Approved consolidated baseline and monitoring methodology ACM0013

"Consolidated baseline and monitoring methodology for new grid connected fossil fuel fired power plants using a less GHG intensive technology"

I. SOURCE AND APPLICABILITY

Sources

This consolidated baseline and monitoring methodology is based on elements from the following proposed new methodologies:

- NM0215: "Baseline and Monitoring Methodology for Grid Connected High-efficiency Coal-fired Electricity Generation in Countries Where Different Power Expansion Plans are Formulated for Broadly Different Power Technologies and Where These Plans are Restrictive" prepared by Huaneng Power International, Inc., Global Climate Change Institute of the Tsinghua University and CDM Office of CWEME, China;
- NM0217: "Grid-connected supercritical coal-fired power generation" submitted by NTPC Ltd, India, whose baseline study and project design document were prepared by Perspectives Climate Change GmbH, Hamburg, Germany.

This methodology also refers to the latest approved versions of:

- Methodology ACM0002 "Consolidated baseline and monitoring methodology for grid-connected electricity generation from renewable sources";
- "Tool for the demonstration and assessment of additionality";
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

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

Selected approach from paragraph 48 of the CDM modalities and procedures

"Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment".

and

"The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category".

Definitions

For the purpose of this methodology the following definition applies:

Power plant. A power plant is a facility for the generation of electric power from thermal energy from combustion of a fuel. In case where several power units have been installed at one site, each unit should be considered as a power plant.

Applicability

The methodology is applicable under the following conditions:

- The project activity is the construction and operation of a new fossil fuel fired grid-connected electricity generation plant that uses a more efficient power generation technology[1] than what would otherwise be used with the given fossil fuel;
- The project activity is not a co-generation power plant;
- Data on fuel consumption and electricity generation of recently constructed power plants is available;
- The identified baseline fuel is used in more than 50% of total generation by utilities in the geographical area within the country, as defined later in the methodology, or in the country.[2] To demonstrate this applicability condition data for latest three year shall be used. Maximum value of same fossil fuel generation estimated for three years should be greater than 50%.

This methodology is only applicable to new electricity generation plants. For project activities involving retrofit of existing facilities with the installation of highly efficient technologies, project proponents are encouraged to submit new methodologies. For project activities involving a switch to a less GHG intensive fossil fuel in existing power plants, project participants may use approved methodology ACM0011. For project activities involving construction and operation of a new power plant with less GHG intensive fossil fuel, project participants may use approved methodology AM0029.

II. BASELINE METHODOLOGY PROCEDURE

Identification of the baseline scenario

Project participants shall use the following steps to identify the baseline scenario:

[1] A possible project activity could be, e.g., the construction and operation of a supercritical coal fired power plant.

[2] For the purpose of demonstrating compliance with the applicability condition the geographical area has to be limited by the physical borders of the host country and cannot be extended to neighboring non-Annex I countries, even if such an extended geographical area is used for the calculation of a benchmark emission factor.

Step 1: Identify plausible baseline scenarios

The identification of alternative baseline scenarios should include all possible realistic and credible alternatives that provide outputs or services comparable with the proposed CDM project activity (including the proposed project activity without CDM benefits), i.e., all type of power plants that could be constructed as alternative to the project activity within the project boundary, as defined in the section "Project boundary" and in Step 2 of the section "Baseline emissions" below.

Alternatives to be analysed should include, *inter alia*:

- The project activity not implemented as a CDM project;
- The construction of one or several other power plant instead of the proposed project activity, including:
    - Power generation using the same fossil fuel type as in the project activity, but technologies other than that used in the project activity;
    - Power generation using fossil fuel types other than that used in the project activity;
    - Other power generation technologies, such as renewable power generation.
- Import of electricity from connected grids, including the possibility of new interconnections.

In establishing these scenarios, project participants should clearly identify and document which type of fuel would be used in each alternative, taking into account the requirements of the technology.

