GLOBAL CARBON COUNCIL

Driving Climate Actions

Draft Methodology for Renewable Energy Generation Projects Supplying Electricity to Grid or Captive Consumption

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Contents

1. Introduction

1.1 Background to baseline and monitoring methodologies of GCC

1. This methodology applies to renewable energy generation projects that supply electricity to the grid or captive consumption. Such renewable energy generation projects may be integrated with energy storage energy systems, such as Battery energy storage system (BESS), Pumped-hydro storage plant (PSP), etc.

1.2 Methodology key elements

2. GCC methodologies define the requirements for establishing baseline scenarios, demonstrating additionality, calculating GHG emission reductions, monitoring key parameters, and supporting Project Owners in developing the Project Submission Form (PSF).

3. The following table describes the key elements of the methodology.

Table 1. Methodology key elements

Typical Projects	Construction and operation of a renewable energy power plant/unit that uses renewable energy sources and supplies electricity to the grid or captive consumption. The electricity generated from renewable energy sources can be directly supplied to the grid/captive consumption OR may be stored in a battery energy storage system (BESS) or a pumped-hydro storage plant (PSP) operating in conjunction with renewable energy project activity and later delivered to the grid/captive consumption.
Type of GHG emissions mitigation action	Renewable energy: Displacement of electricity that would be supplied to the grid by more GHG emission-intensive sources.

2. Source/s of this Baseline and Monitoring Methodology

4. For the development of GCC methodologies, the requirements of the 'GCC Program Manual' and the 'Standard for the Development of Methodologies' are applied. The determination of the baseline scenario and baseline emissions are consistent with the UNFCCC's Clean Development Mechanism (CDM) guideline "Guideline for determining baseline for measure/s" (Baseline Guideline), referred in the above standard.

5. This methodology is based on the following CDM baseline and monitoring methodology.

   (a) ACM0002: Grid-connected electricity generation from renewable sources.

6. This methodology also refers to the latest approved versions of the following CDM Tools and Guidelines:

   (a) Tool 01: "Tool for the demonstration and assessment of additionality"

   (b) Tool 03: "Tool to calculate project or leakage CO2 emissions from fossil fuel combustion"

   (c) Tool 05: "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"

(d) Tool 07: "Tool to calculate the emission factor for an electricity system"

(e) Tool 11: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period

(f) Tool 19: "Demonstration of additionality of microscale project activities"

(g) Tool 24: Methodological Tool for "Common Practice"

3. Description of Key Terms

7. The following description of key terms applies to projects using this methodology:

Sr. No.	Key Term	Description
1	**BESS**	Battery storage, or Battery Energy Storage Systems (BESS), are devices that enables renewable energy, like solar and wind, to be stored and then released as per grid availability or when customers need power the most. A BESS qualifying under this methodology should be located near the RE-based USPP or DPP.
2	**Captive Consumption**	Captive consumption means that the user is either the same company that generates renewable energy or belongs to the same group of companies.
3	**Distributed Power Plants (DPPs)**	DPPs are distributed power plants, which are implemented only for the purpose of producing electricity (using renewable energy types applicable in this methodology) and supplying it to the regional or national electricity grid, with or without the use of electricity for any domestic, commercial or industrial captive purpose. The DPPs may be comprised of multiple power units, at one or a single site, or distributed in multiple sites with a maximum capacity of an individual unit of 100 kW[1]. An example of DPPs is residential rooftop solar PVs, which supply electricity to the grid in addition to meeting the domestic electricity demand.
4	**DMRV**	Digital monitoring, reporting and verification refer to the use of digital tools and technologies to track, assess, and confirm the accuracy and compliance of processes, data, or activities. This may involve: **Data Collection**: Gathering information from various digital sources, such as sensors, software applications, or online platforms. **Analysis**: Using algorithms and data analytics to evaluate the collected information, identifying patterns, discrepancies, or compliance with established standards. **Verification**: Confirming the authenticity and accuracy of the data or processes, often through automated checks or cross-referencing with other data sources. **Reporting**: Presenting findings in a clear format for stakeholders to understand and act upon, which can include dashboards, alerts, or detailed reports.
5	**Existing reservoir**	A reservoir that has been in operation for at least 3 years before the implementation of the project activity.

[1] Refer 25(a) of in section 3.2 of 'Standard for Development of Methodologies'.at Standard for Development of Methodologies V3 (globalcarboncouncil.com)

6	**Installed capacity or nameplate capacity**	The installed or nameplate capacity of a power unit is the capacity of power generation, expressed in Kilowatts/Megawatts or one of its multiples, for which the power unit has been designed to operate at nominal conditions. The installed capacity of a USPP or a DPP is the sum of the installed capacities of its power units.
7	**Integrated hydro power project**	Integration of multiple hydro power plants/unis with single or multiple reservoirs designed to work together.
8	**Pumped Hydro Storage Plant (PSP)**	Pumped Hydro Storage Plant (PSP) is a type of hydroelectric energy storage system that includes two water reservoirs at different elevations that generate power as water moves down from the upper to the lower reservoir, passing through a turbine. The system consumes power to pump the water back to the upper reservoir.
9	**Recipient captive user[2]**	The existing user of electricity, other than the grid, receives electricity from the renewable energy project activity and demonstrates that it is connected to the grid in the presence or absence of the project activity and would have received electricity from the grid in the absence of project activity.
10	**Reservoir**	A reservoir is a water body to store water generally made by the construction of a dam.
11	**Utility Scale Power Plant (USPP)**	USPPs are power plants that are implemented only for the purpose of producing electricity (using renewable energy types applicable in this methodology) and supplying it to a regional or national electricity grid, with or without use of electricity for any domestic, commercial or industrial captive purpose. The power plant can be comprised of multiple power units at a single site or multiple sites. An example of a USPP is a large-scale solar PV plant connected to grid.

