CLEAN DEVELOPMENT MECHANISM

AM0103

Large-scale Methodology

Renewable energy power generation in isolated grids

Version 03.0

Sectoral scope(s): 01

United Nations
Framework Convention on
Climate Change

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1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	Power generation using renewable energy sources connected to a new or an existing isolated grid
Type of GHG emissions mitigation action	Renewable energy: Displacement of electricity that would be provided to the isolated grid by more-GHG-intensive means

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology covers renewable energy based power generation projects connected to a new or an existing isolated grid.

2.2. Applicability

3. This methodology applies to power generation using renewable energy sources connected to a new or an existing isolated grid. The methodology is applicable under the following conditions:

(a) The project activity is the installation, capacity addition, retrofit or replacement of a power plant/unit of one of the following types: hydro power plant/unit (either with a run-of-river reservoir or an accumulation reservoir), wind power plant/unit, geothermal power plant/unit, solar power plant/unit, wave power plant/unit or tidal power plant/unit;

(b) In the case of capacity additions, retrofits or replacements (except for capacity addition projects for which the electricity generation of the existing power plant(s) or unit(s) is not affected) the existing plant started commercial operation prior to the start of a minimum historical reference period of five years, used for the calculation of baseline emissions and defined in the baseline emission section, and no capacity addition or retrofit of the plant has been undertaken between the start of this minimum historical reference period and the implementation of the project activity.

4. In case of hydro power plants:

(a) At least one of the following conditions must apply:

(i) The project activity is implemented in an existing single or multiple reservoirs, with no change in the volume of any of the reservoirs; or

(ii) The project activity is implemented in an existing single or multiple reservoirs, where the volume of any of reservoirs is increased and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2 after the implementation of the project activity; or

(iii) The project activity results in new single or multiple reservoirs and the power density of each reservoir, as per the definitions given in the project emissions section, is greater than 4 W/m^2 after the implementation of the project activity.

5. In case of hydro power plants using multiple reservoirs where the power density of any of the reservoirs is lower than 4 W/m^2 after the implementation of the project activity all of the following conditions must apply:

(a) The power density calculated for the entire project activity using equation 5 is greater than 4 W/m^2;

(b) All reservoirs and hydro power plants are located at the same river and were designed together to function as an integrated project[1] that collectively constitutes the generation capacity of the combined power plant;

(c) The water flow between the multiple reservoirs is not used by any other hydropower unit which is not a part of the project activity;

(d) The total installed capacity of the power units, which are driven using water from the reservoirs with a power density lower than 4 W/m^2, is lower than 15 MW;

(e) The total installed capacity of the power units, which are driven using water from reservoirs with a power density lower than 4 W/m^2, is less than 10% of the total installed capacity of the project activity from multiple reservoirs.

6. The methodology is not applicable to the following:

(a) Project activities that involve switching from fossil fuels to renewable energy sources at the site of the project activity, since in this case the baseline may be the continued use of fossil fuels at the site;

(b) Biomass fired power plants;

(c) A hydro power plant[2] that results in the creation of a new single reservoir or in the increase in an existing single reservoir where the power density of the reservoir is less than 4 W/m^2.

[1] This requirement can be demonstrated, for example: (i) by the fact that water flow from upstream power units spilling directly to the downstream reservoir, or (ii) through the analysis of the water balance. Water balance is the mass balance of water fed to power units, with all possible combinations of multiple reservoirs and without the construction of reservoirs. The purpose of such water balance is to demonstrate the requirement of specific combination of multiple reservoirs constructed under CDM project activity for the optimization of power output. This demonstration has to be carried out in the specific scenario of water availability in different seasons to optimize the water flow at the inlet of power units. Therefore, this water balance will take into account seasonal flows from river, tributaries (if any), and rainfall for minimum three years prior to implementation of CDM project activity.

[2] Project participants wishing to undertake a hydroelectric project activity that result in a new reservoir or an increase in the existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchments area, may request a revision to the approved consolidated methodology.