These alternatives need not consist solely of power plants of the same capacity, load factor and operational characteristics (i.e. several smaller plants, or the share of a larger plant may be a reasonable alternative to the project activity), however they should deliver similar services (e.g. peak vs. baseload power). Note further that the baseline scenario candidates identified may not be available to project participants, but could be other stakeholders within the grid boundary (e.g. other companies investing in power capacity expansions). Ensure that all relevant power plant technologies that have recently been constructed or are under construction or are being planned (e.g. documented in official power expansion plans) are included as plausible alternatives. A clear description of each baseline scenario alternative, including information on the technology, such as the efficiency and technical lifetime, shall be provided in the CDM-PDD.

The project participant may exclude baseline scenarios that are not in compliance with all applicable legal and regulatory requirements.

If one or more scenarios are excluded, appropriate explanations and documentation to support the exclusion of these scenarios shall be provided.

Step 2: Identify the economically most attractive baseline scenario alternative

The economically most attractive baseline scenario alternative is identified using investment analysis. The levelized cost of electricity production in $/kWh should be used as financial indicator for investment analysis. Calculate the suitable financial indicator for all alternatives remaining after Step 1. Include all relevant costs (including, for example, the investment cost, fuel costs and operation and maintenance

costs), and revenues (including subsidies/fiscal incentives,[3] ODA, etc. where applicable), and, as appropriate, non-market cost and benefits in the case of public investors.

The investment analysis should be presented in a transparent manner and all the relevant assumptions should be provided in the CDM-PDD, so that a reader can reproduce the analysis and obtain the same results. Critical techno-economic parameters and assumptions (such as capital costs, fuel price projections, lifetimes, the load factor of the power plant and discount rate or cost of capital) should be clearly presented. Justify and/or cite assumptions in a manner that can be validated by the DOE. In calculating the financial indicator, the risks of the alternatives can be included through the cash flow pattern, subject to project-specific expectations and assumptions (e.g. insurance premiums can be used in the calculation to reflect specific risk equivalents). Where assumptions, input data, and data sources for the investment analysis differ across the project activity and its alternatives, differences should be well substantiated.

The CDM-PDD submitted for validation shall present a clear comparison of the financial indicator for all scenario alternatives. The baseline scenario alternative that has the best indicator (e.g. highest IRR) can be pre-selected as the most plausible baseline scenario.

A sensitivity analysis shall be performed for all alternatives, to confirm that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions (e.g. fuel prices and the load factor). The investment analysis provides a valid argument in selecting the baseline scenario only if it consistently supports (for a realistic range of assumptions) the conclusion that the pre-selected baseline scenario is likely to remain the most economically and/or financially attractive.

If sensitivity analysis confirms the result, then select the most economically attractive alternative as the most plausible baseline scenario. In case the sensitivity analysis is not fully conclusive, select the baseline scenario alternative with the lowest emission rate among the alternatives that are the most financially and/or economically attractive.

If the type of power plant identified as the baseline scenario is different from the power plant technologies that have recently been constructed or are under construction or are being planned (e.g. documented in official power expansion plans), the project participants shall provide explanations to this apparent discrepancy between observations and what should be considered as rational economic behavior.

If the emission rate of the selected baseline scenario is clearly below that of the project activity (e.g. the baseline scenario is hydro, nuclear or biomass power), then the project activity should not be considered to yield emission reductions, and this methodology cannot be applied.

The methodology is only applicable if the most plausible baseline scenario is the construction of (a) new power plant(s) using the same fossil fuel type as used in the project activity. This means that if the most likely baseline scenario identified through the baseline identification procedure is the import of electricity or the construction of a new power plant(s) that (partly) use renewable energy sources, nuclear sources or other types of fossil fuels than the fossil fuel type fired in the project activity plant, then this methodology is not applicable.

[3] Note the guidance by EB 22 on national and/or sectoral policies and regulations.

