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Annex 1

DRAFT - Approved baseline methodology AM00XX

"Consolidated baseline methodology for zero-emissions grid-connected electricity generation from renewable sources"

Sources

This baseline methodology is based on the following proposed new methodologies:

- NM0012-rev: Wigton Wind Farm Project in Jamaica whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Ecosecurities ltd;
- NM0023: El Gallo Hydroelectric Project, Mexico whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Prototype Carbon Fund (approved by the CDM Executive Board on 14 April 2004);
- NM0024-rev: Colombia: Jepirachi Windpower Project whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Prototype Carbon Fund;
- NM0030-rev: Haidergarh Bagasse Based Co-generation Power Project in India whose Baseline study, Monitoring and Verification Plan and Project Design Document was submitted by Haidergarh Chini Mills, a unit of Balrampur Chini Mills Limited;
- NM0036: Zafarana Wind Power Plant Project in the Arab Republic of Egypt whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Mitsubishi Securities;
- NM0043: Bayano Hydroelectric Expansion and Upgrade Project in Panama whose Baseline study, Monitoring and Verification Plan and Project Design Document were prepared by Econergy International Corporation.

For more information regarding the proposal and its consideration by the Executive Board please refer to http://cdm.unfccc.int/methodologies/approved.

Applicability

This methodology is applicable to grid-connected zero-emission renewable power generation project activities under the following conditions:

- Applies to electricity capacity additions from hydro, wind, geothermal, and solar sources;
- This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity;
- The applicability of this methodology to hydro projects is dependent on the forthcoming EB decision on whether the uncertainty about methane and carbon dioxide emissions from hydro projects precludes use of this methodology. Until that decision is made hydro projects cannot use this methodology[1];
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Electricity exports from the grid are included in electricity generation data used for calculating and monitoring the baseline emission rate to avoid potential leakage; and

[1] The Executive Board may provide guidance on how to adequately address the issue of methane emissions from hydropower reservoirs. This paragraph may be redrafted accordingly.

- There is sufficient publicly available information to document in a transparent and conservative manner the nature of the prohibitive barriers which the proposed project activity faces, and the means by which its registration as a CDM activity would enable the project to overcome those barriers (and thus be successfully undertaken); and there is sufficient publicly available information to document in a transparent and conservative manner that the proposed project is occurring in a sector and investment context that does not feature the type of proposed activity as a common practice.

Project activity

The project activity is grid-connected electricity generation from renewable energy sources. There are a number of different sizes and sub-types of this project activity (hydro, wind, geothermal, solar sources).

Additionality

INSERT TEXT FROM CONSOLIDATED METHODOLOGY

Baseline

Provide a narrative description of the baseline scenario. (For example, the baseline scenario may be that electricity would have otherwise been generated by the operation of existing grid-connected power plants and by the addition of new generation sources.)

For modifications of existing facilities, the guidance provided by EB8 should be taken into account.[2]

A baseline emission factor (EF_y) is calculated as a combined margin (CM), consisting of the combination of operating margin (OM) and build margin (BM) factors according to the following 3 steps. Calculations for this combined margin must be based on data from an official source (where available)[3] and made publicly available.

STEP 1. Calculate the Operating Margin emission factor(s) (*EF_OM_y*) based on one of the three following methods: a) Simple, b) Simple with Low-Cost/Must-Run Adjustment, or c) Dispatch Data Analysis, each of which is described below. The Simple OM method can only be used where low-

[2] "If a proposed CDM project activity seeks to retrofit or otherwise modify an existing facility, the baseline may refer to the characteristics (i.e. emissions) of the existing facility only to the extent that the project activity does not increase the output or lifetime of the existing facility. For any increase of output or lifetime of the facility which is due to the project activity, a different baseline shall apply." (EB08, Annex 1, http://cdm.unfccc.int/EB/Meetings/).