7. The methodology is applicable if the isolated grid complies with one of the following situations:

   (a) Scenario 1: Any isolated grid located in a Least Developed Country (LDC) or small island development State (SIDS) where at least 65% of the power installed capacity is based on ***fossil fuel*** sources - solid, liquid or gaseous;

   (b) Scenario 2: Any isolated grid where 65% of the power installed capacity is based on ***liquid fossil fuel*** sources;

   (c) Scenario 3: Any isolated grid with a maximum power installed capacity of 1000 MW and at least 80% of the power installed capacity is based on ***fossil fuel*** sources - solid, liquid or gaseous.

8. Project participants can claim emission reductions only as long as the grid remains isolated and the conditions above are fulfilled. Emission reductions are considered as zero if the isolated grid is connected to another electric grid or if the conditions above are not fulfilled.

9. In addition, the applicability conditions included in the tools referred to above apply.

10. Finally, this methodology is only applicable if the application of the procedure to identify the baseline scenario results in the scenario that the installation of a fossil fuel power plant is the most plausible baseline scenario.

2.3. Entry into force

11. The date of entry into force is the date of the publication of the EB 100 meeting report on the 31 August 2018.

2.4. Applicability of sectoral scopes

12. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 01 is mandatory.

3. Normative references

13. This baseline and monitoring methodology is based on elements from the approved baseline and monitoring methodology “ACM0002: Consolidated baseline methodology for grid-connected electricity generation from renewable sources”.

14. This methodology also refers to the latest approved versions of the following tools:

   (a) “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality”;

   (b) “TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”.

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

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

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

4. Definitions

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

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

(a) **Isolated grid** - an electrical network supplying electricity to household users, and if applicable, industries and commercial areas that is not connected to any other electrical network;

(b) **Renewable energy sources** - this includes: hydro power plants (either with a run-of-river reservoir or an accumulation reservoir), wind power plants, geothermal power plants, solar power plants, wave power plants or tidal power plants;

(c) **Installed power generation capacity (or installed capacity or nameplate capacity)** - the installed power generation capacity of a power unit is the capacity, expressed in Watts or one of its multiples, for which the power unit has been designed to operate at nominal conditions. The installed power generation capacity of a power plant is the sum of the installed power generation capacities of its power units;

(d) **Capacity addition** - an increase in the installed power generation capacity of an existing power plant through: (i) the installation of a new power plant beside the existing power plant/units; or (ii) the installation of new power units, additional to the existing power plant/units. The existing power plant/units continue to operate after the implementation of the project activity**;**

(e) **Retrofit (or Rehabilitation or Refurbishment)** - an investment to repair or modify an existing power plant/unit, with the purpose to increase the efficiency, performance or power generation capacity of the plant, without adding new power plants or units, or to resume the operation of closed (mothballed) power plants. A retrofit restores the installed power generation capacity to or above its original level. Retrofits shall only include measures that involve capital investments and not regular maintenance or housekeeping measures;

(f) **Replacement** - investment in a new power plant or unit that replaces one or several existing unit(s). The new power plant or unit has the same or a higher power generation capacity than the plant or unit that was replaced. The new power plant(s) or unit(s) may be either installed at the same location as the existing power plant(s) or unit(s) or (partially) at a different location;

(g) **Reservoir** - a water body created in valleys to store water generally made by the construction of a dam;

(h) **Existing reservoir** - a reservoir is to be considered as an “existing reservoir” if it has been in operation for at least three years before the implementation of the project activity.

5. Baseline methodology

5.1. Project boundary

19. The spatial extent of the project boundary includes the project power plant and all power plants connected physically to the isolated grid that the CDM project power plant is connected to.