4. Project Activities and their Applicability Conditions

8. The project activities eligible under this methodology are subject to the following eligibility conditions:

   (a) The renewable energy generation projects using this methodology shall supply electricity to either a grid or a recipient captive user[3] which is connected to the grid in the presence or absence of the project activity and would use electricity supplied by the grid in the absence of the project activity. The project activity will displace electricity from an electricity distribution system that is or would have been supplied by a national or regional grid (grid hereafter). The following renewable energy generation technologies qualify under this methodology:

      (i) Solar Photovoltaic;

      (ii) On-shore or Off-shore Wind;

      (iii) Tidal;

[2] In this methodology, a recipient captive user means the user is either the same company that generates renewable energy or belongs to the same group of companies

[3] The methodology does not apply if the electricity is supplied by the project plant to a captive recipient via grid wheeling or a banking mechanism.

(iv) Wave;

(v) Hydro Power Plant(s) with or without reservoir(s)

(b) Project activities may also involve setting up and implementing a BESS/PSP along with the renewable energy generation plant.

(c) A project activity in which a BESS/PSP has been deployed can either be a greenfield installation in which the BESS/PSP was conceptualized along with the renewable energy generation unit, or may be retrofitted into an existing setup of a renewable energy project, whether it is registered with the GCC or not.

(d) If the Project Owners wish to claim carbon credits due to the retrofit of the BESS/PSP into an existing renewable energy generation unit, they shall demonstrate that historically the renewable energy unit was subject to reduced output due to low grid stability or capacity limitations[4] in the grid infrastructure for handling the increased generation. This shall be done using evidence of the existence of technical, regulatory and/or commercial constraints.

(e) Project activities may involve the installation of a Greenfield renewable energy power plant with a grid-connected Greenfield pumped hydro storage plant (PSP), where the renewable energy plant may or may not be integrated with a BESS, wherein: (i) the renewable energy plant is connected directly to the PSP without any grid interface and the PSP is connected to the grid; or (ii) the renewable energy plant and PSP are connected to the grid.

(f) If the project activity involves the integration of a BESS, the methodology is applicable to grid-connected renewable energy power generation project activities wherein the BESS is located at the site of the greenfield renewable power plant.

(g) Project activities should not involve combined heat and power (co-generation) systems or co-firing of fossil fuels of any kind.

(h) Project activities shall not involve biomass-fired power plants/unit.

(i) Project activities may include electricity consumption (from grid or on-site generation) for site offices.

(j) DPPs that supply electricity for domestic, commercial, or industrial captive purposes either wholly or in addition to supplying to the grid, shall demonstrate that grid connection was available at the site before the implementation of project activity and would have received electricity from the grid in absence of the project activity.

(k) Under no condition may the BESS be charged or the PSP utilize the electricity from the grid or from onsite fossil fuel power generation except in the case of emergency situations such as deep discharge, or exceptional operational situations due to requirements from regulatory authorities that safeguard the safety and operational integrity of the connected grid system. In such exceptional cases, the corresponding GHG emissions shall be accounted for as project emissions. Charging using the grid or using fossil fuel-based electricity generators should not

[4] BESS helps store the excess energy that can be supplied at another period of time, when the grid is capable of absorbing the excess renewable energy without facing infrastructure constraints or grid instability issues.

amount to more than 2 percent of the electricity generated by the project's renewable energy plant during a monitoring period[5]. In cases where the project BESS consumes more than 2 percent of the electricity for charging (e.g., days, weeks, months), the Project Owner/s shall not be entitled to the issuance of the emission reductions for the corresponding monitoring period.

(l) GHG-intensive refrigerants/cleaning agents should be avoided in the BESS facility. However, if the BESS employs cooling and/or fire suppression systems using GHG-intensive refrigerants/cleaning agents (e.g., Hydrofluorocarbon (HFC) or Chlorofluorocarbon (CFC)), the GHG emissions from the use of such refrigerant/cleaning agent, even if used during testing/maintenance and initial charging, shall be included in the project emissions.

10. In the case of hydro power plants or PSP, one of the following conditions shall apply[6]:

(a) The project activity is implemented in existing single or multiple reservoirs, with no change in the volume of any of the reservoirs and no existing power generation unit; or

(b) The project activity is implemented in existing single or multiple reservoirs where the volume of the reservoir(s) is increased and the power density, calculated using equation (6), is greater than 4 W/m^2; or

(c) The project activity results in new single or multiple reservoirs, and the power density, calculated using equation (6), is greater than 4 W/m2 or

(d) The project activity is an integrated hydro power project involving multiple reservoirs, where the power density for any existing or new reservoir, calculated using equation (6) respectively, is lower than or equal to 4 W/m2, and all of the following conditions shall apply:

(i) The power density calculated using the total installed capacity of the integrated project, as per equation (7), is greater than 4 W/m2;

(ii) Water flow between reservoirs is not used by any other hydropower unit that is not a part of the project activity;

(iii) Installed capacity of the power plant(s) with power density lower than or equal to 4 W/m2 are:

- Lower than or equal to 15 MW;
- Less than 10 per cent of the total installed capacity of the integrated hydro power project.

(e) In the case of integrated hydro power projects, the project owner shall demonstrate that water flow from upstream power plants/units spill directly to the downstream reservoir and that collectively constitute to the generation capacity of the integrated hydro power project; or provide an analysis of the water balance covering the water fed to power units, with all possible combinations of reservoirs and without the construction of reservoirs. The purpose of water balance is to demonstrate the

[5] The calculation of the 2 per cent limit for charging of the battery using the grid or using a fossil fuel-based electricity generator shall exclude the time period/s during which the renewable energy plant is shut down due to reasonably justifiable situations e.g. natural accidents, equipment failures, force majeure, etc.

