Approved baseline and monitoring methodology AM0061

"Methodology for rehabilitation and/or energy efficiency improvement in existing power plants"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Source

This baseline methodology is based on:

- NM0202-rev "AzDRES Power Plant Energy Efficiency and Change in Fuel mix" prepared by Ecofys BV, Netherlands.

For more information regarding the proposals and their consideration by the Executive Board please refer to <https://cdm.unfccc.int/methodologies/approved>.

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

- "Combined tool for identification of baseline scenario and demonstration of additionality";
- "Tool to calculate the emission factor for an electricity system";
- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

 Please refer to: <https://cdm.unfccc.int/goto/MPappmeth>.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

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

Project activity power plant. An existing fossil fuel fired power plant where the project activity is implemented.

Electricity grid. Electricity supply system to which many consumers and many power plants are connected, as defined in "Tool to calculate the emission factor for an electricity system". The power plants connected to the electricity supply system are dispatched by a dispatch center.

~~Rehabilitation. Rehabilitation in the context of this methodology refers to an investment in an existing power plant, whose performance has deteriorated over the years, with the purpose to upgrade its performance~~ **Rehabilitation and/or energy efficiency improvement measures.** Rehabilitation **and/or energy efficiency improvement measures** in the context of this methodology refers to an investment in an existing power plant, whose performance has deteriorated over the years, with the purpose to upgrade its performance without adding new generating units. The power plant should be currently operational and would remain operational along the whole crediting period. A minor increase in nameplate capacity up to

15% could happen due to the installation of improved equipment compared to the original design. An example of rehabilitation would be to use more advanced technology blades in an existing steam turbine, replacement of leaking piping, installation of control systems, etc. Rehabilitation does not include the complete replacement of major components of the power plant such as turbines or boilers.

Applicability

This methodology is applicable to project activities that implement rehabilitation and/or energy efficiency improvement measures in an existing fossil fuel fired power plant for electricity generation. The methodology is also applicable to the project activities that along with rehabilitation and/or energy efficiency measures implement a fuel switch, whether partial or total, but no emissions reductions, if any, will be credited for the fuel switch.

The following conditions apply:

- The project activity power plant supplies electricity to the electricity grid;[1]
- The project activity is implemented in an existing power plant and does not involve the installation and commissioning of new electricity generation ~~capacity~~units. The installed power generation capacity of each unit (nameplate capacity) may increase as a result of the project activity but this increase is limited to 15% of the previous existing power generation capacity (nameplate capacity) of the whole plant, i.e. throughout the crediting period the installed power generation capacity of the project activity power plant does not exceed the nameplate power generation capacity of the project activity power plant previous to the implementation of the project activity by more than ~~5~~15%. Please, refer to parameters CAP_{design} and $CAP_{PJ,y}$ in the monitored/not monitored parameters;
- The existing power plant has an operation history of at least ten years[2] and data on fuel consumption and electricity generation for the most recent five historical years prior to the implementation of the project activity are available;
- Only rehabilitation and/or energy efficiency improvement measures which require capital investment shall be included. Regular maintenance and housekeeping measures cannot be included in the proposed CDM project activity;
- The methodology is applicable if the most plausible baseline scenario is the continuation of the operation of the project activity power plant, continuing to use all power generation equipment that was already in use prior to the implementation of the project activity and undertaking business as usual maintenance.

The methodology is **not** applicable to:

- Greenfield power plants;
- Cogeneration power plants.[3]

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[1] The methodology is limited to power plants supplying electricity to grid, as procedure for identification of baseline and demonstration of additionality of the project activities that are implemented in captive power plant or power plant that supply to captive consumers is not provided for in the methodology.

[2] In case when the power plant has been in operation for less than ten years, the methodology is applicable if project participants provide documented evidence of the deterioration of the plant due to mechanical failure or damage confirming that its average annual heat rate increased by at least 25% along with a considerable drop in its output of not less than 10%.