20. The greenhouse gases and emission sources included in or excluded from the project boundary are shown in Table 2.

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

Source		Gas	Included	Justification/Explanation
Baseline	CO_2 emissions from electricity generation in fossil fuel fired power plants	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
Project activity	For geothermal power plants, fugitive emissions of CH_4 and CO_2 from non-condensable gases contained in geothermal steam	CO_2	Yes	Main emission source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emission source
	For solar thermal and geothermal power plants, CO_2 emissions from combustion of fossil fuels for electricity generation	CO_2	Yes	Main emission source
		CH_4	No	Minor emission source
		N_2O	No	Minor emission source
	For hydro power plants, emissions of CH_4 from the reservoir	CO_2	No	Minor emission source
		CH_4	Yes	Main emission source
		N_2O	No	Minor emission source

5.2. Identification of the baseline scenario and demonstration of additionality

21. Project proponents shall determine the most plausible baseline scenario and demonstrate additionality through the use of the latest version of the “TOOL02: Combined tool to identify the baseline scenario and demonstrate additionality” (hereinafter “Combined Tool”). Where applicable, project proponents may use the provisions under section 5.2.1 below for additionality.

22. In applying Step 1 of the Combined Tool, define realistic and credible alternative scenarios that could provide the same amount of electricity as the proposed CDM project activity. These alternatives should include, inter alia:

(a) The proposed project activity undertaken without being registered as a CDM project activity;

(b) Standalone Solar PV generation with a storage capacity of up to five days;

(c) Other renewable power generation, including geothermal, wind, biomass or hydro power generation;

(d) Additional investment by the project participant in power generation using fossil fuels;

(e) Power generation using hybrid systems with a storage capacity of at least one day, e.g. solar PV+diesel;

(f) Continuation of operation of the existing isolated grid.

23. This methodology is only applicable to situations where the baseline scenario is either case (d) or case (f).

24. In cases where the entity developing the project is the grid operator or a government entity, the savings related to the fuel switch shall be considered as revenues and if applicable, the sale of electricity or reduction in subsidies as well. In cases the entity developing the project is a Private entity and is not related to the Grid operation (e.g. IPP), the revenues shall consider the sale of electricity and if applicable, subsidies, grants or any other similar income.

5.2.1. Simplified procedure to demonstrate additionality

25. The simplified procedure to demonstrate additionality is applicable to the following grid connected electricity generation technologies (positive list):

(a) Solar photovoltaic technologies;

(b) Solar thermal electricity generation including concentrating solar Power (CSP);

(c) Off-shore wind technologies;

(d) Marine wave technologies;

(e) Marine tidal technologies;

(f) Ocean thermal technologies.

26. A specific technology in the positive list in paragraph 25 above is defined as automatically additional if at the time of PDD submission[3] any of the following conditions is met:

(a) The percentage share of total installed isolated grid power generation capacity of the specific technology in the total installed isolated grid power generation capacity in the host country is equal to or less than two per cent; or

(b) The total installed isolated grid power generation capacity of the specific technology in the host country is less than or equal to 50 MW.

[3] For registration of the project activity or inclusion of the component project activity (CPA) in a programme of activities.

27. The project proponents that apply simplified procedure to demonstrate additionality shall provide information on actual capital cost of the project activity or the CPA at the time of the first verification.[4]

28. The positive list of technologies indicated in paragraph 25 above is valid for two years from the date of entry into force of version 03.0 of AM0103 on 31 August 2018. The Board may reassess the validity of these simplified procedures and extend or update them if needed. Any update of the simplified procedures does not affect the projects that request registration as a CDM project activity or a programme of activities by 30 August 2020 and apply the simplified procedures contained in version 03.0 of AM0103.