[6] Project owners wishing to undertake a hydroelectric project activity that results in a new reservoir or an increase in the volume of an existing reservoir, in particular where reservoirs have no significant vegetative biomass in the catchment area, may request a revision to the approved consolidated methodology.

requirement of a specific combination of reservoirs constructed under the GCC 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 the river, tributaries (if any), and rainfall for a minimum of five years prior to the implementation of the project activity

(f) If the project activity involves the installation of a PSP, the project owner shall demonstrate that the project activity does not use water that would have been used to generate electricity in the baseline.

5. Sectoral Scope Applicable to GCC Validation and Verification Body

9. The sectoral scopes eligible under GCC have been defined in 'Standard forDevelopment of Methodologies'. Only a third-party verifier approved under GCC for the sectoral scope 1: Energy Industries (renewable/non-renewable sources) can conduct Validation and Verification of the GCC project that applies this methodology.

6. Project Boundary

10. The spatial extent of the project boundary includes the project power plant, BESS (where deployed), and all power plants connected physically to the electricity system that the GCC project power plant or distributed-type power generation devices or the recipient captive users are physically connected to.

The GHGs included in or excluded from the project boundary are listed in Table A.

Table A: Emission sources included in or excluded from the Project Boundary

Source		GHG	Included	Justification/explanation	Determination ofEmissions
Baseline	CO_2 emissions from electricity generation in fossil fuel-fired power plants that are displaced due to the project activity	CO_2	Yes	The major source of emissions in the baseline	CDM Tool: "Tool to calculate the emission factor for an electricity system"
		CH_4	No	Excluded for simplification.This emission source is assumed to be very small	-
		N_2O	No	Excluded for simplification.This emission source is assumed to be very small	-
	CO_2 emissions from incremental electricity delivery to the grid by BESS installation in case of retrofit	CO_2	Yes	The major source of emissions in the baseline	CDM Tool: "Tool tocalculate the emission factor for an electricity system"
		CH_4	No	Excluded for simplification.This emission source is	-

				assumed to be very small	
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small	-

Project Activity	Emissions from on-site fossil fuel based or grid electricity use for BESS charging or PSP during emergency situations (e.g. in case of deep discharge of batteries or exceptional operational situations or maintenance or due to requirements from regulatory authorities)	CO_2	Yes	May be an important emission source.	CDM Tool: "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and Monitoring of electricity generation"
		CH_4	No	Excluded for simplification.This emission source is assumed to be very small	-
		N_2O	No	Excluded for simplification.This emission source is assumed to be very small	-
	Emissions from refrigerant released to the atmosphere during initial charging, testing/maintenance of cooling and fire-fighting system for BESS	HFCs	Yes	An important emission source.	-
		CO_2	No	Excluded for simplification	-
		CH_4	No	Excluded for simplification.This emission source is assumed to be very small	-
	For hydro plant and PSP, emissions of CH4 from the reservoir	CH_4	Yes	May be an important emission source	-
		CO_2	No	Excluded for simplification	-
		N_2O	No	Excluded for simplification	-

7. Baseline Scenario

11. The rationale as per these baseline guidelines for the determination of the baseline scenario is that the electricity delivered to the grid by the project activity would be generated by the operation of grid-connected power plants and by the addition of new generation sources into the grid. If the electricity is delivered to a recipient captive user, it has to be demonstrated that the user would have received the electricity from the grid in the absence of project activity.

12. Hypothetically, this means that a power plant with emission factors equivalent to the grid mix would have supplied electricity in the absence of the new project plant or added capacity due to BESS/PSP. A grid emission factor is a reasonable benchmark that provides the proxy performance of the baseline power plant.

13. In the case of the deployment of a BESS/PSP along with a greenfield or existing renewable energy generation units, the baseline scenario is that the amount of electricity delivered to the gridor supplied to a recipient captive user by a power plant (including renewable energy generation unit/s and BESS) would have been generated by the grid-connected power plants.

14. For retrofitting a BESS into existing renewable energy generation unit/s, historical daily generation data for a period of 3 years prior to the installation of the BESS shall be available. If the renewable energy generation unit is less than 3 years old, historical daily energy generation data for a period of at least 1 year shall be available.

15. If the project activity is the installation of a Greenfield PSP/BESS associated with a greenfield renewable power plant, the project participant shall demonstrate that the baseline scenario is not the installation of the Greenfield renewable power plant without a PSP/BESS. Provided that this is demonstrated, the baseline scenario is electricity delivered to the grid by the project activity that would have otherwise been generated by the operation of grid-connected power plants and by the addition of new generation sources, as reflected in the combined margin (CM) calculations described in TOOL07. If the project participant fails to demonstrate that the baseline scenario is not a Greenfield renewable energy plant without a PSP/BESS, this methodology is not applicable.

8. Additionality

8.1 Project Specific Additionality

16. Under the project-specific additionality approach, the additionality of GCC projects shall be determined by the Project Owner using the CDM Tool: “Tool for the Demonstration and Assessment of Additionality” and Methodological Tool for “Common Practice”.

17. The legal requirements and policies[7] in the host Country, related to the implementation of the project, additionality determination, environmental and social risks and safeguards, and sustainable development shall be assessed and considered in the assessment of the Project Activity at the time of investment decision.

18. For Micro-Scale category projects, additionality shall be demonstrated as per CDM Tool 19: “Demonstration of additionality of microscale project activities.”

19. For projects in which a BESS/PSP is installed, and the Project Owner chooses the option of the demonstration of financial additionality, the following guidelines shall apply:

(a) Greenfield renewable energy generation plant with BESS/PSP:

- In cases where the Project Owner has the flexibility of charging/storage in the BESS/PSP during the off-peak period and the generation/sale of power to the national grid/captive user during the peak period and thus getting a favorable tariff, the highest tariff received by the Project Owner for the total electricity supplied to the grid/captive user will be conservatively used in the cash flow for demonstrating the economic

[7] Policies that are aligned with the goals of the Paris Agreement, the host country's Nationally Determined Contribution (NDC), and the Long-term Low-Emission Development Strategies (LT-LEDs) shall not be considered in the assessment of additionality.

attractiveness of the project, if the objectively demonstratable estimate of the additional quantity of electricity to be potentially supplied to the grid/captive user due to BESS during the peak period/s is not available.

