Table 1. Household kerosene consumption as reviewed in various literature sources

Source	Coverage	Litres/year	kg CO_2/year
Mills (2005)	All developing countries	132	339
Lighting Africa (2010)	Review of 28 surveys from across the globe	60 (range: 36 to 360)	154 (92 to 920)
CDM project 2279: Rural Education for Development Society (REDS) CDM Photovoltaic Lighting Project	Rural India	131	336
CDM Project 2699: D.light Rural Lighting Project	Rural India	83.8	215
Cambodia (UNDP 2008)	Rural households in Kampong Speu and Svay Rieng	15–23	38–59
CDM project from United Republic of Tanzania	Sumbawanga Region	36–60	92–154

Uganda (Harsdorff and Bamanyaki 2009)	Unelectrified rural households	38	97

A report by GOGLA titled “Standardised Impact Metrics”[7] estimated that an average 431 kg of GHG, including black carbon, is emitted by a kerosene lantern annually.

Based on the above, when outliers are removed, lowest observed consumption would be 36 litres of kerosene per month. However, applying the guidance on ambitious benchmark for the baseline under the the RMP, 60 litres per month or 150 kg CO_2/year of emissions per household from kerosene usage for lighting may be a reasonable, conservative estimate that is below BAU.

Under this methodology, two tiers have been proposed to provide emission factors for electricity supplied to off grid households: tier 1 inovlves consumption up to 55 kWh/year/household of electricity primariliy for lighting purposes, and tier 2 involves consumption of more than 55 kWh/year/household for other purposes. For tier 1, a default emission factor of 2.72 kg CO_2/kWh (i.e. 2.72 t CO_2/MWh) is proposed, based on guidance in the RMP, paragraph 27 (a) and 27 (b), and taking into account guidance on suppressed demand. 2.72 kg CO_2/kWh instead of 6.8 kg CO_2/kWh used under the CDM methodologies will lead to conservative estimates while still recognising a degree of suppressed demand.

Table 2 below shows the impact of emission reduction estimates based on two samples of CDM Programme of Activities implemented in Mozambique and Uganda. Important to observe that the version of AMS-I.L. applied by both samples (version 03) contains three tiers of electricity supplied to off grid households: below 55 kWh/year/household, between 55 and 250 kWh/year/household and above 250 kWh/year/household, whereas the proposed updated approach merges the 2nd and 3rd tiers into a single one.[8]

Table 2. Impact on emission reductions based on emissions factor value used

	Original approach (version 03 of AMS-I.L.)			Proposed updated approach		Difference between proposed updated approach and original approach
	Tiers of electricity supplied to off grid households (kWh/year/household)					
	Up to 55 kWh	**Between 55 and 250 kWh**	**Above 250 kWh**	**Up to 55 kWh**	**Above 55 kWh**	
Emission factor (tCO_2e/MWh)	6.8	1.3	1.0	2.7	0.7	
Emission reductions – CASE 1 (tCO_2e)	21,580	0 (no users identified for this tier)	0 (no users identified for this tier)	8,569	0 (no users identified for this tier)	60.3%
Emission reductions – CASE 2 (tCO_2e)	3,133	2,123	921	1,244	1,788	50.9%

[6] Available at https://www.lightingafrica.org/wp-content/uploads/2016/07/Solar-Lighting-for-the-BOP-overview-of-an-emerging-mkt.pdf.

[7] See pages 37 and 50 of the report available at https://www.gogla.org/sites/default/files/resource_docs/gogla_impact_metricsv4.pdf.pdf.

[8] The merging of the 2nd and 3rd tiers was reflected in the latest version of AMS-I.L. (version 04) approved by the CDM-EB on 08/09/2022.

*For illustration purposes only, the data was obtained either from a CDM project or from a CDM PoA listed below as the required data was available (no other criteria was used for this selection)**;***
Case 1 – "PoA 10203: Off-grid renewable energy for rural electrification in Mozambique managed by FUNAE", from Mozambique
Case 2 – "PoA 10186: Accelerating Electrification through Grid Extension and Off-Grid Electrification in Rural Areas of Uganda"

For the second tranche (more than 55 kWh of electricity supplied to the user in a given year), a default emission factor of 0.7 kg CO2/kWh (i.e. 0.7 t CO2/MWh) has been proposed, based on a conservative emission factor of diesel generator systems.