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

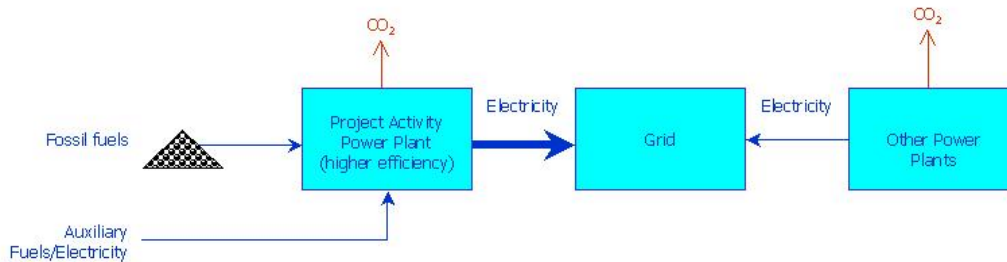## II. BASELINE METHODOLOGY

Project boundary

The spatial extent of the project boundary includes the project site and all power plants connected to the electricity grid which the CDM project power plant is connected to. This is also reflected in Figure 1.

Figure 1 - Diagram of the project boundary

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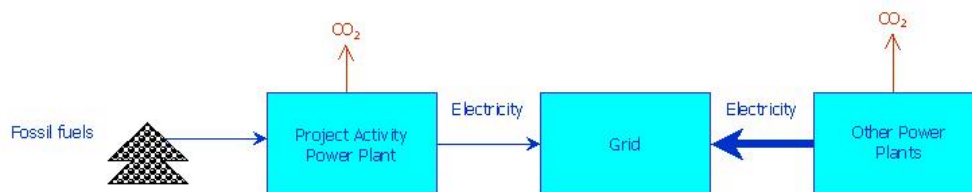
[3] Methodological procedures for estimating baseline emissions are only applicable to power only generation projects.

The sources and gases included in the project boundary are listed in Table 1.

Table 1 - Emissions sources included in or excluded from the project boundary

	Source	Gas	Included	Justification / Explanation
Baseline	Emissions due to the combustion of fossil fuels for electricity production in the project activity power plant	CO_2	Yes	CO_2 is the main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
	Emissions due to the combustion of fossil fuels for electricity production in power plants connected to the grid	CO_2	Yes	CO_2 is the main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
Project Activity	Emissions due to the combustion of fossil fuels in the project activity power plant	CO_2	Yes	CO_2 is the main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source

Procedure for estimating remaining lifetime of the power generation equipments

The following approaches shall be used to estimate the remaining lifetime of the existing power equipments, i.e. the time when the existing power equipments would need to be replaced/rehabilitated in the absence of the project activity:

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

(b) The practices of the responsible company regarding replacement/rehabilitation schedules may be evaluated and documented (e.g. based on historical replacement records for similar power equipments).

The time of replacement/rehabilitation of the existing power equipments in the absence of the project activity should be chosen in a conservative manner, i.e. the earliest point in time should be chosen in cases where only a time frame can be estimated and should be documented in CDM-PDD.

If the remaining lifetime of the power equipments is increased due to the project activity, the crediting period has to be limited to the earliest estimated remaining lifetime amongst the set of power equipments, i.e. the earliest point in time when one of the existing power equipments would need to be replaced/rehabilitated in the absence of the project activity.

Procedure for the identification of the most plausible baseline scenario and assessment of additionality

For the selection of the most plausible baseline scenario and assessment of additionality, use the latest version of the "Combined tool to identify the baseline scenario and demonstrate additionality" agreed by the CDM Executive Board, available at the UNFCCC CDM website. The following specific guidance is provided for the application of the combined tool:

Specific guidance

This methodology considers the implementation of a package of measures.

For the purpose of this activity a *measure* is defined as the smallest combination of actions which would result in an energy efficiency improvement if it would be implemented independently.

A *package of measures* is the combination of *measures* which are interdependent. Measures are considered to be interdependent when the resulting energy efficiency improvement of one measure is influenced by the implementation of another.

The project has to include in the CDM-PDD a detailed description of all rehabilitation/energy efficiency improvement *measures* which are implemented as part of the project activity and further group them in *packages of measures*.

For the determination of the investment costs of the proposed project activity the project shall only include those measures and package of measures which result in a direct energy efficiency improvement, e.g. measures related to improving health and safety standards or general construction work on the building cannot be included.

For each measure and package of measures the energy efficiency impact needs to be determined. In the case the measure or the individual package of measures is non-additional, the energy efficiency impact of those measures ($\Delta \eta_{non\text{-}add}$) needs to be subtracted from the energy efficiency improvement as described in the baseline emissions section (see equation 10).