- In cases where the objectively demonstratable estimate of the additional quantity of electricity to be potentially supplied to the grid/captive user from the BESS/PSP during peak period/s is available, the tariff/s of the respective peak period/s can be applied only to that quantity of electricity that will be potentially supplied during the peak period. For the remainder of the electricity, the respective tariff/s shall be applied as applicable. This shall be transparently presented in the investment analysis for the demonstration of additionality.

(b) BESS/PSP implementation in an existing renewable energy generation plant:

- In cases where the Project Owner has the flexibility of charging/storage in a BESS/PSP during off-peak periods and generation/sale of power to the national grid/captive user during the peak period, and thus getting a favorable tariff,
- If the objectively demonstrable estimate of the additional electricity to be potentially supplied to the grid/captive user due to BESS/PSP during peak period/s is not available, the highest tariff received by the Project Owner for the electricity supplied to the grid/captive user will be conservatively used in the cash flow for the demonstration of economic attractiveness of the project.
- If the objectively demonstratable estimate of the additional quantity of electricity to be potentially supplied to the grid due to the BESS/PSP during peak period/s is available, the tariff/s of respective peak period/s can be applied only to that quantity of electricity that will be potentially supplied during the peak period due to the BESS/PSP. For the remainder of the electricity supplied due to BESS/PSP the respective tariff/s shall be applied as applicable. This shall be transparently presented in the investment analysis to include, but not limited to, the demonstration of additionality.

20. For renewable energy power plants, with or without installation of BESS/PSP, where the generated power is consumed by a recipient captive user that replaces grid power and is in the jurisdictions where differentiated time-of-day tariff are applied by grid authorities, the economic attractiveness of the project shall be demonstrated using the highest tariff (if apportioning cannot be demonstrated) at which the recipient captive user would have received power from the grid in the baseline.

21. For renewable energy power plants, with or without a BESS/PSP, where the generated power is consumed by a recipient captive user that replaces grid power, the economic attractiveness of the project shall be demonstrated using the higher tariff among those paid to the project owner by the captive user based on the signed powerpurchase agreement; that otherwise would have been paid by grid authorities, based on the publicly available tariff, had the power been supplied to the grid.

22. For renewable energy power plants, with or without a BESS/PSP, the supplied power to

both the grid and the recipient captive user, a combination of above approaches shall be used appropriately for the demonstration of additionality.

23. For installation of a greenfield power plant together with a grid-connected greenfield BESS/PSP (the greenfield power plant may be directly connected to the BESS/PSP or connected to the BESS/PSP through the grid), additionality shall be demonstrated for the combination of greenfield renewable power plant and BESS/PSP, and also for the greenfield renewable power plant alone to ensure that the installation of the latter is not a baseline scenario.

9. Baseline Emissions

24. Baseline emissions include only CO2 emissions from electricity generation in 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 grid-connected power plants and the additional of new grid-connected power plants.

25. The operating margin (OM) and build margin (BM) emission factors for grid-connected power generation in year y are to be calculated using the latest version of the "Tool 07: Tool to Calculate the Emission Factor for an Electricity System," but only with the ex-post calculation option for OM and BM.

26. For the simple OM, the simple adjusted OM and the average OM, the emissions factor is determined for the year in which the project activity displaces grid electricity, requiring the emissions factor to be updated annually during monitoring. If the data required to calculate the emission factor for year y is usually only available more than six months after the end of year y, alternatively the emission factor of the previous year y-1 may be used. If the data is usually only available 18 months after the end of year y, the emission factor of the year preceding the previous year y-2 may be used. The same data vintage (y, y-1 or y-2) shall be used throughout all crediting periods.

27. For the dispatch data analysis OM, use the data for the year in which the project activity displaces grid electricity and update the emission factor annually during monitoring.

28. For the first crediting period, if information on newly built units is not yet available, the build margin calculation must include those units built up to the most recent year for which information is available. The build margin (BM) emission factor shall be updated annually, ex post, including those units built up to the year of registration or commissioning of the project activity, whichever is later. For the second and third crediting periods, the build margin emission factor should be updated based on the most recent information available on units already built up to the time of submission of the request for renewal of the crediting period to the VVB.

29. The combined margin grid emission factor under this methodology shall be calculated ex-post, as per step 6 of Tool 07, with the operating margin and build margin emission factors calculated in accordance with paragraphs 26 to 29. The grid emission factor calculations shall be based on data from an official source and publicly available (where available)[8].

[8] For determining OM and BM emission factor for grid connected power generation' using the latest version of the "Tool to calculate the emission factor for an electricity system" (tCO2/MWh) of the CDM, the plant data should be obtained in the following priority:

a) *Acquired directly* from the dispatch center or power producers, if available;

b) *Calculated*, if data on fuel type, fuel Emission Factor, fuel input, and power output can be obtained for each plant. If confidential data available from the relevant host-country authority are used, the calculation carried out by the project owner shall be verified by the independent verifier and the project submission document may only show the resultant carbon emission factor and the corresponding list of plants.

30. If it is objectively demonstrated that sufficient data to calculate the operating margin and build margin emission factors is not available, the following grid emission factor from a secondary source, most recently available at the time of submitting PSF and thereafter at the time of submission of each monitoring report to the VVB, shall be used in the preferential order listed below:

(a) The latest available grid emission factor of the host country as approved within a CDM standardized baseline shall be used if that emission factor is not older than 3 years.

(b) If it is demonstrated that option (a) is not available, the latest available grid emission factor of the host country, approved by its relevant National Authority or Designated National Authority (DNA) under the CDM or the UNFCCC focal point, shall be used if the emission factor is not older than 3 years.