The CO_2 emission factors for diesel generating sets vary significantly according to the size of the diesel generating sets (kW), load factor and efficiency of the system including generators and alternators.

A literature review was conducted, including information from manufacturers. Default values used in the methodologies by other mechanisms such as the Joint Crediting Mechanism (JCM) were also reviewed.

The JCM methodology[9] "Displacement of Grid and Captive Genset Electricity by a Small-scale Solar PV System, version 01.0" for a project in Palau estimated that the current CO_2 emission factor for diesel generating systems ranges from 0.631 t CO_2/MWh to 0.805 t CO_2/MWh in the region based on an efficiency range of 33 per cent to 41 per cent.

The JCM methodology proposed 0.533 t CO_2/MWh as the baseline emission factor[10] for an efficiency rate of 49[11] per cent.[12]

Diesel engines in use are reported to have efficiencies that range from 30 per cent to 45 per cent,[13] and the power generation efficiency of diesel engine systems ranges from 30 per cent to 48 per cent[14].

ICF, in its study titled "Diesel Generators: Improving Efficiency and Emission Performance in India",[15] noted that typically the combined efficiency of diesel generating sets varies between 30 per cent to 55 per cent, while the stand-alone efficiency of diesel engines and alternators is 35–

[9] https://www.jcm.go.jp/pw-jp/methodologies/18.

[10] Calculated as [t CO_2/MWh] (CO_2 emission factor of diesel oil [kg-CO_2/GJ]/1,000*3.6) / (power generation efficiency (lower heating value basis) [%]/100), applying the default value of the CO_2 emission factor of diesel oil (72.6 kg CO_2/GJ) from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

[11] Which is yet to be achieved by the world's leading diesel generator manufacturers but is expected to be achieved in the near future.

[12] Paul Breeze, 2014. Power generation technologies, 2nd Edition. Furthermore, in 'Approach on High Efficiency Diesel and Gas Engine, 2008, Mitsubishi Heavy Industries Technical Review Vol. 45 No. 1.', it is indicated that the SU3 and MARK-30B engines have attained generation efficiencies of 44.1 per cent and 46.8 per cent, respectively; according to the company's technical review, better than any other diesel engine in that class at the time of publication of the review.

[13] Handbook of Energy Efficiency and Renewable Energy, 2007, Edited by D. Yogi Goswami.

[14] Cogeneration Plan and Design Manual, 6th edition, 2008, Japan Institute of Energy.

[15] Available at https://shaktifoundation.in/wp-content/uploads/2017/06/ICF-2014-Diesel-Generators-Improving-Efficiency-and-Emission-Performance-in-India.pdf.

60 per cent and 85–95 per cent, respectively.[16] The study considered the efficiency of 82 diesel generator models from five major manufacturers in India.[17].

Tables 3 and 4 below show emission factors for various sizes of diesel generators operating at various loads, from a United States of America-based and Australia-based diesel generator supplier/manufacturer, respectively. A conversion factor of 2.69 kg CO_2 per litre of diesel has been used based on the density of diesel as 0.85 kg/litre[18],[19].

Table 3. Emission factors for diesel generator systems (kg CO_2/kWh[20])

Size	Load factors [%]		
	25%	50%	100%
>=15<35 kW	1.5	1.1	0.9
>=35 <135 kW	1.1	0.9	0.8
>=135<200 kW	1.0	0.8	0.7
> 200 kW	0.9	0.8	0.7

Table 4. Emission factors for diesel generator systems (kg CO_2/kWh[21])

Size	Load factors [%]		
	25%	50%	100%
<15 kW	1.0	0.9	0.8
>=15 <35 kW	1.0	0.8	0.8
>=35 <135 kW	1.0	0.8	0.8
>=135<200 kW	0.9	0.8	0.8
> 200 kW	0.9	0.8	0.8

While the ICF study cited above assumed a 75 per cent loading of generators, the study by Access to Energy GmbH[22] in Nigeria found that generators were about 5-times larger than needed and as a result had an average load under 20 per cent.