[3] Plant emission factors used in the calculating the operating and build margins below can be obtained in the following ways:

- *acquired directly* from the dispatch center or power producers, if available;
- *calculated*, if data on fuel type, fuel emission factor, fuel input and power output can be obtained for each plant; or
- *calculated*, as above, but using estimates such as
  - default IPCC figures for calorific value and carbon emissions factors for fuels (instead of plant-specific or country-specific figures); or
  - technology provider's name plate power plant efficiency, (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 name plate performance would imply.

cost/must run resources[4] constitute less than 50% of total grid generation in: 1) each of the five most recent years, and 2) based on long-term normals (e.g. 30-year or 50-year averages) for hydroelectricity production.

a) *Simple OM (EF_OM_y Simple).* The Simple OM emission factor is the generation-weighted average emissions per electricity unit (tCO_2/MWh) of all generating sources serving the system, not including low-operating cost and must-run power plants

$$EF\_OM_y\ Simple\ (tCO_2/\ MWh) = [\textstyle\sum_{i,j} F_{i,j,y} * COEF_{i,j}] / [\textstyle\sum_j GEN_{j,y}],\ \text{where} \quad (1)$$

$F_{i,j,y}$ is the amount of fuel i (in gigajoules, GJ) consumed by relevant power sources j in year(s) y,
j is the set of plants delivering electricity to the grid, not including low-operating cost and must-run power plants, and including imports to the grid.
$COEF_{i,j\,y}$ is the carbon coefficient of fuel i (tCO_2-equivalent/GJ), taking into account the carbon content of the fuels used by relevant facilities j and the percent oxidation of the fuel in year(s) y. [5]

In the case of imports, the emission rate ($COEF_{i,j\,y\,IMPORTS}$) is 0 tCO_2/MWh by default. If the specific imported generation resource is known, its emissions rate can be used. The average emission rate of the exporting grid can be used, if net imports do not exceed 20% of total grid generation.

$GEN_{j,y}$ is the electricity (MWh) delivered to the grid by source j.

The Simple OM emission factor can be calculated using either of the two following data vintages for years(s) y:

- A 3-year average, based on the most recent statistics available at the time of PDD submission, or
- The year in which project generation occurs, if EF_OM_y is updated based on ex post monitoring.

b) *Simple OM with Low-Cost/Must-Run Adjustment.* This emission factor (EF_OM_y *SimpleAdjusted*) is a variation on the previous method, where the relevant power sources (including imports) include a fraction (λ_y) of low-cost/must-run power plants (k).

$$EF\_OM_y\ SimpleAdjusted\ (tCO_2/\ MWh) = \frac{[\sum_{i,j} F_{i,j,y} * COEF_{i,j}] + \lambda_y [\sum_{i,k} F_{i,k,y} * COEF_{i,k}]}{[\sum_j GEN_{j,y}] + \lambda_y [\sum_k GEN_{k,y}]} \quad (2)$$

[4] Low operating cost and must run resources typically include hydro, geothermal, wind, low-cost biomass, nuclear and solar generation. If coal is obviously used as must-run, it should also be included in this list, i.e. excluded from the set of plants..

[5] The GHG emission coefficients $COEF_i$ is obtained as

$$COEF_i = E\_CON_i * C\_CON_i * OXID_i$$

where E_CON_i is the energy (caloric) content per unit of $\Delta F_{i,y}$ (*e.g.*, mass unit), C_CON_i is the carbon content per unit of energy, $OXID_i$ is the oxidization ratio of the fuel i, for energy-related CO_2 emissions. Local values of E_CON_i and C_CON_i are used for monitoring. If no such values are available, country-specific values (see *e.g.*, IPCC Good Practice Guidance on GHG Inventory) are preferable than IPCC world-wide default values.
For other cases/GHGs, $COEF_i$ depends on process. In case that the project participant can demonstrate such non-energy/CO_2 effects to be negligible (in comparison to other major effects), these effects need not be counted.

where $F_{i,k,y}$, $COEF_{i,k}$ and GEN_k are analogous to the variables described for the simple OM method above for plants k; the years(s) *y* can reflect either of the two vintages noted for simple OM above, and:

$$\lambda_y(\%) = \frac{\text{Number of hours per year for which low-cost/must-run sources are on the margin}}{\text{8760 Hours per year}} \quad (3)$$

where "lambda" (λ_y) should be calculated as follows (see figure below):