(c) If there is no DNA in the host country and option (b) is not available, the combined margin grid emission factor shall be calculated as per step 6 of Tool 07; wherein the operating margin emission factor is set to the OM value most recently published by the International EnergyAgency (IEA)[9] for the host country and the build margin emission factor is calculated based on data for the power plants built in the country within the past five years e.g. installed plant capacity, type of fuel used, date of commissioning and electricity generation from each plant (If available, otherwise please refer to para 29 above).

31. The baseline emissions are to be calculated as follows:

Case-1: For greenfield renewable energy generation project activities with or without BESS or a PSP operating in coordination with a greenfield renewable energy plan connected directly to the PSP without any grid interface, and the PSP connected to the grid, as described in paragraph 8 (e) (i):

$$BE_{y1} = EG_{PJ,y} \times EF_{grid,y} \qquad \textit{Equation (1)}$$

Where:

BE_{y1} = Baseline emissions in year *y* (t CO_2) in case 1

$EG_{PJ,y}$ = Quantity of net electricity generation that is produced and fed into the grid or supplied to a recipient captive user, replacing grid power as a result of the implementation of the GCC project activity in project year *y* in a greenfield project activity (MWh)

$EF_{grid,y}$ = CO_2 emission factor for grid-connected power generation in year *y* (t CO_2/MWh)

Case-2: For project activities where BESS/PSP is installed as a retrofit to an existing renewable energy generation project activity

c) *Calculated*, as above, but using estimates such as: default IPCC values from the 2006 IPCC Guidelines for *National* GHG Inventories for net calorific values and carbon emission factors for fuels instead of plant-specificvalues technology provider's nameplate power plant efficiency or the anticipated energy efficiency documented in official sources (instead of calculating it from fuel consumption and power output). This is likely to be a conservative estimate, because under actual operating conditions plants usually have lower efficiencies and higher emissions than nameplate performance would imply; conservative estimates of power plant efficiencies, based on expert judgments on the basis of the plant's technology, size and commissioning date;

d) *Calculated*, for the simple operating margin (OM) and the average OM, using aggregated generation and fuel consumption data, in cases where more disaggregated data is not available.

[9] http://data.iea.org/payment/products/122-emissions-factors.aspx

$$BE_{y2} = EG_{PJretrofit,y} \times EF_{grid,y}$$ *Equation (2)*

Where:

BE_{y2}	=	Baseline emissions in year *y* (t CO_2) in case 2
$EG_{Pj,y,retrofit}$	=	Incremental amount of net electricity generation that is produced due to installation of BESS and fed into the grid or supplied to a recipient captive user that replaces grid power during year *y* (MWh)
$EF_{grid,y}$	=	Same as above

The Incremental amount of net electricity generation produced due to the installation of BESS will be calculated as follows:

$$EG_{Pj,y,retrofit} = EG_{Pj,y} - EG_{historical,y}$$ *Equation (3)*

Where:

$EG_{Pj,y}$	=	Quantity of net electricity generation that is produced and fed into the grid or consumed captive thus replacing grid power as a result of the retrofit of BESS into the existing renewable energy generation unit in project year *y* (MWh)
$EG_{historical,y}$	=	Annual average amount of electricity generation from the renewable energy generation unit in the 3 years prior to implementation of BESS project activity (MWh) or Annual average amount of electricity generation from the renewable energy generation unit in at least 1 year prior to implementation of BESS project activity, if the existing renewable energy generation unit is less than 3 years old (MWh)

Case-3: For greenfield renewable energy generation project activities where greenfield renewable energy plant and PSP are connected to the grid, as described in paragraph 8 (e) (ii), $EG_{PJ,y}$ is estimated as follows:

$$EG_{Pj,y} = EG_{REplant,y} + EG_{PSP,y} - EC_{PSP,y}$$ *Equation (4)*

Where:

$EG_{Pj,y}$	=	Quantity of net electricity generation that is produced and fed into the grid or supplied to recipient captive user replacing grid power as a result of the implementation of the GCC project activity in project year y, as described in paragraph 8(e)(ii), (MWh)
$EG_{REplant,y}$	=	Quantity of net electricity generated by the project greenfield renewable energy plant in year y (MWh)
$EG_{PSP,y}$	=	Quantity of electricity generation that is produced and fed into the grid in year y as a result of the implementation of the PSP, as described in paragraph 8(e)(ii), (MWh)
$EC_{PSP,y}$	=	Quantity of electricity consumed by the PSP in year y (MWh)

32. The energy consumed by the PSP should be lower than the electricity generated by the renewable energy power plant while the renewable power plant is operating. This shall be

monitored on an hourly basis. No emission reduction shall be claimed during the hours where this condition is not fulfilled.

10. Project Emissions

33. For most renewable energy project activities, project emissions are equal to zero. However, CO_2 emissions from on-site consumption of electricity by the project activity shall be calculated using the latest version of the CDM methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

34. In addition to the parameters mentioned in the monitoring section of this methodology, the parameters referred to in the tool above shall be monitored.

35. Project emissions are calculated using the following equation:

$$PE_y = PE_{EC,y} + PE_{FF,y} + PE_{HPSP,y} + PE_{BESS,y} + PE_{PSP,y} + PE_{Ref,P,y}$$ *Equation (5)*

PE_y	=	Project emissions in year *y* (t CO_2e)
$PE_{EC,y}$	=	Project emissions from on-site consumption of electricity by project activity in year y (t CO_{2e})
$PE_{FF,y}$	=	Project emissions from on-site fossil fuel consumption of fossil fuel generators in year y (t CO_{2e})
$PE_{HPSP,y}$	=	Project emissions from water reservoirs of hydro power plants or PSP in year *y* (t CO_2e)
$PE_{BESS,y}$	=	Project emissions from charging of a BESS using electricity from the grid or from fossil fuel electricity generators (t CO_2), please refer to paragraph 8(k)
$PE_{PSP,y}$	=	Project emissions from utilizing electricity from the grid for pumping operation of the PSP in excess to the production of the renewable power plant operating in coordination with the PSP (t CO_2), please refer to paragraph 8(n)
$PE_{Ref,P,y}$	=	Project emissions from refrigerant released to atmosphere from project source e.g. initial charging, cooling system, during testing and maintenance of fire-fighting system (t CO_2e)

10.1 Project Emissions from on-site consumption of electricity ($P_{EC,y}$) and fossil fuel ($P_{FF,y}$)

36. Project emissions (tCO_{2e}) from on-site consumption of electricity by the project activity and from on-site consumption of fossil fuel for electricity generation shall be calculated using the latest version of the CDM methodological Tool05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" and Tool03 "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" respectively.