5.3. Project emissions

29. For most renewable power generation project activities, PE_y = 0. However, some project activities may involve project emissions that can be significant. These emissions shall be accounted for by using the following equation:

$$PE_y = PE_{FF,y} + PE_{GP,y} + PE_{HP,y}$$ Equation (1)

Where:

PE_y	=	Project emissions in year *y* (t CO_2e/yr)
$PE_{FF,y}$	=	Project emissions from fossil fuel consumption in year *y* (t CO_2e/yr)
$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$PE_{HP,y}$	=	Project emissions from reservoirs of hydro power plants in year *y* (t CO_2e/yr)

30. The procedure to calculate the project emissions from each of these sources is presented next.

5.3.1. Fossil Fuel Combustion ($PE_{FF,y}$)

31. For geothermal and solar thermal projects, which also use fossil fuels for electricity generation, CO_2 emissions from the combustion of fossil fuels shall be accounted for as project emissions ($PE_{FF,y}$).

32. $PE_{FF,y}$ shall be calculated as per the latest version of the "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

5.3.2. Emissions of non-condensable gases from the operation of geothermal power plants ($PE_{GP,y}$)

33. For geothermal project activities, project participants shall account for fugitive emissions of carbon dioxide and methane due to release of non-condensable gases from produced

[4] This information will be used for further work on positive list and will not affect the registered projects.

steam.[5] Non-condensable gases in geothermal reservoirs usually consist mainly of CO_2 and H_2S. They also contain a small quantity of hydrocarbons, including predominantly CH_4. In geothermal power projects, non-condensable gases flow with the steam into the power plant. A small proportion of the CO_2 is converted to carbonate/bicarbonate in the cooling water circuit. In addition, parts of the non-condensable gases are re-injected into the geothermal reservoir. However, as a conservative approach, this methodology assumes that all non-condensable gases entering the power plant are discharged to atmosphere via the cooling tower. Fugitive carbon dioxide and methane emissions due to well testing and well bleeding are not considered as they are negligible.

34. $PE_{GP,y}$ is calculated as follows:

$$PE_{GP,y} = (w_{steam,CO2,y} + w_{steam,CH4,y} \times GWP_{CH4}) \times M_{steam,y} \quad \text{Equation (2)}$$

Where:

$PE_{GP,y}$	=	Project emissions from the operation of geothermal power plants due to the release of non-condensable gases in year *y* (t CO_2e/yr)
$w_{steam,CO2,y}$	=	Average mass fraction of carbon dioxide in the produced steam in year *y* (t CO_2/t steam)
$w_{steam,CH4,y}$	=	Average mass fraction of methane in the produced steam in year *y* (t CH_4/t steam)
GWP_{CH4}	=	Global warming potential of methane valid for the relevant commitment period (t CO_2e/tCH_4)
$M_{steam,y}$	=	Quantity of steam produced in year *y* (t steam/yr)

5.3.3. Emissions from water reservoirs of hydro power plants (*$PE_{HP,y}$*)

35. For hydro power project activities that result in new reservoirs or in the increase of existing reservoirs, project proponents shall account for CH_4 and CO_2 emissions from the reservoir, estimated as follows:

(a) If the power density of the project activity (*PD*) is greater than 4 W/m^2 and less than or equal to 10 W/m^2;

$$PE_{HP,y} = \frac{EF_{Res} \times TEG_y}{1000} \quad \text{Equation (3)}$$

Where:

$PE_{HP,y}$	=	Project emissions from reservoirs of hydro power plants in year *y* (t CO_2e/yr)
EF_{Res}	=	Default emission factor for emissions from reservoirs of hydro power plants in year *y* (kgCO_2e/MWh)

[5] In the case of retrofit or replacement projects at geothermal plants, this methodology does not account for baseline emissions from release of non-condensable gases from produced steam or fossil fuel combustion. Project participants are welcome to propose revisions to this methodology to account for these baseline emissions.