Additionality

The latest version of the "Tool for the demonstration and assessment of additionality", agreed by the CDM Executive Board, should be applied to assess the additionality of the proposed project activity. Ensure consistency with the procedure to determine the most likely baseline scenario as provided above. In the case Option II (Investment comparison analysis) is applied in Sub-step 2b, it should be demonstrated that the baseline alternative is available to the project participant(s).

Project boundary

The spatial extent of the project boundary includes the power plant at the project site and all power plants considered for the calculation of the baseline CO_2 emission factor ($EF_{BL,CO2,y}$).

In the calculation of project emissions, only CO_2 emissions from fossil fuel combustion in the project plant are considered. In the calculation of baseline emissions, only CO_2 emissions from fossil fuel combustion in power plant(s) in the baseline are considered.

The greenhouse gases included in or excluded from the project boundary are shown in Table 1.

Table 1: Overview of emissions sources included in or excluded from the project boundary

	Source	Gas	Included ?	Justification / Explanation
Baseline	Power generation in baseline	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.
Project Activity	On-site fuel combustion in the project plant	CO_2	Yes	Main emission source
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification

Project emissions

The project activity is the on-site combustion of fossil fuels in the project plant to generate electricity. The CO_2 emissions from electricity generation in the project plant (PE_y) should be calculated using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", where the process *j* in the tool corresponds to the combustion of fossil fuels in the project plant.

Baseline emissions

Baseline emissions are calculated by multiplying the electricity generated in the project plant ($EG_{PJ,y}$) with a baseline CO_2 emission factor ($EF_{BL,CO2,y}$), as follows:

$$BE_y = EG_{PJ,y} \times EF_{BL,CO2,y} \quad \textbf{(1)}$$

Where:

BE_y	=	Are the baseline emissions in year *y* (tCO_2)
$EG_{PJ,y}$	=	Is the net quantity of electricity generated in the project plant in year *y* (MWh)
$EF_{BL,CO2,y}$	=	Is the baseline emission factor in year *y* (tCO_2/MWh)

$EF_{BL,CO2}$ will be determined using the lower value between the emission factor of the technology and fuel type that has been identified as the most likely baseline scenario and a benchmark emission factor determined based on the performance of the top 15% power plants that use the same fuel as the project plant and any technology available in the geographical area as defined in Step 2 below.

Project participants shall use for $EF_{BL,CO2,y}$ the lowest value among the following two options:

Option 1: The emission factor of the technology and fuel identified as the most likely baseline scenario under "Identification of the baseline scenario" section above, and calculated as follows:

$$EF_{BL,CO2,y} = 3.6 \cdot \frac{MIN\left(EF_{FF,BL,CO2,y}; EF_{FF,PJ,CO2,y}\right)}{\eta_{BL}} \quad \textbf{(2)}$$

Where:

$EF_{BL,CO2,y}$	=	Is the baseline emission factor in year *y* (tCO_2/MWh)
$EF_{FF,BL,CO2,y}$	=	Is the CO_2 emission factor of the fossil fuel type that has been identified as the most likely baseline scenario (tCO_2/GJ)
$EF_{FF,PJ,CO2,y}$	=	Is the average CO_2 emission factor of the fossil fuel type used in the project plant in year *y* (tCO_2/GJ)
η_{BL}	=	Is the energy efficiency of the power generation technology that has been identified as the most likely baseline scenario
3.6	=	Is the unit conversion factor from GJ to MWh

Option 2: The average emissions intensity of all power plants *j*, corresponding to the power plants whose performance is among the top 15 % of their category, as follows:

$$EF_{BL,CO2,y} = \frac{\sum_j FC_{j,x} \cdot NCV_{j,x} \cdot EF_{CO2,j,x}}{\sum_j EG_{j,x}} \quad \textbf{(3)}$$

Where:

$EF_{BL,CO2,y}$	=	Is the baseline emission factor in year *y* (tCO_2/MWh)
$FC_{j,x}$	=	Is the amount of fuel consumed by power plant *j* in year *x* (Mass or volume unit)
$NCV_{j,x}$	=	Is the net calorific value of the fossil fuel type consumed by power plant *j* in year *x* (GJ/Mass or volume unit)
$EF_{CO2,j,x}$	=	Is the CO2 emission factor of the fossil fuel type consumed by power plant *j* in year *x* (tCO_2/GJ)
$EG_{j,x}$	=	Is the net electricity generated and delivered to the grid by power plant *j* in year *x* (MWh)

x	=	Is the most recent year prior to the start of the project activity for which data is available
j	=	The top 15% performing power plants (excluding cogeneration plants and including power plants registered as CDM project activities), as identified below, among all power plants in a defined geographical area that have a similar size, are operated at similar load and use the same fuel type as the project activity

Note: That in case of Option 2, $EF_{BL,CO2,y}$ is not monitored annually but only calculated once at the start of the crediting period and updated at the renewal of a crediting period.

For determination of the top 15% performer power plants *j*, the following step-wise approach is used:

Step 1: Definition of similar plants to the project activity

The sample group of similar power plants should consist of all power plants (except for cogeneration power plants)

- That use the same fossil fuel type as the project activity, where fuel types are defined in the following categories:
  - Coal;
  - Oils (e.g. diesel, kerosene, residual oil);
  - Natural gas.
- That have been constructed in the previous five years;
- That have a comparable size to the project activity, defined as the range from 50% to 150% of the rated capacity of the project plant;
- That are operated in the same load category, i.e. at peak load (defined as a load factor of less than 3,000 hours per year) or base load (defined as a load factor of more than 3,000 hours per year) as the project activity; and
- That have operated (supplied electricity to the grid) in the year prior to the start of the project activity.

Step 2: Definition of the geographical area

The geographical area to identify similar power plants should be chosen in a manner that the total number of power plants "N" in the sample group comprises at least 10 plants. As a default, the grid[4] to which the project plant will be connected should be used. If the number of similar plants, as defined in Step 1, within the grid boundary is less than 10, the geographical area should be extended to the country. If the number of similar plants is still less than 10, the geographical area should be extended by including all neighboring non-Annex I countries. If the number remains to be less than 10, all non-Annex I countries in the continent should be considered.

[4] The grid boundary is defined as per the approved consolidated baseline and monitoring methodology ACM0002.

If the necessary data on power plants of the sample group in the relevant geographical area are not available, or if there are less than 10 similar power plants in all non-Annex I countries in the continent, then data from power plants annex I or OECD countries can be used instead.

Step 3: Identification of the sample group

Identify all power plants *n* that are to be included in the sample group. Determine the total number "N" of all identified power plants that use the same fuel as the project plant and any technology available within the geographical area, as defined in Step 2 above.

The sample group should also include all power plants within the geographical area registered as CDM project activities, which meet the criteria defined in Step 1 above.

Step 4: Determination of the plant efficiencies

Calculate the operational efficiency of each power plant *n* identified in the previous step. The most recent one-year data available shall be used. The operational efficiency of each power plant *n* in the sample group is calculated as follows:

$$\eta_{n,x} = 3.6 \cdot \frac{EG_{n,x}}{FC_{n,x} \cdot NCV_{n,x}} \quad \textbf{(4)}$$

Where:

$\eta_{n,x}$	=	Is the operational efficiency of the power plant *n* in year *x*
$EG_{n,x}$	=	Is the net electricity generated and delivered to the grid by the power plant *n* in the year *x* (MWh)
$FC_{n,x}$	=	Is the quantity of fuel consumed in the power plant *n* in year *x* (Mass or volume unit)
$NCV_{n,x,}$	=	Is the net calorific value of the fuel type fired in power plant *n* in year *y* (GJ/mass or volume unit)
3.6	=	Is the unit conversion factor from GJ to MWh
n	=	Are all power plants in the defined geographical area that have a similar size, are operated at similar load and use the same fuel types as the project activity
x	=	Is the most recent year prior to the start of the project activity for which data are available