[16] ICF analysis based on the typical fuel consumption of diesel generators. Available at https://shaktifoundation.in/wp-content/uploads/2017/06/ICF-2014-Diesel-Generators-Improving-Efficiency-and-Emission-Performance-in-India.pdf.

[17] Data were derived from the product catalogues of Ashok Leyland, Caterpillar, Cummins, Kirloskar and Powerica; available on the manufacturers' websites.

[18] Part I, Chapter 2 - Production, properties and environmental impact of hydrocarbon fuel conversion, Advances in Clean Hydrocarbon Fuel Processing, Science and Technology, A volume in Woodhead Publishing Series in Energy, (2011).

[19] A litre of diesel contains 86.32 per cent carbon as per the CO2 Emission Factors for Fossil Fuels by the German Environment Agency, available at https://www.umweltbundesamt.de/sites/default/files/medien/1968/publikationen/co2_emission_factors_for_fossil_fuels_correction.pdf. The molecular weight of CO_2 is 44 and the molecular weight of carbon is 12.

[20] Based on fuel consumption values as reported at https://www.generatorsource.com/Diesel_Fuel_Consumption.aspx.

[21] Based on fuel consumption values as reported in https://www.ablesales.com.au/blog/diesel-generator-fuel-consumption-chart-in-litres.html.

[22] WWW.A2EI.ORG/DATA.

It is evident from the above analysis that the emission factor for diesel generating systems should be dependent on the capacity and load of the system. The emission factor used in JCM methodologies would meet the condition of BAT under the RMP however may not meet the 'economically feasible condition' as the technology is not commercially available. Based on the above analysis and taking into account the guidance on BAT and ambitious benchmark for baselines in the RMP 0.7 kg CO_2e/kWh, is proposed as the emission factor. Thus for renewable energy supplied to households, in off-grid settings, for consumption above 55 kWh, 0.7 kg CO_2/kWh is proposed. This value is lower than the 0.8 kg CO_2/kWh in Table 6 and the default value contained in "TOOL 07: Tool to calculate the emission factor for an electricity system" for off-grid systems (i.e. 0.8 t CO_2/MWh).

5.1.1. Greenfield and/or rehabilitation of individual renewable generation systems

28. Baseline emissions for the ~~entire project~~ activity are calculated as:

$$BE_y = BE_{55,y} + BE_{55\,plus,y}$$ Equation (1)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$BE_{55,y}$	=	Aggregate baseline emissions for consumers that consumed equal to or less than 55 kWh of renewable electricity from project renewable electricity systems in year *y* (t CO_2)
$BE_{55\,plus,y}$	=	Aggregate baseline emissions for consumers that consumed more than 55 kWh of renewable electricity from project renewable electricity systems in year *y* (t CO_2)

29. For consumers that consumed equal to or less than 55 kWh, baseline emissions are calculated as:

$$BE_{55,y} = \sum_{x}^{N} EG_{x,y} \times EF_{CO2,55}$$ Equation (2)

Where:

$EG_{x,y}$	=	Electricity delivered by project renewable electricity generation system to consumer *x*, where the electricity delivered to that facility is equal to or less than 55 kWh in year *y* (MWh)
$EF_{CO2,55}$	=	A default emission factor value as ~~provided~~ specified under para 26 (a) above for first 55 kWh of electricity supplied (t CO_2/MWh)
x	=	Consumer supplied with renewable electricity from operating project renewable electricity generation systems consuming equal to or less than 55 kWh in year *y*
N	=	Number of consumers in the project activity consuming equal to or less than 55 kWh/year

30. For consumers that consumed more than 55 kWh baseline emissions are calculated as:

$$BE_{55\,plus,y} = \sum_{z}^{M} \left[\left(EG_{z,y} - 0.055 \right) \times EF_{CO2,55\,plus} + C \right] \quad \text{Equation (3)}$$

Where:

$EG_{z,y}$	=	Electricity delivered by project renewable electricity generation system to consumer *z* in year *y*, where the electricity delivered to the facility is more than 55 kWh
$EF_{CO2,55\,plus}$	=	A default emission factor value as specified under para 26 (b) above (t CO_2/MWh)
z	=	Consumer supplied with renewable electricity from operating project renewable electricity generation systems consuming more than 55 kWh in year *y*
c	=	A constant calculated by multiplying 55 kWh electricity supply and a default emission factor value as specified under para 26 (a) above for first 55 kWh of electricity supplied (t CO_2)
M	=	Number of facilities in the project activity consuming more than 55 kWh