In addition, the costs associated with any maintenance measure in the package of proposed rehabilitation energy efficiency improvement measures which was executed in the past 5 years will have to be excluded from the additionality test. The associated energy efficiency improvement ($\Delta \eta_{reg}$) needs to be determined and subtracted from the efficiency improvement as described in the baseline emissions section (see equation 10).

Specific guidance on Step 1a. Identify all realistic and credible alternatives to the project activity

Consider, at least, the following alternative(s) to the proposed project activity:

E1   Continuation of operation of the project activity power plant, continuing to use all power generation equipment that was already used prior to the implementation of the project activity and undertaking business as usual maintenance. In case of generation increase in the project activity compared to the maximum in the baseline (parameter $EL_{BL,MAX}$ as defined below), additional power generated would be supplied by the grid (related costs should be included in the investment analysis, if relevant) in absence of the project activity;

E2   Continuation of operation of the project activity power plant, continuing to use all power generation equipment that was already used prior to the implementation of the project activity and undertaking business as usual maintenance. In case of generation increase in the project activity compared to the maximum in the baseline (parameter $EL_{BL,MAX}$ as defined below), additional power generated would be supplied by investment in new power generation capacity in absence of the project activity;

E3   Investment in new power generation capacity;

E4   The proposed project activity not undertaken under the CDM;

E5   Individual *measures* which are part of the total package of proposed energy efficiency measures not undertaken under the CDM (this is required to distinguish the additional measures from the non-additional ones);

E6   Individual *packages of measures* part of the total package of proposed energy efficiency measures not undertaken under the CDM (this is required to distinguish the additional package of measures from the non-additional ones).

Scenario E2 is a group of scenario, with each fuel/technology for a new power plant representing a scenario. 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 provide 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.

Specific guidance on Sub-step 2a. Identify barriers that would prevent the implementation of alternative scenarios

The only eligible barrier for such project activities is the investment barrier. No other barrier shall be used to identify the baseline scenario and demonstrate additionality.

The project shall identify which measures would be implemented even if there is investment barrier (i.e. without access to external capital). Any such measures shall be classified as non-additional. To substantiate this claim the project shall support this claim by providing access to official due diligence documentation (such as feasibility studies) sent to financial institutions which have been contacted for financing purposes.

If a measure or an individual package of measures is considered non-additional, the estimated efficiency of that package of measures ($\Delta \eta_{non-add}$) shall be subtracted from the energy efficiency improvement in the baseline (see equation 10).

Baseline emissions

Electricity generation in the project activity power plant will displace in the baseline scenario less efficient electricity generation in the project plant and can, in addition, displace electricity in the grid and/or in other power plants, identified as per the baseline identification procedure, that would be built in the absence of the project activity, if the quantity of electricity generation is increased as result of the project activity. The calculation of baseline emissions is therefore based on different emission factors for different quantities of electricity generated. As represented in figure 2, the following cases are differentiated:

Figure 2 - Different emission factors for different quantities of electricity generated.
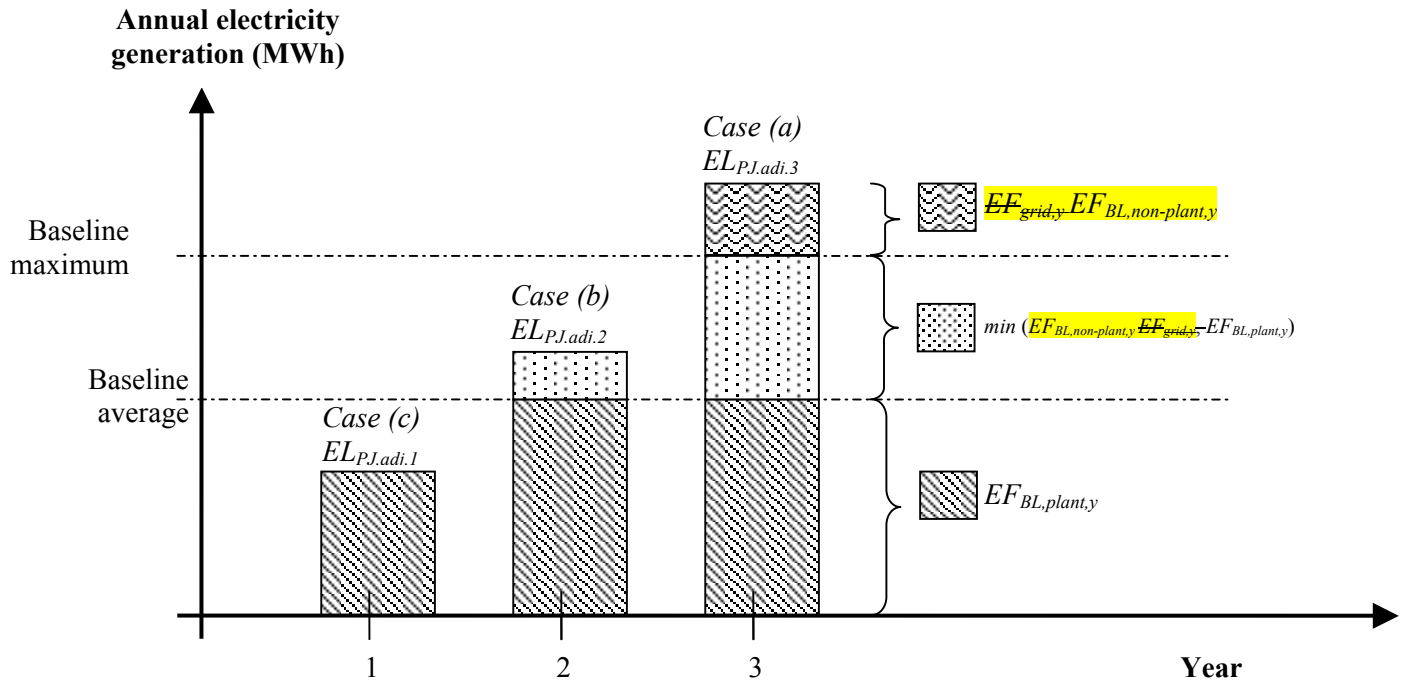
Case (a)

The quantity of electricity generated in the project activity power plant ($EL_{PJ,adj,y}$) exceeds the maximum annual quantity of electricity that the power plant could have produced without the implementation of the project activity ($EL_{BL,MAX}$), i.e. $EL_{PJ,adj,y} > EL_{BL,MAX}$:

$$BE_y = EL_{BL,AVR} \cdot EF_{BL,plant,y} + \left(EL_{BL,MAX} - EL_{BL,AVR}\right) \cdot min\left(EF_{BL,plant,y}, EF_{BL,non-plant,y}\right)$$
$$+ \left(EL_{PJ,adj,y} - EL_{BL,MAX}\right) \cdot EF_{BL,non-plant,y} \tag{1}$$

Case (b)

The quantity of electricity generated in the project activity power plant ($EL_{PJ,adj,y}$) is lower than the maximum annual quantity of electricity that the power plant could have produced without the implementation of the project activity ($EL_{BL,MAX}$), but higher than the average historical electricity production ($EL_{BL,AVR}$). i.e. $EL_{BL,AVR} < EL_{PJ,adj,y} < EL_{MAX}$:

$$BE_y = EL_{BL,AVR} \cdot EF_{BL,plant,y} + \left(EL_{PJ,adj,y} - EL_{BL,AVR}\right) \cdot min\left(EF_{BL,plant,y}, EF_{BL,non-plant,y}\right) \tag{2}$$

Case (c)

The quantity of electricity generated in the project activity power plant ($EL_{PJ,adj,y}$) is lower than the average electricity production in the baseline ($EL_{BL,AVR}$) or $EL_{PJ,adj,y} < EL_{BL,AVR}$:

$$BE_y = EL_{PJ,adj,y} \cdot EF_{BL,plant,y} \tag{3}$$

Where:

BE_y	=	Baseline emissions in year y of the crediting period (tCO$_2$)
$EL_{PJ,adj,y}$	=	Total amount of electricity supplied to the electricity grid by the project activity power plant in year y of the crediting period adjusted for the calculation of baseline emissions (MWh)
$EL_{BL,MAX}$	=	Maximum annual amount of electricity that could be supplied to the electricity grid by the project activity power plant based on its installed capacity prior to the implementation of project activity (MWh)
$EL_{BL,AVR}$	=	Average annual amount of electricity supplied to the electricity grid by the project activity power plant during the most recent five historical years prior to the implementation of the project activity (MWh)
$EF_{BL,plant,y}$	=	Emission factor for the project activity power plant in the baseline (tCO$_2$/MWh)
~~$EF_{grid,y}$~~	=	~~Emission factor of the electricity grid to which the project activity power plant is connected (tCO$_2$/MWh). Calculated as per the latest approved version of "Tool to calculate emission factor for electricity system"~~
$EF_{BL,non-plant,y}$	=	Conservative emission factor used in the calculation of baseline emissions for the electricity supplied to the electricity grid by the project activity power plant in excess if $EL_{BL,AVR}$, i.e. the historical level of generation (tCO$_2$/MWh)
y	=	Year during the crediting period