Step 5: Identification of the top 15% performer plants j

Sort the sample group of *N* plants from the power plants with the highest to the lowest operational efficiency. Identify the top 15% performer plants *j* as the plants with the 1st to Jth highest operational efficiency, where the *J* (the total number of plants *j*) is calculated as the product of N (the total number of plants *n* identified in Step 3) and 15%, rounded down if it is decimal.[5] If the generation of all identified plants *j* (the top 15% performers) is less than 15% of the total generation of all plants n (the whole sample group), then the number of plants *j* included in the top 15% performer group should be enlarged until the group represents at least 15% of total generation of all plants *n*.

All steps should be documented transparently, including a list of the plants identified in Steps 3 and 5, as well as relevant data on the fuel consumption and electricity generation of all identified power plants.

Leakage

No leakage emissions are to be considered.

Emission reductions

To calculate the emission reductions the project participant shall apply the following equation:

$$ER_y = BE_y - PE_y \quad \textbf{(5)}$$

Where:

ER_y	=	Are the emission reductions in year *y* (tCO_2)
BE_y	=	Are the baseline emissions in year *y* (tCO_2)
PE_y	=	Are the project emissions in year *y* (tCO_2)

Changes required for methodology implementation in 2nd and 3rd crediting periods

At the renewal of a crediting period, project participants should assess whether the baseline scenario is still valid by applying the procedure to select the most plausible baseline scenario, as described above. Moreover, the baseline emission factor ($EF_{BL,CO2,y}$) should be updated, applying both Options 1 and 2 and choosing for the subsequent crediting period again the lower value among the two options. For Option 1, the most likely power plant technology identified in the application of the procedure to select the baseline scenario should be used. For Option 2, the baseline emission factor should be updated based on the most recent available data at the time of renewal of the crediting period.

[5] This is conservative as this limits the number of the top 15% performer plants, which will always lead to exclusion of the least efficient plant among them.

Data and parameters not monitored

Parameter:	$EF_{FF,BL,CO2,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the fossil fuel type that has been identified as the most likely baseline scenario
Source of data:	The fuel type is determined as part of the baseline scenario selection procedure. Choose the CO_2 emission factor corresponding to that fuel type (e.g. sub-bituminous coal). Use preferably well-documented and reliable regional or national average values. If such data is not available, IPCC default values may be used
Measurement procedures (if any):	-
Any comment:	-

Parameter:	η_{BL}
Data unit:	-
Description:	Energy efficiency of the power generation technology that has been identified as the most likely baseline scenario
Source of data:	This parameter is determined as part of the baseline scenario selection procedure
Measurement procedures (if any):	-
Any comment:	As a conservative approach, the efficiency should be determined as the efficiency at optimum load, e.g., as provided by the manufacturers

Parameter:	$FC_{j,x}$ and $FC_{n,x}$
Data unit:	Mass or volume unit
Description:	Amount of fuel consumed by power plant *j* or *n* in year *x,* where: • *j* are the top 15% performer plants among all power plants in a defined geographical area that have a similar size, are operated at similar load and use the same fuel type as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section • *n* are all power plants (including power plants registered as CDM project activities) in the defined geographical area that have a similar size, are operated at similar load and use the same fuel types as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section, and • *x* is the most recent year prior to the start of the project activity for which data are available
Source of data:	Fuel consumption statistics, e.g. from central-/regional regulatory authorities
Measurement procedures (if any):	-
Any comment:	-