TEG_y	=	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year *y* (MWh/yr)

(b) If the power density of the project activity (*PD*) is greater than 10 W/m^2.

$$PE_{HP,y} = 0 \quad \text{Equation (4)}$$

36. The power density of the project activity (*PD*) is calculated as follows:

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}} \quad \text{Equation (5)}$$

Where:

PD	=	Power density of the project activity (W/m^2)
Cap_{PJ}	=	Installed capacity of the hydro power plant after the implementation of the project activity (W)
Cap_{BL}	=	Installed capacity of the hydro power plant before the implementation of the project activity (W). For new hydro power plants, this value is zero
A_{PJ}	=	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m^2)
A_{BL}	=	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero

5.4. Baseline emissions

37. Baseline emissions include only CO_2 emissions from electricity generation in fossil fuel fired power plants that are displaced due to the project activity. The methodology assumes that all project electricity generation above baseline levels would have been generated by existing and/or new power plants connected to the isolated grid. The baseline emissions are to be calculated as follows:

$$BE_y = EG_{PJ,y} \times EF_{CM,y} \quad \text{Equation (6)}$$

Equation (7)

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the isolated grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)

$EF_{CM,y}$	=	Combined margin CO_2 emission factor for grid connected power generation in year *y* calculated using the applicable option as provided under section 6.6.3 'Simplified combined margin emission factor approach for isolated grid system' of the latest version of the "TOOL07: Tool to calculate the emission factor for an electricity system" (t CO_2/MWh)

5.4.1. Calculation of $EG_{PJ,y}$

38. The calculation of $EG_{PJ,y}$ is different for: (a) greenfield plants; (b) retrofits and replacements; and (c) capacity additions. These cases are described next:

5.4.1.1. (a) Greenfield renewable energy power plants

39. If the project activity is the installation of a new isolated grid-connected renewable power plant/unit at a site where no renewable power plant was operated prior to the implementation of the project activity, then:

$$EG_{PJ,y} = EG_{facility,y} \quad \text{Equation (8)}$$

Where:

$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the isolated grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EG_{facility,y}$	=	Quantity of net electricity generation supplied by the project plant/unit to the isolated grid in year *y* (MWh/yr)

5.4.1.2. (b) Retrofit or replacement of an existing renewable energy power plant

40. If the project activity is the retrofit or replacement of an existing isolated grid-connected renewable power plant, the baseline scenario is the continuation of the operation of the existing plant. For hydro power plants, if the replacement involves the installation of a hydro power plant in a new reservoir, then the applicability conditions on multiple reservoirs must be satisfied by the project activity.

41. The methodology uses historical electricity generation data to determine the electricity generation by the existing plant in the baseline scenario, assuming that the historical situation observed prior to the implementation of the project activity would continue.

42. The power generation of renewable energy projects can vary significantly from year to year, due to natural variations in the availability of the renewable source (e.g. varying rainfall, wind speed or solar radiation). The use of few historical years to establish the baseline electricity generation can therefore involve a significant uncertainty. The methodology addresses this uncertainty by adjusting the historical electricity generation by its standard deviation. This ensures that the baseline electricity generation is established in a conservative manner and that the calculated emission reductions are attributable to the project activity. Without this adjustment, the calculated emission

reductions would mainly depend on the natural variability observed during the historical period, rather than the effects of the project activity.[6]

43. $EG_{PJ,y}$ is calculated as follows:

$$EG_{PJ,y} = EG_{facility,y} - (EG_{historical} + \sigma_{historical}); until\ DATE_{BaselineRetrofit} \quad \text{Equation (9)}$$

and

$$EG_{PJ,y} = 0; on/after\ DATE_{BaselineRetrofit} \quad \text{Equation (10)}$$

Where:

$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the isolated grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EG_{facility,y}$	=	Quantity of net electricity generation supplied by the project plant/unit to the isolated grid in year *y* (MWh/yr)
$EG_{historical}$	=	Annual average historical net electricity generation delivered to the isolated grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr)
$\sigma_{historical}$	=	Standard deviation of the annual average historical net electricity generation delivered to the isolated grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity (MWh/yr)
$DATE_{BaselineRetrofit}$	=	Point in time when the existing equipment would need to be replaced in the absence of the project activity (date)

44. $EG_{historical}$ is the annual average of historical net electricity generation, delivered to the isolated grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity. To determine $EG_{historical}$, project participants may choose between two historical periods. This allows some flexibility: the use of the longer time period may result in a lower standard deviation and the use of the shorter period may allow a better reflection of the (technical) circumstances observed during the more recent years.