5.1.2. Greenfield ~~or expansion of~~ renewable mini-grid systems

31. An ex ante census of project electricity consumers are intended to be supplied with electricity from the project renewable mini-grid shall be carried out to document the physical location of each consumer and the anticipated annual electricity consumption of each consumer. As an option, the anticipated annual electricity consumption of individual consumer may be established based on the type of connection or payment arrangement provided (e.g. load limited, fee for service based connection). The consumers should be categorised as either households (Type I consumers) or non-households[23] (Type II consumers). Electricity consumption of each Type I consumer that is expected to consume more than 1,000 kWh per year and each Type II consumer shall be individually metered. Type I consumers whose consumption is required to be individually metered are called Type I-M consumers and Type I consumers whose consumption is not required to be individually metered are called as Type I-NM facilities.

32. Baseline emissions are the sum of emissions associated with:

(a) Consumers that will be connected to the new ~~or expanded~~ mini-grid but were not connected to any existing grids prior to the project activity; these are defined as new consumers (either Type I and Type II consumers);

~~(b) Consumers that will be connected to the new or expanded mini-grid but were connected to an existing grid prior to the project activity; these are defined as existing consumers (for existing consumers, whether they are Type I and Type II consumers is not relevant).~~

[23] These include commercial consumers; small, medium and micro enterprises (SMMEs); public institutions; street lighting and small-scale industrial consumers as well as agricultural facilities (such as irrigation pump sets).

33. Baseline emissions are the sum of emissions associated with new consumers (Type I and Type II consumers) ~~and existing consumers~~ are calculated as follows:

$$BE_y = (BE_{T1,y} + BE_{T2,y} + \cancel{BE_{exist,y}}) \times BCFy \qquad \text{Equation (4)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$BE_{T1,y}$	=	Baseline emissions for Type I consumers in year *y* (t CO_2)
$BE_{T2,y}$	=	Baseline emissions for Type II consumers in year *y* (t CO_2)
$\cancel{BE_{exist,y}}$	~~=~~	~~Baseline emissions of existing consumers, i.e. baseline emissions from displacement of electricity from an existing mini-grid (t CO_2) $BE_{exist,y}$ = 0, if there are no existing consumers~~
BCF_y	=	Baseline Contraction Factor in year *y* (fraction) to adjust the baseline downwards to implement more stringent baselines over time

~~34. Baseline emissions of existing consumers are calculated as follows:~~

$$\cancel{BE_{exist,y} = ED_{exist,y} \times EF_{mgrid}} \qquad \text{~~Equation (5)~~}$$

~~Where:~~

$\cancel{ED_{exist,y}}$	~~=~~	~~Total electricity delivered to existing consumers ($N_{exist,y}$) (MWh)~~
$\cancel{EF_{mgrid}}$	~~=~~	~~Baseline emissions factor for the mini-grid (t CO_2)~~ ~~For a mini-grid system where all generators use exclusively fuel oil and/or diesel fuel, emission factor specified in para 21(b) shall be applied.~~

35. The following two approaches can be used to estimate baseline emissions associated with new Type I and Type II consumers.

(a) **Approach 1**. Detailed calculations based on tranches of electricity consumption;

(b) **Approach 2**. Simplified calculation based on average electricity consumption per consumer.

5.1.2.1. Approach 1. Detailed calculations based on tranches of electricity consumption

36. With this approach, baseline emissions of Type II consumers, $BE_{T2,y}$ are calculated as follows:

$$BE_{T2,y} = \sum_{i}^{N_y} EC_{T2,i,y} \times EF_{CO2,T2} \qquad \text{Equation (6)}$$

Where:

$BE_{T2,y}$	=	Baseline emissions for Type II consumers in year *y* (t CO_2)
$EC_{T2,i,y}$	=	Metered annual electricity consumption of Type II consumer *i* in year *y* (MWh)
$EF_{CO2,T2}$	=	A default emission factor value as specified under para 26 (b) (t CO_2/MWh)
N_y	=	Number of Type II consumers in year *y*