Calculation of $EL_{PJ,adj,y}$

The total amount of electricity supplied to the electricity grid by the project activity power plant in year y of the crediting period has to be adjusted for the calculation of baseline emissions taking in to consideration that future energy efficiency measures (i.e. measures that may be implemented after the project activity)

shall not result in emissions reductions. Therefore, the electricity used for calculating baseline emissions shall be conservatively adjusted by the applying a discount factor based on the minimum of the monitored efficiencies after the implementation of the project activity, as described in the equation below:

$$EL_{PJ,adj,y} = EL_{PJ,y} \cdot \frac{\eta_{PJ,min,y}}{\eta_{PJ,y}}$$ **(4)**

Where:

$EL_{PJ,adj,y}$ = Total amount of electricity supplied to the electricity grid by the project activity power plant in year y of the crediting period adjusted for the calculation of baseline emissions (MWh)

$EL_{PJ,y}$ = Total amount of electricity supplied to the electricity grid by the project activity power plant in year y of the crediting period (MWh)

$\eta_{PJ,min,y}$ = Minimum of the efficiencies of the project activity power plant monitored during the previous years (1 to y-1) after the implementation of the project activity

$\eta_{PJ,y}$ = Average energy efficiency of the project activity power plant in year y of the crediting period

Calculation of $\eta_{PJ,min,y}$

$$\eta_{PJ,min,y} = min(\eta_{PJ,1},...,\eta_{PJ,y-1})$$ **(5)**

Where:

$\eta_{PJ,min,y}$ = Minimum of the efficiencies of the project activity power plant monitored during the previous years (1 to y-1) after the implementation of the project activity

$\eta_{PJ,i}...\eta_{PJ,y-i}$ = Average energy efficiency of the project activity power plant in years 1 to y-1 of the crediting period (refer to $\eta_{PJ,y}$ in the monitoring tables)

y = Each year of the crediting period

Calculation of $EL_{BL,MAX}$

The maximum annual amount of electricity that could be supplied to the electricity grid by the project activity power plant prior to the implementation of the project activity is calculated as:

$$EL_{BL,MAX} = CAP_{BL} \cdot T_{BL}$$ **(6)**

$EL_{BL,MAX}$ = Maximum annual amount of electricity that could be supplied to the electricity grid by the project activity power plant in the baseline based on its installed capacity prior to the implementation of project activity (MWh)

CAP_{BL} = Actual power generation capacity of the project activity power plant previous to the implementation of the project activity (MW)

T_{BL} = Maximum amount of time during a year in which the project activity power plant could have operated at actual power generation capacity prior to the implementation of the project activity (hours)

Calculation of T_{BL}

$$T_{BL} = 8,760 - \frac{\sum_{x=1}^{5} HMR_x}{5} \qquad (7)$$

T_{BL} = Maximum amount of time during a year in which the project activity power plant could have operated at actual power generation capacity prior to the implementation of the project activity (hours)

HMR_x = Average number of hours in a year during which the plant did not operate due to maintenance or repair, based on data for the five most recent years x prior to the implementation of the project activity (hours)

Calculation of $EL_{BL,AVR}$

The average annual amount of electricity supplied to the electricity grid by the project activity power plant prior to the implementation of the project activity is calculated as follows:

$$EL_{BL,AVR} = \frac{\sum_{x=1}^{5} EL_x}{5} \qquad (8)$$

EL_x = Annual electricity supplied to the electricity grid by the project activity power plant in years x prior to the implementation of the project activity (MWh)

x = Each one of the five most recent years prior to the implementation of the project activity