45. Project participants may choose among the following two time spans of historical data to determine $EG_{historical}$:

(a) The five last calendar years prior to the implementation of the project activity; or

[6] As an alternative approach for hydropower plants, the baseline electricity generation could be established as a function of the water availability. In this case, the baseline electricity generation would be established ex post based on the water availability monitored during the crediting period. Project participants are encouraged to consider such approaches and submit the related request for a revision to this methodology.

(b) The time period from the calendar year following $DATE_{hist}$, up to the last calendar year prior to the implementation of the project, as long as this time span includes at least five calendar years, where $DATE_{hist}$, is latest point in time between:

(i) The commercial commissioning of the plant/unit;

(ii) If applicable: the last capacity addition to the plant/unit; or

(iii) If applicable: the last retrofit of the plant/unit.

5.4.1.3. (c) Capacity addition to an existing renewable energy power plant

46. The addition of a new power plant or unit may affect or displace the electricity generated by the existing plant(s) or unit(s). Following are the examples to depict these situations:

(a) Example 1: Addition of hydro turbine. The existing turbines continue to operate, but their operation/output is affected;

(b) Example 2: Replacement of a wind turbine by a wind turbine of higher capacity.

47. In this case Option 1, mentioned below, shall be used to calculate $EG_{PJ,y}$. In other cases, the addition of new capacity does not affect the electricity generated by existing plant(s) or unit(s).[7] In this case, the electricity fed into the grid by the added power plant(s) or unit(s) could be directly metered and used to determine $EG_{PJ,y}$. In these cases, Option 2, as mentioned below, shall be used to calculate $EG_{PJ,y}$.

5.4.1.3.1. Options to determine $EG_{PJ,y}$ for project activity of capacity addition

48. **Option 1:** Use the approach applied to retrofits and replacements above (section b). $EG_{facility,y}$ corresponds to the total electricity generation of the existing plant(s) or unit(s) and the added plant(s) or unit(s). A separate metering of electricity fed into the grid by the added plant(s) or unit(s) is not necessary under this option.

49. **Option 2:** The following approach can be used provided that the electricity fed into the grid by the added power plant(s) or unit(s) addition is separately metered:

$$EG_{PJ,y} = EG_{PJ\_Add,y} \quad \text{Equation (11)}$$

Where:

$EG_{PJ,y}$	=	Quantity of net electricity generation that is produced and fed into the isolated grid as a result of the implementation of the CDM project activity in year *y* (MWh/yr)
$EG_{PJ\_Add,y}$	=	Quantity of net electricity generation supplied to the isolated grid in year *y* by the project plant/unit that has been added under the project activity (MWh/yr)

50. Project participants should document in the CDM-PDD which option is applied.

[7] In this case of wind power capacity additions, some shadow effects can occur but are not accounted under this methodology.

5.4.1.4. Calculation of $DATE_{BaselineRetrofit}$

51. In order to estimate the point in time when the existing equipment would need to be replaced/retrofitted in the absence of the project activity ($DATE_{BaselineRetrofit}$), project participants may take the following approaches into account:

    (a) The typical average technical lifetime of the type equipment may be determined and documented, taking into account common practices in the sector and country, e.g. based on industry surveys, statistics, technical literature, etc.;

    (b) The common practices of the responsible company regarding replacement/retrofitting schedules may be evaluated and documented, e.g. based on historical replacement/retrofitting records for similar equipment.

52. The point in time when the existing equipment would need to be replaced/retrofitted in the absence of the project activity should be chosen in a conservative manner, i.e. if a range is identified, the earliest date should be chosen.