37. Baseline emissions from Type I consumers, $BE_{T1,y}$ are calculated as a function of total electricity consumed by all the Type I consumers and a baseline emission factor chosen based on the average annual electricity consumption of all Type I consumers.

$$BE_{T1,y} = \left[\left(EC_{T1NM,y} \times NM_y\right) \times EF_{CO2,T1,NM}\right] + \left[\left(EC_{T1M,y} \times M_y\right) \times EF_{CO2,T1M}\right] \quad \text{Equation (7)}$$

$$EC_{T1NM,y} = \frac{\left(EC_{tot\_T1NM,y}\right)}{NM_y} \quad \text{Equation (8)}$$

$$EC_{T1M,y} = \frac{\left(\sum_j^M EC_{T1M,j,y}\right)}{M_y} \quad \text{Equation (9)}$$

$$EC_{tot\_T1NM,y} = \left[\left(ED_{tot,y} - \cancel{ED_{exist,y}}\right) \times \left(1 - TDL_p\right)\right] - \sum_i^N EC_{T2,i,y} - \sum_j^M EC_{T1,M,j,y} \quad \text{Equation (10)}$$

Where:

$BE_{T1,y}$	=	Baseline emissions for Type I consumers in year *y* (t CO_2)
$EC_{T1NM,y}$	=	Average annual electricity consumption of all Type I-NM consumers in year *y* (MWh)
$EC_{T1M,y}$	=	Average annual electricity consumption of all Type I-M consumers in year *y* (MWh)
$EC_{T1M,j,y}$	=	Annual electricity consumption of Type I-M consumer *j* in year *y* (MWh)
NM_y	=	Number of Type I-NM consumers in year *y*
M_y	=	Number of Type I-M consumers in year *y*
$EF_{CO2,T1,NM}$	=	(a) If $EC_{T1NM,y}$ is less than or equal to 55 kWh/y, then use a default emission factor value as provided for first 55 kWh of electricity supplied as specified under para 26 (a) above (t CO_2/MWh);

		(b) If $EC_{T1NM,y}$ is more than 55 kWh/y, use a default emission factor value as specified under para 26 (b) above (t CO_2/MWh)
$EF_{CO2,T1M}$	=	(a) If $EC_{T1M,y}$ is equal to or less than 55 kWh/y, then use a default emission factor value as provided for first 55 kWh of electricity supplied as specified under para 26 (a) above (t CO_2/MWh);
		(b) If $EC_{T1M,y}$ is more than 55 kWh/y, use a default emission factor value as specified under para 26 (b) above (t CO_2/MWh)
$EC_{tot\_T1NM,y}$	=	Total electricity delivered to the community of all Type I-NM consumers, net of transmission and distribution losses (MWh)
$ED_{tot,y}$	=	Total electricity delivered to the community of all Type I, Type-II and existing consumers (MWh)
TDL_p	=	Transmission and distribution losses within the project area (%), with 10 per cent as a default value

5.1.2.2. Approach 2. Simplified calculation based on average electricity consumption per consumer

38. With this approach, baseline emissions of Type-I and Type-II consumers, are calculated as follows:

$$BE_{T1,y} + BE_{T2,y} = \left(ED_{tot,y} \cancel{- ED_{exist,y}}\right) \times \left(1 - TDL_p\right) \times EF_{CO2,tot} \qquad \text{Equation (11)}$$

Where:

$EF_{CO2,tot}$	=	A default emission factor value as specified under para 21 (a)

5.2. Project emissions

39. Project emissions are considered zero (i.e. PE_y = 0) except in the cases below where method indicated in AMS-I.D. is applied to calculate project emissions:

(a) Emissions related to the operation of geothermal power plants (e.g. non-condensable gases, electricity/fossil fuel consumption);

(b) Emissions from water reservoirs of hydro power plants.

5.3. Leakage

Draft Requirements

Avoid Leakage where applicable

26. Paragraph 33 of the RMP states that the 'Mechanism methodologies shall avoid leakage, where applicable'.

27. Leakage is the net change of anthropogenic emissions by sources of greenhouse gases (GHGs) which occurs outside the project boundary, and which is measurable and attributable to the Article 6.4 activity, as applicable.