10.2 Project Emissions from water reservoirs of hydro power plants and pumped hydro storage plants (PE*HPSP,y*)

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

$$PD = \frac{Cap_{PJ} - Cap_{BL}}{A_{PJ} - A_{BL}}$$ *Equation (6)*

Where:

PD	=	Power density of the project activity (W/m2)
Cap_{PJ}	=	Installed capacity of the hydro power plant or PSP after the implementation of the project activity (W)

Cap_{BL}	=	Installed capacity of the hydro power plant or PSP before the implementation of the project activity (W).
A_{PJ}	=	Area of the single or multiple reservoirs measured in the surface of the water, after the implementation of the project activity, when the reservoir is full (m2)
A_{BL}	=	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full (m2).

38. For hydro power plants or PSP activities that result in new single or multiple reservoirs and hydro power plants or PSP activities that result in the increase of single or multiple reservoirs, the project owner shall account for CH4 and CO2 emissions from the reservoirs, estimated as follows:

(a) For integrated hydro power plant or PSP, the project density of the entire project is calculated as follows:

$$PD = \frac{\sum Cap_{PJ,i}}{\sum A_{PJ,j}} \quad \text{Equation (7)}$$

Where:

i	=	Individual power plants included in integrated PSP
j	=	Individual reservoirs included in integrated PSP

(b) If the power density PD of the project activity using equation (6) or in case of integrated hydro power plant/PSP using equation (7) is

(i) greater than 4 W/m2 but less than or equal to 10 W/m2, the project emissions are:

$$PE_{HPSP,y} = \frac{EF_{RES} \times TEGgross_y}{1000} \quad \text{Equation (8)}$$

Where:

$PE_{HPSP,y}$	=	Project emissions from water reservoirs of PSP in year *y* (t CO_2e)
EF_{RES}	=	Default emission factor for emissions from reservoirs of PSPs (kg CO2e/MWh)
$TEGgrossy$	=	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)

(ii) greater than 10 W/m^2, the project emissions are:

$$PE_{HPSP,y} = 0 \quad \text{Equation (9}$$

10.3 Project Emissions from charging a BESS using grid or from fossil fuel electricity generators $PE_{BESS,y}$)

39. Under normal conditions, the BESS should be charged with the electricity generated by the associated renewable power plant. Exceptionally, the BESS may be charged using grid electricity or electricity from fossil fuel generators.

40. In cases where the BESS is charged with grid power in an emergency situation (such as deep charging), the project emissions ($PE_{BESS,y}$) associated with the consumption of grid power are calculated using option A2 (a) of paragraph 20 of the latest version of the CDM methodological tool "Tool to calculate baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" TOOL05 (i.e. using a conservative emission factor of 1.3t CO2/MWh).

41. In cases where the BESS is charged using electricity from fossil fuel generators, the corresponding project emissions ($PE_{BESS,y}$) shall be calculated according to the procedure described in TOOL03.

42. In line with the requirement under paragraph 8(k) above, charging using the grid or a fossil fuel electricity generator should not amount to more than 2 per cent of the electricity generated by the project renewable energy plant during a monitoring period. During periods where the BESS consumes more than 2 per cent of the electricity for charging, the project participant shall not be entitled to the issuance of the Approved Carbon Credits for the period concerned.

43. Furthermore, the project owner should compensate in full, any negative emissions reductions that may arise from the power consumption from the grid by the BESS, including for monitoring periods for which no emission reductions can be claimed.

10.4 Project Emissions from utilizing grid electricity by pumped hydro storage plants ($PE_{PSP,y}$)

44. Under normal conditions, a PSP uses the electricity generated by the associated renewable power plant. Only under exceptional circumstances may the PSP utilize grid electricity in excess to the electricity supplied by the renewable power plant ($EC_{PSP,y}$).

45. In cases where the PSP utilizes grid electricity in excess to the production of the renewable power plant, the corresponding project emissions ($PE_{PSP,y}$) shall be calculated according to the procedure described in TOOL05 using a conservative emission factor of 1.3t CO2/MWh as indicated under option A2(a) under paragraph 20 of TOOL05.

46. In line with the requirement under paragraph 8 (n) above, use of electricity from the grid should not amount to more than 2 per cent in excess to the electricity generated by the project renewable energy plant during a specific monitoring period. During periods where the PSP consumes more than 2 per cent of the electricity in excess of the electricity generated by the project renewable energy plant, the project participant is not entitled to issuance of the Approved Carbon Credits for the period concerned.

47. Furthermore, the project owner should compensate in full, any negative emissions reductions which may arise from the power consumption from the grid by the PSP, including for monitoring periods for which no emission reductions can be claimed.

10.5 Project Emissions from refrigerant released to the atmosphere from the project source (t CO2e)

48. The emissions from refrigerant released to the atmosphere e.g. initial charging, cooling system, during testing and maintenance of fire-fighting system can be calculated as follows

$$PE_{Ref,P,y} = Q_{PJ,y} \times GWP_{Ref,y} \qquad \textit{Equation (10)}$$

Where:

$PE_{Ref,P,y}$	=	Project emissions from refrigerant released to atmosphere (t CO_2e)
$Q_{PJ,y}$	=	Quantity of refrigerant initially charged and released to atmosphere from project source e.g. cooling system, during testing and maintenance of fire-fighting system (t)
$GWP_{Ref,y}$	=	Global Warming Potential of Refrigerant (t CO2e/t refrigerant)

11. Leakage Emissions

49. No leakage emissions are anticipated under this methodology. It is considered to be conservative to neglect potential emissions from the supply chain, plant construction, and upstream emissions from fossil fuel sources with respect to the baseline scenario.