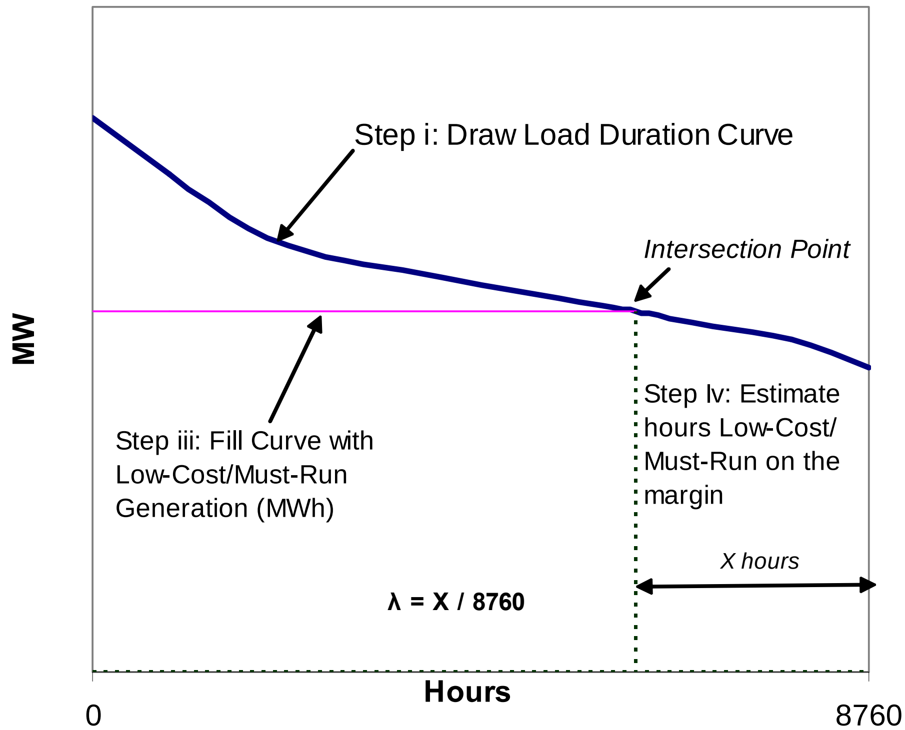
Step i) Plot a Load Duration Curve. Collect chronological load data (typically in MW) for each hour of a year, and sort load data from highest to lowest MW level. Plot MW against 8760 hours in the year, in descending order.

Step ii): Organize Data by Generating Sources. Collect data for, and calculate total annual generation (in MWh) from low-cost/must-run resources [i.e. $\sum_k GEN_{k,y}$].

Step iii): Fill Load Duration Curve. Plot a horizontal line across load duration curve such that the area under the curve (MW times hours) equals the total generation (in MWh) from low-cost/must-run resources [i.e. $\sum_k GEN_{k,y}$].

Step iv): Determine the "Number of hours per year for which low-cost/must-run sources are on the margin". First, locate the intersection of the horizontal line plotted in step (iii) and the load duration curve plotted in step (i). The number of hours (out of the total of 8760 hours) to the right of the intersection is the number of hours for which low-cost/must-run sources are on the margin. If the lines do not intersect, then one may conclude that low-cost/must-run sources do not appear on the margin and λ_y is equal to zero. Lambda, λ_y, is the calculated number of hours divided by 8760.

Figure 1 1. Illustration of Lambda Calculation for Simple Adjusted OM Method



Note: Step ii is not shown in the figure, it deals with organizing data by source.

c) *Dispatch Data Analysis OM*. The Dispatch Data OM emission factor (EF_OM_y *DispatchData*) is summarized as follows:

$$EF\_OM_y \; Dispatch\,Data \; (tCO_2/\,MWh) = E\_OM_y/EG_y \quad (4)$$

where EGy is the generation of the project (in GWh) in year *y*, and E_OM_y are the emissions (tCO_2) associated with the operating margin calculated as

$$E\_OMy = \underline{\sum_h} EG_h \underline{*EF\_DD_h} \quad (5)$$

where EG_h is the generation of the project (in GWh) in each hour *h* and EF_DD_h is the hourly generation-weighted average emissions per electricity unit (tCO_2/MWh) of the set of power plants (*n*) in the top 20% of grid system dispatch order during hour *h*.