28. Mechanism methodologies shall:

(a) Ensure that the potential sources of leakage in a typical activity covered by the mechanism methodology are identified, including, but not limited to, used equipment transferred outside of the project boundary and diversion of resources from other activities, or diversion of production or service provision;

(b) Include provisions to avoid or minimize all sources of leakage as far as possible;

(c) Quantify the leakage that cannot be avoided and deduct it from the emission reduction achieved by the Article 6.4 activities;

(d) Require the activity participant to follow any guidance from the designated national authority (DNA) of the host Party on leakage, where available.

29. For some classes of activities, monitoring at jurisdictional level may be necessary to quantify and account for leakage. In addition, further work will be required to assess the implications of activities implemented outside national borders and transboundary activities. Supervisory Body will develop further guidance in this regard at a future meeting of the Supervisory Body.

40. Activity participants applying this methodology shall avoid leakage, where applicable by:

(a) Identifying the potential sources of leakage, such as baseline equipment transferred outside of the project boundary or used equipment deployed as project technology, diversion of production or service provision;

(b) Describing provisions that will be implemented to avoid or minimize all sources of leakage;

(c) Applying approaches to quantify leakage that cannot be avoided and deduct it from the emission reduction achieved by the Article 6.4 activity;

(d) Following any guidance from the designated national authority (DNA) of the host Party on leakage.

Rationale for changes

The above requirements are self explanatory.

5.4. Emission reductions

41. Emission reductions on annual basis (ER_y) are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (12)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/y)
BE_y	=	Baseline Emissions in year *y* (t CO_2/y)
PE_y	=	Project emissions in year *y* (t CO_2/y)
LE_y	=	Leakage emissions in year *y* (t CO_2/y)

6. Monitoring methodology

6.1. Individual, renewable electricity generation system

42. Net annual amount of renewable electricity supplied to a facility is monitored as below:

(a) **Option 1**. Measure the net amount of renewable electricity delivered to each consumer connected to the project renewable electricity generation system(s). Such measurements shall be made continuously and recorded at least on a monthly basis;

(b) **Option 2**. Calculate the net amount of renewable electricity delivered to all the consumers connected to the project renewable electricity generation system(s) as the installed capacity of the project renewable electricity generation systems times annual average value for availability.[24] This option can only be applied to project activities involving installation or rehabilitation of individual, renewable energy systems and only for consumers (facilities) associated with those systems whose installed capacity is equal to or less than 1.0 kW. For solar photovoltaic electricity systems, the annual average value for availability can be obtained through following options:

(i) **Option 2a.** Assume a conservative default value of twelve per cent (12 per cent) for the annual average value for availability;[25]

(ii) **Option 2b.** Calculate the annual average value for availability based on local site conditions and system characteristics. “RETScreen® International Photovoltaic Project Model” included in the “RETScreen Clean Energy Project Analysis Software”[26] as below:

a. Complete the “Energy Model and Solar Resource & System Load” worksheet;

b. For the cells where “user inputs” are required and where online databases are provided (e.g. weather database), the latter may be used as sources for the input to the cells;

[24] This assumes that all of the renewable energy that is produced will be consumed by the facility.

[25] For example, a 15 Wp Solar Home System would deliver 15.77 kWh annually (0.015 x 8760 x 0.12).

[26] Publicly available at <http://www.retscreen.net/ang/home.php>. Other similar software may be proposed for inclusion following the procedures for a revision of a methodology.

c. If the annual solar radiation[27] (MWh/m^2/year) in the sites of the project activity or the component project activity vary significantly (i.e. greater than +/-10% variation) then:

   i. Perform the calculation for the site receiving the least amount of annual solar radiation; or

   ii. Perform the calculation for a representative selection of sites and take the weighted average value;

d. If there is more than one type of project electricity generation system i.e. the system characteristics of the project systems differ, then perform the calculations separately for each type of system and take the weighted average value. The following parameters may be considered for defining the system characteristics:

   i. The system is a mini-grid or off-grid or water pumping system;

   ii. System is with or without battery backup;

   iii. System includes or excludes inverters;

   iv. Type of solar panel when more than one type of solar panel is used (e.g. monocrystalline silicon, polycrystalline silicon and thin films);

   v. Type of tracking device when more than one type of solar tracking devices are used (i.e. fixed, one-axis, two-axis, azimuth);

   vi. Type of control method, orientation and slope (i.e. maximum power point tracker and clamped control methods, degrees above horizontal for the slope, azimuth of solar panel in degrees from due South).

   vii. Assume a value of 10 per cent loss for the miscellaneous losses;

(iii) **Option 2c**. Source the annual average value for availability from the project feasibility report (e.g. provided by the manufacturer/supplier of the system) when it includes the calculations for estimating the output from the system (i.e. weather data used, system characteristics and losses assumed are described).