Calculation of $EF_{BL,plant,y}$

$$EF_{BL,plant,y} = min\left(\frac{3.6}{1000} \cdot \frac{1}{\eta_{BL,adj}} \cdot \frac{\sum_{x=1}^{5}\sum_{i}\left(EF_{i,x} \cdot F_{i,x} \cdot NCV_{i,x}\right)}{\sum_{x=1}^{5}\sum_{i}\left(F_{i,x} \cdot NCV_{i,x}\right)} ; \frac{3.6}{1000} \cdot \frac{1}{\eta_{BL,adj}} \cdot \frac{\sum_{i}\left(EF_{i,y} \cdot F_{i,y} \cdot NCV_{i,y}\right)}{\sum_{i}\left(F_{i,y} \cdot NCV_{i,y}\right)} \right) \qquad (9)$$

Where:

$EF_{BL,plant,y}$ = Emission factor for the project activity power plant in the baseline (tCO$_2$/MWh)

$\eta_{BL,adj}$ = Adjusted efficiency of the project activity power plant prior to implementation of the project activity

$EF_{i,x}$ = CO$_2$ emission factor for the fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity (tCO$_2$/TJ)

$NCV_{i,x}$ = Net calorific value for the fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity (TJ/mass or volume units)

$F_{i,x}$ = Amount of fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity (mass or volume units)

$EF_{i,y}$	=	CO_2 emission factor for the fossil fuel type i used in the project activity power plant in year y of the crediting period (tCO_2/TJ)
$NCV_{i,y}$	=	Net calorific value for the fossil fuel type i in year y of the crediting period (TJ/mass or volume units)
$F_{i,y}$	=	Amount of fossil fuel type i used in the project activity power plant in year y of the crediting period (mass or volume units)
i	=	Type of fossil fuels used in the project activity power plant
x	=	Each one of the five most recent years prior to the implementation of the project activity
y	=	Year of the crediting period

Calculation of $\eta_{BL,adj}$

The efficiency of the project activity power plant in the baseline has to be adjusted for the calculation of baseline emissions taking into consideration that non-additional energy efficiency measures (i.e. measures that are implemented with the project activity but are not additional) shall not result in emissions reductions. The non-additional measures are defined as part of the additionality assessment and include regular maintenance measures as carried out in the five years before the project. Therefore, the efficiency shall be adjusted as:

$$\eta_{BL,adj} = \eta_{BL,optm} + \Delta\eta_{reg} + \Delta\eta_{non-add} \qquad\qquad (10)$$

$\eta_{BL,adj}$	=	Adjusted efficiency of the project activity power plant prior to implementation of the project activity
$\eta_{BL,optm}$	=	Optimal efficiency of the project activity power plant prior to implementation of the project activity, estimated as per procedure providing in monitoring section
$\Delta\eta_{reg}$	=	Energy efficiency improvement resulting from regular maintenance as defined by maintenance practices implemented in the 5 years prior to the project activity
$\Delta\eta_{non-add}$	=	Energy efficiency improvement resulting from non-additional measures implemented along with the package of measures that are additional as part of the proposed CDM project activity

Calculation of $EF_{BL,non-plant,y}$

In situations where the electricity supplied by the project activity plant is more than the historical average annual electricity supplied by the plant in the baseline ($EL_{BL,AVR}$), due to increase in capacity and/or generation, there is a considerable uncertainty relating to the source of power generation substituted by the increased power generation of the project plant. In order to address this uncertainty in a conservative manner, project participants shall use for $EF_{BL,non-plant,y}$ the lowest emission factor among the following three options:

For the first crediting period:

Option 1.   The build margin emission factor for the grid to which the project plant is connected, calculated according to "Tool to calculate the emission factor for an electricity system";

Option 2   The combined margin emission factor for the grid to which the project plant is connected, calculated according to "Tool to calculate the emission factor for an electricity system", using a 50/50 OM/BM weight;

Option 3   The emission factor of the technology (and fuel) identified as the most likely baseline scenario as per the "Procedure for the identification of the most plausible baseline scenario and assessment of additionality", and calculated as follows

$$EF_{BL,non-plant,y} = \frac{3.6}{1000} \times \frac{COEF_{BL}}{\eta_{BL}}$$ **(11)**

Where:

$EF_{BL,non-plant,y}$ = Conservative emission factor used in the calculation of baseline emissions for the electricity supplied to the electricity grid by the project activity power plant in excess if $EL_{BL,AVR}$, i.e. the historical level of generation (tCO$_2$/MWh)

$COEF_{BL}$ = Fuel emission coefficient for the fuel identified as the most likely baseline scenario as per the "Procedure for the identification of the most plausible baseline scenario and assessment of additionality" (tCO2e/TJ)

η_{BL} = Energy efficiency of the technology identified as the most likely baseline scenario as per the "Procedure for the identification of the most plausible baseline scenario and assessment of additionality"

This determination will be made once at the validation stage based on an *ex ante* assessment, once again at the start of each subsequent crediting period (if applicable). If either option 1 (BM) or option 2 (CM) are selected, they will be estimated *ex post*, as described in "Tool to calculate the emission factor for an electricity system".

Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{FC,elec,y} + PE_{FC,aux,y} + EL_{aux,grid,y} \cdot EF_{grid,y}$$ **(12)**

Where:

PE_y = Project emissions in year *y* of the crediting period (tCO$_2$)

$PE_{FC,elec,y}$ = Project emissions due to the combustion of fossil fuels for the production of electricity in year *y* of the crediting period (tCO$_2$)

$PE_{FC,aux,y}$ = Project emissions due to the combustion of fossil fuels to serve auxiliary and back-up loads in the project activity power plant in year *y* of the crediting period (tCO$_2$)

$EL_{aux,grid,y}$ = Grid electricity used in the project activity power plant in year *y* of the crediting period to serve auxiliary and back-loads, if any (MWh)

$EF_{grid,y}$ = Emission factor of the electricity grid to which the project activity power plant is connected to (tCO$_2$/MWh)

y = Year of the crediting period

Calculation of $PE_{FC,elec,y}$

The project emissions due to the combustion of fossil fuels for the production of electricity are calculated as:

$$PE_{FC,elec,y} = PE_{FC,j,y} \qquad (13)$$

Where:

$PE_{FC,elec,y}$ = Project emissions due to the combustion of fossil fuels in the project activity power plant for the production of electricity in year *y* of the crediting period (tCO2)

$PE_{FC,j,y}$ = Emissions from fossil fuel combustion in process j during the year *y*, where j stands for the operation of the project activity power plant (tCO$_2$). This parameter shall be calculated as per the latest version of the "Tool to calculate project or leakage CO$_2$ emissions from fossil fuel combustion"

Calculation of $PE_{FC,aux,y}$

The project emissions due to the combustion of fossil fuels to serve auxiliary and back-up loads are calculated as:

$$PE_{FC,aux,y} = PE_{FC,j,y} \qquad (14)$$

Where:

$PE_{FC,aux,y}$ = Project emissions due to the combustion of fossil fuels to serve auxiliary and back-up loads in the project activity power plant in year *y* of the crediting period (tCO$_2$)

$PE_{FC,j,y}$ = Emissions from fossil fuel combustion in process j during the year *y*, where j stands for auxiliary and back-up loads in the project activity power plant (tCO$_2$). This parameter shall be calculated as per the latest version of the "Tool to calculate project or leakage CO$_2$ emissions from fossil fuel combustion"

Leakage

Leakage is considered zero in this methodology.

Emission reductions

Emissions reduction by the project activity during a given year *y* are the difference between the baseline emissions, project emissions and leakage emissions, as follows:

$$ER_y = BE_y - PE_y \qquad (15)$$

Where:

ER_y = Emission reductions during the year *y* (tCO$_2$/yr)

BE_y = Baseline emissions during the year *y* (tCO$_2$/yr)

PE_y = Project emissions during the year y (tCO2/yr)

Negative emission reductions

In case the project results in negative emission reductions, in accordance with section 4.8 of the Guidelines for new methodologies any further CERs will only be issued when the emissions increase has been compensated by subsequent emission reductions by the project activity.

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

At the start of the second and third crediting period project proponents have to address two issues:

- Assess the continued validity of the baseline; and
- Update the baseline.

In assessing the continued validity of the baseline, a change in the relevant national and/or sectoral regulations between two crediting periods has to be examined at the start of the new crediting period. If at the start of the project activity, the project activity was not mandated by regulations, but at the start of the second or third crediting period regulations are in place that enforce the practice or norms or technologies that are used by the project activity, the new regulation (formulated after the registration of the project activity) has to be examined to determine if it applies to existing plants or not. If the new regulation applies to existing CDM project activities, the baseline has to be reviewed and, if the regulation is binding, the baseline for the project activity should take this into account. This assessment will be undertaken by the verifying DOE.