$$EF\_DD_h \; (tCO_2/MWh) = [\textstyle\sum_{i,n} F_{i,n,h} * COEF_{i,n}] \,/\, [\textstyle\sum_n GEN_{n,h}],$$

where F, COEF, and GEN are analogous to the variables described for the simple OM method above, but calculated on an hourly basis for the set of plants (*n*) falling within the top 20% of the system dispatch. To determine the set of plants (*n*), obtain from a national dispatch center: a) the merit order of operation for each power plant of the system; and b) the amount of power (MWh) that is dispatched from all plants in the system during each hour that the project activity is operating (GEN_h). At each hour, *h*, stack each plant's generation (GEN_h) using the merit order. The set of plants (n) consists of those plants at the top of the stack (i.e., having the least merit), whose combined generation [$\sum GEN_{,h}$] comprises 20% of total generation from all plants during that hour (including imports to the extent they are dispatched).

STEP 2. Calculate the Build Margin emission factor (EF_BM_y) as the generation-weighted average emission factor of a sample of power plants *m*, as follows,

$$EF\_BM_y = [\sum_{i,m} F_{i,m,y} * COEF_{i,m}] / [\sum_m GEN_{m,y}] \qquad (6)$$

where the sample group *m* consists of either the 5 most recent or the most recent 20% of power plants built or under construction, whichever group's average annual generation is greater (in MWh); and where $F_{i,m,y}$, $COEF_{\underline{i,m}}$ and $GEN_{m,}$ are analogous to the variables described for the simple OM method above for plants m.

For projects greater than 60 MW in size, the sample should include all plants [under construction][6], and EF_BM_y [must be][7] updated annually *ex post* for the year in which actual project generation, and associated emissions reductions, occur. Smaller projects may calculate the build margin *ex ante* based on the most recent information available for sample group *m* at the time of PDD submission.

STEP 3. Calculate a baseline emission factor EF_y as the weighted average of the Operating Margin emission factor (EF_OM_y) and the Build Margin emission factor (EF_BM_y,):

$$EF_y = (w_{OM} * EF\_OM_y) + (w_{BM} * EF\_BM_y) \qquad (7)$$

where the weights w_{OM} and w_{BM}, by default, are 50% (i.e., $w_{OM} = w_{BM} = 0.5$), and *EF* values are calculated as described in Steps 1 and 2 below and are expressed in tCO_2/MWh. Alternative weights can be used, as long as $w_{OM} + w_{BM} = 1$, and the resulting baseline emission factor is lower than that resulting from the default weighting.[8]

Emissions Reductions:

The emission reductions ER_y by the project activity during a given year *y* is the difference between baseline emissions (BE_y in tCO_2) and leakage, as follows

$$ER_y = BE_y - Leakage \qquad (8)$$

where leakage and the baseline emissions (BE_y) are the product of the baseline emissions factor (EF_y in tCO_2/MWh) calculated in Step 3, times the electricity supplied to the grid (EG_y in MWh), as follows:

[6] Four panel members expressed concern about the requirement to include plants under construction in the build margin calculation.
[7] One panel members expressed concern about ex post generally, and one had concern with ex post only if under construction plants had to be included in the build margin.
[8] Panel members suggested that more analysis on other possible weightings may be necessary and this methodology could be revised based on this analysis. There might be a need to propose different weightings for different situations.

$$BE_y = EG_y * EF_y \qquad (9)$$

The project activity mainly reduces carbon dioxide (CO_2) through substitution of the grid electricity generated by fossil fuel power plant by renewable electricity. The methane (CH_4) and nitrous oxide (N_2O) emissions from the grid and/or from the project should be monitored if the project participants do not provide sufficient reasons and information to neglect them such as by demonstrating them to be much smaller than the uncertainty level.

Estimation of Emissions Reductions Prior to Validation

The project participant should prepare an estimate of likely project emissions reductions [for the project lifetime]. This estimate should employ the same methodology as selected above (i.e. OM option 1a, 1b, or 1c). In the case of option 1c, where the baseline is first determined in the monitoring phase, an ex ante baseline should be estimated using available (historical) dispatch data.

Leakage

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, fuel handling (extraction, processing, and transport), and land inundation (for hydroelectric projects – see applicability conditions above). Project activities using this baseline methodology shall not claim any credit for the project on account of reducing these emissions below the level of the baseline scenario.