43. When option 2 in paragraph 42 above is applied, the number of operating project renewable electricity generation systems is determined on a sample basis either annually choosing [90/10] confidence/precision [when using digital technologies such as data sensors or data loggers] or biennially choosing [95/10] [95/x] confidence/precision for the sample size estimation following the requirements under "Standard on sampling and surveys for project activities and PoAs". This monitored value determines N/M/P (number of consumers) in equations (2) and, (3). Renewable electricity generation systems can be

[27] If the solar radiation values are available for each month it may be annualized by taking the average for 12 months.

counted as operating only if they can be shown to be able to produce electricity by means of one of the following:

(a) The manufacturer's warranty; or

(b) Regular maintenance arrangement (e.g. with suppliers/distributors/implementers); or

(c) Showing that the systems are procured following the standards/guidelines (local/national/international) to ensure that the systems are of adequate quality and provide the required performance; or

(d) By direct monitoring of systems, if necessary on sample basis.

44. In the absence of this demonstration, the system capacity shall be de-rated following manufacturers guidelines or as per relevant international standards/guidelines.

45. Both monitoring options 1 and 2 in paragraph 42 can be used within the same project activity provided that:

(a) A procedure that ensures no double counting of emissions reductions has been implemented;

46. Option 2 is applied to all systems with a capacity for renewable electricity generation is equal to or less than 1.0 kW.This methodology includes assumptions, parameters, data sources and key factors applicable to activities under this methodology. Where applicable, the activity participant shall transparently and clearly describe additional parameters and assumptions and the data sources associated with the parameters, and include a definition of uncertainty and related adjustments where relevant.

6.2. Greenfield ~~or expansion of~~ renewable mini-grid systems

47. The metering of all the relevant parameters shall be per the guidance indicated below.

Data / Parameter Table 1.

Data / Parameter:	$ED_{tot,y}$
Data unit:	MWh/y
Description:	Electricity delivered to consumers from the grid/mini-grid system
Measurement procedures (if any):	An electricity meter shall be installed as part of the project activity to measure total gross electricity supplied to all connected consumers (new and existing) from the project renewable electricity generation system. For new mini-grid construction, the metering can be at the mini-grid plant itself. For mini-gird extension, this can be at the substation from which the electrification project is supplied
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	-

Data / Parameter Table 2.

Data / Parameter:	$EC_{T2,i,y}$
Data unit:	MWh/y
Description:	Electricity metered at Type II consumer *i*
Measurement procedures (if any):	Measurements are undertaken using electricity meters at the consumer electricity service entrance
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	-

Data / Parameter Table 3.

Data / Parameter:	$EC_{T1M,j,y}$
Data unit:	MWh/y
Description:	Electricity metered at Type I-M consumer
Measurement procedures (if any):	Measurements are undertaken using electricity meters at the facility electricity service entrance
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	-

Data / Parameter Table 4.

Data / Parameter:	$ED_{exist,y}$
Data unit:	MWh/y
Description:	Total electricity delivered in year *y* to the existing consumers
Measurement procedures (if any):	Measurements are undertaken using electricity meters. The measurement should be taken at the nearest pre-existing substation from which the electrification project is supplied
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording
Any comment:	-

Data / Parameter Table 5.

Data / Parameter:	***Proportion of N_y, NM_y, $N_{exist,y}$ and M_y having access to mini-grid***
Data unit:	-
Description:	Check for continued access to electricity
Measurement procedures (if any):	Annual/biennial checks that mini-grid connections are still working, done with a census or a statistically significant sample of consumers. Use [90/10] and [95/10] [95/x] precision for annual and biennial checks, respectively
Monitoring frequency:	Annual/biennial
Any comment:	-

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