12. Emission Reductions

50. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \qquad \textit{Equation (11)}$$

Where:

ER_y = Emission reductions in project year *y* (t CO_{2e})

BE_y = Baseline Emissions in project year *y* (t CO_2)

PE_y = Project emissions in project year *y* (t CO_{2e})

13. Monitoring Methodology

51. All assumptions made related to monitoring parameters shall be explained and documented transparently in the project submission to GCC.

52. In addition to the parameters mentioned in the monitoring section of this methodology, the parameters referred to in the CDM Tool05 above shall be monitored.

13.1 Parameters not monitored during the crediting period

53. 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.

Table 1: Data / Parameter

Data / Parameter:	$EG_{historical,y}$
Data unit:	MWh/year
Description:	Annual average amount of electricity generation from the renewable energy generation unit in the 3 years prior to implementation of BESS project activity (MWh) or Annual average amount of electricity generation from the renewable energy generation unit in at least 1 year prior to implementation of BESS project activity, if the existing renewable energy generation unitis less than 3 years old (MWh)
Source of data:	Electricity meter(s)
Measurement procedures (if any):	This parameter should be either measured and monitored using a bi- directional energy meter or calculated as the difference between (a) the quantity of net electricity supplied by the project plant/unit to the grid, and (b) the quantity of electricity delivered to the project plant/unitfrom the grid during historical years (as above) prior to implementationof the BESS retrofit in the plant. In case it is calculated, then the following parameters shall be measured: (a) The quantity of electricity supplied by the project plant/unit tothe grid; and (b) The quantity of electricity delivered to the project plant/unit from the grid
Quality Procedure, if any:	Monitored data should have been measured using calibrated meters that had been calibrated as per national standards or requirements setby the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set bythe grid operators or national requirements. If these standards are not available, and the meter supplier does not specify, calibrate the metersevery 3 years and use the meters with at least 0.5 accuracy class (e.g. a meter with 0.2 accuracy class is more accurate and thus it is accepted). The digital monitoring reporting and verification (DMRV) system is encouraged for cross-reference.
Any comment:	Monthly or yearly recording frequency.

Table 2: Data / Parameter

Data / Parameter:	EF_{RES}
Data unit:	kgCO2e/MWh
Description:	Default emission factor for emissions from reservoirs
Source of data:	Decision at the 23rd meeting of the CDM Executive Board
Measurement procedures (if any):	Default value: 90 kgCO_2e/MWh

Quality Procedure, if any:	-
Any comment:	-

Table 3: Data / Parameter

Data / Parameter:	Cap_{BL}
Data unit:	W
Description:	Installed capacity of the PSP before the implementation of the project activity. For PSP this value is zero.
Source of data:	Project site
Measurement procedures (if any):	For PSP this value is zero. Determine the installed capacity based on manufacturer's specifications or recognized standards
Quality Procedure, if any:	
Any comment:	

Table 4: Data / Parameter

Data / Parameter:	A_{BL}
Data unit:	m^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, before the implementation of the project activity, when the reservoir is full. For new reservoirs, this value is zero
Source of data:	Project site
Measurement procedures (if any):	For new reservoirs, this value is zero. Measured from topographical surveys, maps, satellite pictures, etc.
Quality Procedure, if any:	
Any comment:	

Table 5: Data / Parameter

Data / Parameter:	Cap_{PJ}
Data unit:	W
Description:	Installed capacity of the PSP after the implementation of the project activity
Source of data	Project site
Measurement procedures (if any):	Determine the installed capacity based on manufacturer's specifications or commissioning data or recognized standards
Quality Procedures,if	-

any.	
Monitoring frequency:	Once at the beginning of each crediting period

Table 6: Data / Parameter

Data / Parameter:	A_{PJ}
Data unit:	m^2
Description:	Area of the single or multiple reservoirs 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.
Quality Procedures,if any.	
Monitoring frequency:	Once at the beginning of each crediting period

Table 7: Data / Parameter

Data / Parameter:	$GWP_{Ref,y}$
Data unit:	t CO2e/t refrigerant
Description:	Global Warming Potential for refrigerant for 100-year time horizon
Source of data	IPCC
Measurement procedures (if any):	-
Quality Procedures,if any.	Latest published data
Monitoring frequency:	Once at the beginning of each crediting period

13.2 Parameters to be monitored during the crediting period

Table 1: Data / Parameter

Data / Parameter:	$EF_{grid,,y}$
Data unit:	t CO_2e/MWh
Description:	CO_2 emission factor of the grid electricity in year *y*
Source of data	-
Measurement procedures (if any):	CO_2 emission factor for grid connected power generation in year *y* (t CO_{2e}/MWh) determined as per para 30.
Monitoring frequency:	Yearly
Quality Procedures,if any.	
Any comment:	The emission factor cannot be fixed ex-ante under this methodology, it is to be calculated ex-post.