5.5. Leakage

53. No leakage emissions are considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected.

5.6. Emission reductions

54. Emission reductions are calculated as follows:

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

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
PE_y	=	Project emissions in year *y* (t CO_2e/yr)

5.7. Data and parameters not monitored

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

Data / Parameter table 1.

Data / Parameter:	GWP_{CH4}
Data unit:	t CO_2e/t CH_4
Description:	Global warming potential of methane valid for the relevant commitment period
Source of data:	IPCC

Value to be applied:	For the first commitment period: 21 t CO_2e/t CH_4. For the second commitment period: 25 t CO_2e/t CH_4
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	EF_{Res}
Data unit:	kgCO_2e/MWh
Description:	Default emission factor for emissions from reservoirs of hydro power plants in year *y*
Source of data:	Decision by EB 23
Value to be applied:	90 kgCO_2e/MWh
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the hydro power plant before the implementation of the project activity. For new hydro power plants, this value is zero
Source of data:	Project site
Value to be applied:	Determine the installed capacity based on recognized standards
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m^2). For new reservoirs, this value is zero
Source of data:	Project site
Value to be applied:	Measured from topographical surveys, maps, satellite pictures, etc.
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$EG_{historical}$
Data unit:	MWh/yr
Description:	Annual average historical net electricity generation delivered to the isolated grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data:	Project activity site
Value to be applied:	Electricity meters
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$\sigma_{historical}$
Data unit:	MWh/yr
Description:	Standard deviation of the annual average historical net electricity generation delivered to the isolated grid by the existing renewable energy plant that was operated at the project site prior to the implementation of the project activity
Source of data:	Calculated from data used to establish $EG_{historical}$
Value to be applied:	Parameter to be calculated as the standard deviation of the annual generation data used to calculate $EG_{historical}$ for retrofit or replacement project activities
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	$DATE_{hist}$
Data unit:	date
Description:	Point in time from which the time span of historical data for retrofit or replacement project activities may start
Source of data:	Project activity site
Value to be applied:	$DATE_{hist}$ is the latest point in time between: The commercial commissioning of the plant/unit; If applicable: the last capacity addition to the plant/unit; or If applicable: the last retrofit of the plant
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$DATE_{BaselineRetrofit}$
Data unit:	date
Description:	Point in time when the existing equipment would need to be replaced in the absence of the project activity
Source of data:	Project activity site
Value to be applied:	As per provisions in the methodology above
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	**The percentage share of total installed capacity of the specific technology**
Data unit:	%
Description:	The percentage share of total installed capacity of the specific technology in the total installed grid connected power generation capacity in the host country
Source of data:	National statistics or other official data
Value to be applied:	-
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	**The total installed capacity of the technology**
Data unit:	%
Description:	the total installed capacity of the technology in the host country
Source of data:	National statistics or other official data
Value to be applied:	-
Any comment:	-

6. Monitoring methodology

56. Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and QA/QC procedures that will be applied. Where the methodology provides different options (e.g. use of default values or on-site measurements), specify which option will be used. All meters and instruments should be calibrated regularly as per industry practices.

57. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred percent of the data should be monitored if not indicated differently in the comments in the tables below.

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

6.1. Data and parameters monitored

Data / Parameter table 11.

Data / Parameter:	$EG_{facility,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied by the project plant/unit to the isolated grid in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	Electricity meters
Monitoring frequency:	Continuous measurement and at least monthly recording
QA/QC procedures:	Cross check measurement results with records for sold electricity
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	$EG_{PJ\_Add,y}$
Data unit:	MWh/yr
Description:	Quantity of net electricity generation supplied to the isolated grid in year *y* by the project plant/unit that has been added under the project activity
Source of data:	Project activity site
Measurement procedures (if any):	-

Monitoring frequency:	Continuous measurement and at least monthly recording
QA/QC procedures:	-
Any comment:	Applicable to wind, solar, wave or tidal power plant(s) or unit(s), provided that Option 2 in the baseline methodology is applied

Data / Parameter table 13.