Approved monitoring methodology AM00XX

"Consolidated monitoring methodology for zero-emissions grid-connected electricity generation from renewable sources"

Sources

This monitoring methodology is based on the following proposed new methodologies:

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Applicability

This monitoring methodology shall be used in conjunction with the approved baseline methodology AM00XX ("Consolidated baseline methodology for zero-emissions grid-connected electricity generation from renewable sources") and:

- Applies to electricity capacity additions from hydro, wind, geothermal, and solar sources;
- This methodology is not applicable to project activities that involve switching from fossil fuels to renewable energy at the site of the project activity;
- The applicability of this methodology to hydro projects is dependent on the forthcoming EB decision on whether the uncertainty about methane and carbon dioxide emissions from hydro projects precludes use of this methodology. Until that decision is made [assume that there are no methane emissions from reservoirs] [hydro projects cannot use this methodology];
- The geographic and system boundaries for the relevant electricity grid can be clearly identified and information on the characteristics of the grid is available;
- Electricity exports from the grid are included in electricity generation data used for calculating and monitoring the baseline emission rate to avoid potential leakage;
- There is sufficient publicly available information to document in a transparent and conservative manner the nature of the prohibitive barriers which the proposed project activity faces, and the means by which its registration as a CDM activity would enable the project to overcome those barriers (and thus be successfully undertaken); and/***or*** there is sufficient publicly available

information to document in a transparent and conservative manner that the proposed project is occurring in a sector and investment context that does not feature the type of proposed activity as a common practice.

Monitoring Methodology

The methodology requires monitoring of the following:

- Electricity generation from the proposed project activity;
- Data needed to recalculate the operating margin emission factor, if needed, based on choice of operating margin (OM) method above;
- *If an annually updated build margin is used in the baseline methodology*, annual determination of the emission factor of the grid (weighted average of recently built plants—represented by the 5 most recent plants or the most 20% of the generating units built) to recalculate the build margin with monitored data;
- Correction of emission factors due to import of electricity (if needed);
- Monitor that applicability conditions continue to apply, in particular that the project activity is still additional at the renewal of the crediting period (condition on barriers and common practice).

Project boundary

The project boundary is defined as the project site. Monitoring considers the electricity grid system to which the project activity is connected. The emissions associated with the electricity import/export are dealt with by adjusting the calculation of emission reductions as outlined in the baseline methodology.

Baseline Emission Parameters

The 6[th] column indicates which monitoring elements are required depending on which operating margin (OM) used in step 1. "Simple OM" is defined in step 1a; "Simple Adjusted OM" in 1b; "Dispatch Data OM" in 1c. Items required for "BM" are for the build margin defined in step 2. "CM" refers to the combination of operating and build margin as defined in Step 3, i.e. these elements are required regardless of which OM and BM are used.

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
1. EG_y (EG_h if *OM_dispatchdata* is used)	electricity	Electricity supplied to the grid by the project	kWh	Directly measured	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	Hourly measure-ment and Monthly recording	100%	electronic	During the crediting period	Electricity supplied by the project activity to the grid. Double check by receipt of sales.
2. EF_y	emission factor	GHG emission factor of the grid	tCO_2eq/ kWh	c	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	yearly	100%	electronic	During the crediting period	Calculated as a weighted sum of emission factors of Operating Margin and Build Margin
3. EF_OM_y	emission factor	GHG emission factor of the grid (Operating Margin)	tCO_2eq/ kWh	c	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM*	yearly	100%	electronic	During the crediting period	Calculated as indicated in the relevant OM baseline method above

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
4. EF_BM_y	emission factor	GHG emission factor of the grid (Build Margin)	tCO_2eq/ kWh	c	*BM*	yearly	100%	electronic	During the crediting period	Calculated as $[\sum_i F_{i,y} * COEF_i] / [\sum_m GEN_{m,y}]$ over recently built power plants defined in the baseline methodology
5. $F_{i,y}$	fuel	Amount of each fossil fuel consumed in each plant	Physical unit	m	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	yearly	100%	electronic	During the crediting period	Obtained from the latest local statistics.
6. $COEF_i$	CO_2-eq coefficient	CO_2-eq emission coefficient of each fuel i	tCO_2eq/ (physical unit of the fuel i)	m	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	yearly	100%	electronic	During the crediting period	Obtained from the latest local statistics. If local statistics are not available, IPCC default values are applied.
7. $GEN_{j/k/n,,y}$	electricity	Electricity generation of the plant j, k, or n	KWh/yr	m	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	yearly	100%	electronic	During the crediting period	Obtained from the latest local statistics.
8.	Plant name	Plant identification for OM	Text	e	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM*	yearly	100% of set of plants	electronic	During the crediting period	Identification of plants (j, k, or n) to calculate Operating Margin emission factors