Table 2: Data / Parameter

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid or consumed by recipient captive user thus replacing grid power in year *y*
Source of data	Electricity meter(s)
Measurement procedures (if any):	This parameter should be either measured and monitored using a bi-directional energy meter or calculated as the difference between (a) the quantity of net electricity supplied by the project plant/unit to the grid or recipient captive user, and (b) the quantity of electricity delivered to the project plant/unit from the grid, or the total amount of power delivered to the internal grid for replacement of grid power from project plant in case of captive consumption. When the project involves the implementation of several DPPs that require sample-based monitoring, the CDM's "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be applied by the Project Owner. In case it is calculated, then the following parameters shall be measured: (d) The quantity of electricity supplied by the project plant/unit to the grid; and (e) The quantity of electricity delivered to the project plant/unit from the grid
Quality Procedures,if any.	The electricity meter measuring net electricity export to grid (and domestic consumption in case DPP or projects delivering power for recipient captive user including internal use of Project Owner e.g. Rooftop PV unit supplying part electricity to the house) will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier or requirements set by the grid operators. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by the grid operators or national requirements. If these standards are not available, and the meter supplier does not specify, calibrate the meters every 3 years anduse the meters with at least 0.5 accuracy class (e.g. a meter with 0.2 accuracy class is more accurate and thus it is accepted).

dMRV Requirements	The digital monitoring reporting and verification (DMRV) system is encouraged for cross-reference/ Data Acquisition. For the project to be able to integrate with GCC DMRV portal, the following requirements are to be taken care of • Primary data related to power generation/consumption (export & Import) have to be pushed / pulled on to the GCC portal along with a secondary independent parameter (Wind speed for wind projects, Irradiation data for solar projects, water flow/ head for hydro projects etc.) to validate variations in the primary data • PO to provide data access to GCC (to pull data) or to push data to GCC portal (as per requirements of GCC standard) • Data to be pulled/pushed to GCC portal via internet or FTP • Data scan frequency must be at a minimum once per 15 mins in case of instantaneous value or daily (once every 24 hrs) in case of cumulative value. • PO to share details of Data structure and Data locations to GCC for the project. • Frequency of Data transfer is once per day. • PO must have provisions of system alarm in case data is not being generated or access to data is stopped. • In case of lack of data due to net connectivity, the data would have to be provided or updated when connectivity is restored. PO to share documents (once per month / event over mail/ Online Portal) related to invoices, meter details and calibration records for QA/QC of data and computation of credits.
Monitoring frequency:	Continuous monitoring, hourly measurement and at least monthly recording.

Table 3: Data / Parameter

Data / Parameter:	$Q_{PJ,y}$
Data unit:	t
Description:	Quantity of refrigerant initially charged and released to atmosphere from project source e.g. cooling system, during testing and maintenance of fire-fighting system (t)
Source of data	Plant logbooks
Measurement procedures (if any):	This parameter should be either measured and monitored using a calibrated flow meter or calculated as the difference of refrigerant stock.
Quality Procedures,if any.	The meter measuring the flow of refrigerant will be subject to regular maintenance and testing in accordance with the stipulation of the meter supplier. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements set by the meter supplier. The accuracy class of the meters should be in accordance with the stipulation of the meter supplier and/or as per the requirements set by national requirements. If these standards are not available, and the meter supplier does not specify, calibrate the meters every year.
Monitoring frequency:	Monitoring at the time of initial and subsequent charging.

Table 4: Data / Parameter

Data / Parameter:	TEG_y
Data unit:	MWh/year
Description:	Total electricity produced by the project activity, including the electricity supplied to the grid and the electricity supplied to internal loads, in year y
Source of data	Project activity site
Measurement procedures (if any):	Electricity meters
Quality Procedures,if any.	Applicable to PSP with reservoirs with a power density greater than 4 W/m^2 and less than or equal to 10 W/m^2
Monitoring frequency:	Continuous measurement and at least monthly recording

Table 5: Data / Parameter

Data / Parameter:	CAP_{PJ}
Data unit:	MW
Description:	Installed capacity of the hydro power plant after the implementation of the project activity
Source of data	Project activity site
Measurement procedures (if any):	Determine the installed capacity based on manufacturer's specifications or commissioning data or recognized standards
Quality Procedures,if any.	-
Monitoring frequency:	Once at the beginning of each crediting period

Table 6: Data / Parameter

Data / Parameter:	A_{PJ}
Data unit:	M^2
Description:	Area of the single or multiple reservoirs measured in the surface of the water, after implementation of the project activity, when the reservoir is full
Source of data	Project activity site
Measurement procedures (if any):	Measured from topographical surveys, maps, satellite pictures etc.
Quality Procedures,if any.	-
Monitoring frequency:	Once at the beginning of each crediting period

DOCUMENT HISTORY		
Version	**Date**	**Comment**
V 5.0	16/04/2026 **(Draft for Public Consultation)**	Revision to: • *Ex-post* monitoring of grid emission factor (shall not be fixed *ex-ante* under this version) • Remove reference to tool with relaxed additionality requirements based on positive list. • Introduce dMRV system requirements for key parameter related to RE power project. • Expand the applicability of the methodology to grid-connected hydro power plants • Eligible for Greenfield pumped hydro storage plants (PSPs) that operate in conjunction with a Greenfield renewable energy generation plant, which may or may not be connected to the grid and may or may not be integrated with a battery energy storage system (BESS) • Include GHG emissions from refrigerant system in BESS projects as project emissions during initial charging, testing and maintenance
V 4.0	02/11/2022	Revision to: • Provide consistency with the latest applicable version of CDM Tool 32: Positive list of technologies. • Aligning with the provisions of ACM0002 on additionality demonstration applying favorable tariff for BESS supplying electricity to the grid during peak time.
V 3.0	22/02/2022	Revision to i. Add applicability of methodologies applying BESS to renewable energy generation units. ii. Allow for captive consumption of part of power generated within the project activity. iii. Remove standardized additionality approach using positive list of various countries.
V 2.0	09/12/2020	Revision to: i Correct the error in the text on demonstration of 2% penetration of RE project activity to claim automatic additionality. ii Incorporate the timeline for A2 type project activity to demonstrate 2% penetration to claim automatic additionality. iii Replace name of “Standard for Key Project Requirements and Methodological Development” with the updated document “Standard for Development of Methodology”.

V 1.0	13/01/2020	Initial adoption based on the following: i. Consideration by individual steering committee member, followed by evaluation of entire steering committee ii. 15-day global stakeholder consultation taken place between 25/11/2019 to 10/12/2019