Data / Parameter:	$w_{steam,CO2,y}$
Data unit:	tCO_2/t steam
Description:	Average mass fraction of carbon dioxide in the produced steam in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	Non-condensable gases sampling should be carried out in production wells and at the steam field-power plant interface using ASTM Standard Practice E1675 for Sampling 2-Phase Geothermal Fluid for Purposes of Chemical Analysis (as applicable to sampling single phase steam only). The CO_2 and CH_4 sampling and analysis procedure consists of collecting non-condensable gases samples from the main steam line with glass flasks, filled with sodium hydroxide solution and additional chemicals to prevent oxidation. Hydrogen sulphide (H_2S) and carbon dioxide (CO_2) dissolve in the solvent while the residual compounds remain in their gaseous phase. The gas portion is then analyzed using gas chromatography to determine the content of the residuals including CH_4. All alkanes concentrations are reported in terms of methane
Monitoring frequency:	At least every three months and more frequently, if necessary
QA/QC procedures:	-
Any comment:	Applicable to geothermal power projects

Data / Parameter table 14.

Data / Parameter:	$w_{steam,CH4,y}$
Data unit:	tCH_4/t steam
Description:	Average mass fraction of methane in the produced steam in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	As per the procedures outlined for $w_{steam,CO2,y}$
Monitoring frequency:	As per the procedures outlined for $w_{steam,CO2,y}$
QA/QC procedures:	-
Any comment:	Applicable to geothermal power projects

Data / Parameter table 15.

Data / Parameter:	$M_{steam,y}$
Data unit:	t steam/yr
Description:	Quantity of steam produced in year *y*
Source of data:	Project activity site

Measurement procedures (if any):	The steam quantity discharged from the geothermal wells should be measured with a venture flow meter (or other equipment with at least the same accuracy). Measurement of temperature and pressure upstream of the venture meter is required to define the steam properties. The calculation of steam quantities should be conducted on a continuous basis and should be based on international standards. The measurement results should be summarized transparently in regular production reports
Monitoring frequency:	Daily
QA/QC procedures:	-
Any comment:	Applicable to geothermal power projects

Data / Parameter table 16.

Data / Parameter:	TEG_y
Data unit:	MWh/yr
Description:	Total electricity produced by the project activity, including the electricity supplied to the isolated grid and the electricity supplied to internal loads, in year *y*
Source of data:	Project activity site
Measurement procedures (if any):	Electricity meters
Monitoring frequency:	Continuous measurement and at least monthly recording
QA/QC procedures:	-
Any comment:	Applicable to hydro power project activities with a power density of the project activity (PD) greater than 4 W/m^2 and less than or equal to 10 W/m^2

Data / Parameter table 17.

Data / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data:	Project site
Measurement procedures (if any):	Determine the installed capacity based on recognized standards
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 18.

Data / Parameter:	A_{PJ}
Data unit:	m^2
Description:	Area of the reservoir measured in the surface of the water, after the implementation of the project activity, when the reservoir is full
Source of data:	Project site

Measurement procedures (if any):	Measured from topographical surveys, maps, satellite pictures, etc.
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	-

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Document information

Version	*Date*	*Description*
03.0	31 August 2018	EB 100, Annex 5 Revision to: • Include the simplified approach for additionality demonstration in line with "ACM0002: Grid connected electricity generation from renewable sources"; • Keep the methodology consistent with the improvement of the "TOOL07: Tool to calculate the emission factor for an electricity system".
02.0	11 May 2012	EB 67, Annex 11 Revision to: • Provide simplified procedures that are applicable to both LDCs and SIDS; • Include an additional option to calculate baseline emissions using a weighted average emission factor.
01.0	2 March 2012	EB 66, Annex 31 Initial adoption.

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