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ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
9.	Plant name	Plant identification for BM	text	e	BM	yearly	100% of set of plants	electronic	During the crediting period	Identification of plants (m) to calculate Build Margin emission factors
10. w_{OM} and w_{BM}	Weighting factor	Weight factor of OM (BM)	non-dimensinal number	m	CM	At the renewal of the crediting period Fixed	100%	electronic	During the crediting period	Default weight factor is 0.5 each. (w_{OM} + w_{BM}=1)
11.	Barriers	Documented evidence	text list	e	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	Once at the renewal time of the crediting period	100%	paper for original documents, else electronic	During the crediting period	Documented evidence of the prohibitive barriers of the proposed project activity
12.	Common practice	Documented evidence	text	e	*Simple OM* *Simple Adjusted OM* *Dispatch Data OM* *BM*	Once at the renewal time of the crediting period	100%	paper for original documents, else electronic	During the crediting period	Documented information related to the alternatives to the project, especially diffusion data
13.	Lambda	λ (lambda)	Percentage	c	*Simple Adjusted OM*	yearly	100%	electronic	During the crediting period	Adjustment factor accounting for number of hours per year during which low-cost/must-run sources are on the margin

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	For which baseline method(s) must this element be included	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
14.	Merit order	Documented evidence	text	e	*Dispatch Data OM*	yearly	100%	Paper for original documents, else electronic	During the crediting period	Required to stack the plants in the dispatch data analysis.

Leakage

ID number	Data type	Data variable	Data unit	Measured (m) calculated (c) estimated (e)	Recording frequency	Proportion of data monitored	How will data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
15. $GEN_{j/k/ll,y}$ *IMPORTS*	electricity	Electricity imported to the grid	kWh	c	yearly	100%	electronic	During the crediting period	Obtained from the latest local statistics. If local statistics are not available, IEA statistics are used to calculate.
16. $COEF_{i,j\,y}$ *IMPORTS*	emission factor	GHG emission factor of the imported electricity	kWh	c	yearly	100%	electronic	During the crediting period	Obtained from the latest local statistics. If local statistics are not available, IPCC default values are used to calculate.

Quality Control (QC) and Quality Assurance (QA) Procedures

All variables, except one related to off-site transportation, used to calculate project and baseline emissions are directly measured or are publicly available official data. To ensure the quality of the data, in particular those that are measured, the data are double-checked against commercial data. The quality control and quality assurance measures planned for the Project are outlined in the following table.

Data	Uncertainty Level of Data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation how QA/QC procedures are planned
1	Low	Yes	These data will be directly used for calculation of emission reductions. Sales record to the grid and other records are used to ensure the consistency.
11, 12	Low	No	These data are used to check whether the applicability conditions are met.
Others	Low	Yes	Default data (for emission factors) and IEA statistics (for energy data) are used to check the local data.

Baseline Data

For default emission factors, IPCC 1996 Guidelines on GHG Inventory (The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC) and Good Practice Guidance Report (Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, IPCC) are to be referred not only for their default values but also for their monitoring methodology as well as uncertainty management to ensure data credibility. These documents are downloadable from http://www.ipcc-nggip.iges.or.jp/. The latter document is a new supplementary document of the former.

1996 Guidelines:
- Vol. 2, Module 1 (Energy) for methodology,
- Vol. 3, Module 1 (Energy) for application (including default values)

2000 Good Practice Guidance on GHG Inventory and Uncertainty Management
- Chapter 2: Energy
- Chapter 6: Uncertainty

IEA (Yearly Statistics)
- CO_2 Emissions from Fuel Combustion
- Energy Statistics of Non-OECD Countries