Parameter:	$NCV_{j,x}$ and $NCV_{n,x}$
Data unit:	GJ/Mass or volume unit
Description:	Net calorific value of the fossil fuel type consumed by power plant *j* or *n* in year *x,* where: • *j* are the top 15% performer plants among all power plants in a defined geographical area that have a similar size, are operated at similar load and use the same fuel type as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section • *n* are all power plants (including power plants registered as CDM project activities) in the defined geographical area that have a similar size, are operated at similar load and use the same fuel types as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section, and • *x* is the most recent year prior to the start of the project activity for which data are available
Source of data:	Use plant-specific data if available (e.g. from national energy balances if the fuel consumption of the plant is provided on an energy basis). Otherwise use well-documented and reliable regional or national average values. If such data are not available, IPCC default values may be used
Measurement procedures (if any):	-
Any comment:	-

Parameter:	$EF_{CO2,j,x}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the fossil fuel type consumed by power plant *j* in year *x* where: • *j* are the top 15% performer plants among all power plants in a defined geographical area that have a similar size, are operated at similar load and use the same fuel type as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section; and • *x* is the most recent year prior to the start of the project activity for which data are available
Source of data:	Use well-documented and reliable regional or national average values. If such data are not available, IPCC default values may be used
Measurement procedures (if any):	-
Any comment:	If the regional or national data are outside the 95% confidence intervals of IPCC default values for the respective fuels, as provided in Table 1.4, Vol. 2 of the 2006 IPCC Guidelines, an explanation should be sought and provided on why the value is significantly different from the IPCC default value

Parameter:	$EG_{j,x}$ and $EG_{n,x}$
Data unit:	MWh
Description:	Net electricity generated and delivered to the grid by power plant *j* or *n* in year *x* where: • j are the top 15% performer plants among all power plants in a defined geographical area that have a similar size, are operated at similar load and use the same fuel type as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section; • *n* are all power plants (including power plants registered as CDM project activities) in the defined geographical area that have a similar size, are operated at similar load and use the same fuel types as the project activity and any technology available within the geographical area, as defined in Step 2 under "Baseline emissions" section; and • *x* is the most recent year prior to the start of the project activity for which data are available
Source of data:	Electricity generation statistics, e.g. from central-/regional regulatory authorities
Measurement procedures (if any):	-
Any comment:	

III. MONITORING METHODOLOGY

All data collected as part of monitoring plan should be archived electronically and be kept at least for 2 years after the end of the last crediting period. 100% of the data should be monitored if not indicated otherwise in the comments in the tables below. All measurements should use calibrated measurement equipment according to relevant industry standards.

For monitoring project emissions from combustion of fossil fuels in the project plant and for monitoring $EF_{FF,PJ,CO2,y}$, the guidance in the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" should be applied.

Data and parameters monitored

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh
Description:	Net quantity of electricity generated in the project plant in year *y*
Source of data:	Measurements by project participants
Measurement procedures (if any):	Electricity meters
Monitoring frequency:	Continuously
QA/QC procedures:	The metered net electricity generation should be cross-checked with receipts from sales
Any comment:	Ensure that $EG_{PJ,y}$ is the net electricity generation (the gross generation by the project plant minus all auxiliary electricity consumption of the plant)

Data / Parameter:	$EF_{FF,PJ,CO2,y}$
Data unit:	tCO_2/GJ
Description:	CO_2 emission factor of the fossil fuel type used in the project plant in year *y*
Source of data:	Each year, the project participants should monitor the fuel type. Choose the CO_2 emission factor corresponding to that fuel type. Use preferably well-documented and reliable regional or national average values. If such data is not available, IPCC default values may be used.
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

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History of the document

Version	Date	Nature of revision
02.1	EB 46, Annex 8 25 March 2009	The methodology was editorially revised: • To correct error in the unit in equation 2 and 3; • To correct unit conversion factor from GJ to MWh in equation 4; • To include $EF_{FF,PJ,CO2,y}$ in the monitoring table under 'data and parameters monitored', and • To correct other unit inconsistencies and editorial errors.
02	EB 39, Annex 6 16 May 2008	The methodology was revised to clarify that in the fourth applicability condition the geographical area has to be limited by the physical borders of the host country and as such cannot be extended to neighboring non-Annex I countries.
01	EB 34, Annex 2 12 September 2007	Initial adoption.