In addition, project participants must assure that the emission reductions from the rehabilitation/energy efficiency measures are still additional. This can be checked by the expected lifetime of the replaced equipment. If after the start of the project activity this point in time has occurred, no emission reductions can be claimed for the rehabilitation or energy efficiency measures.

In the case where the grid baseline emission factors are determined *ex ante* (and not updated during a crediting period), the baseline emissions factor shall be updated for the subsequent crediting period. The CDM project activities are not included in the revised estimation of the baseline emissions.

For updating the baseline at the start of the second and third crediting period, new data available will be used to revise the baseline scenario and emissions. In particular fuel and other prices are to be reconsidered and present and future prices have to be determined for the investment analysis.

It needs to be checked if the default values are still the most suitable default values to be applied by checking the references mentioned for these default values. If more appropriate values are available at the 2nd or 3rd crediting period these should be applied.

$EF_{BL,non-plant,y}$ will be re-estimated at the start of each subsequent crediting period (if applicable). If either option 1 (BM) or option 2 (CM) are selected, they will be estimated *ex post*, as described in "Tool to calculate the emission factor for an electricity system".

Project participants shall assess and incorporate the impact of new regulations on baseline emissions.

Data and parameters not monitored

Parameter	*Remaining lifetime of the power equipments*
Data Unit	Years
Description	Time when the existing equipment would need to be replaced in the absence of the project activity
Source of Data	Project activity
Measurement procedures (if any)	Determined as described in the "Procedure for estimating remaining lifetime of the power equipments"
Any comment	-

Parameter	CAP_{BL}
Data Unit	MW
Description	Actual power generation capacity of the project activity power plant previous to the implementation of the project activity
Source of Data	Project activity site
Measurement procedures (if any)	The parameter shall be tested using internationally approved standard or equivalent national standards by a certified agency
Any Comment	This parameter refers to net capacity, i.e. total capacity minus capacity required to meet internal loads

Parameter	CAP_{design}
Data Unit	MW
Description	Nameplate power generation capacity of the project activity power plant, as per design conditions, previous to the implementation of the project activity
Source of Data	Project activity site
Measurement procedures (if any)	This shall be based on commissioning certificate of the power plant, as issued by the power plant implementing entity
Any Comment	This parameter refers to net capacity, i.e. total capacity minus capacity required to meet internal loads

Parameter	HMR_x
Data Unit	Hours
Description	Average number of hours in a year during which the plant did not operate due to maintenance or repair, based on data for the five most recent years x prior to the implementation of the project activity (hours)
Source of Data	Project activity site
Measurement procedures (if any)	Use historical records for such maintenance and repair intervals
Any comment	-

Parameter	EL_x
Data Unit	MWh
Description	Annual electricity supplied to the electricity grid by the project activity power plant in the five most recent years x prior to the implementation of the project activity
Source of Data	Project activity
Measurement procedures (if any)	Obtain data from production data logs
Any comment	-

Parameter	$EF_{i,x}$	
Data Unit	tCO_2/TJ	
Description	CO_2 emission factor for the fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity	
Source of Data	The following data sources may be used if the relevant conditions apply:	
	Data source	**Conditions for using the data source**
	a. Values provided by the fuel supplier in invoices	This is the preferred source
	b. Measurements by the project participants	If a) is not available
	c. Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
	d. IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available
Measurement procedures (if any)	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options b), c) or d) should be used.	
Any comment	-	

Parameter	$NCV_{i,x}$
Data Unit	TJ/mass or volume units
Description	Weighted average net calorific value for the fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity
Source of Data	The following data sources may be used if the relevant conditions apply: <table><tr><th>Data source</th><th>Conditions for using the data source</th></tr><tr><td>a) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr><tr><td>b) Measurements by the project participants</td><td>If a) is not available</td></tr><tr><td>c) Regional or national default values</td><td>If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)</td></tr><tr><td>d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></table>
Measurement procedures (if any)	For a) and b): Measurements should be undertaken in line with national or international fuel standards.
Any comment	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards. Note that for the NCV the same basis (pressure and temperature) should be used as for the fuel consumption.

Parameter	$F_{i,x}$
Data Unit	Mass or volume units
Description	Amount of fossil fuel type i used in the project activity power plant in year x prior to the implementation of the project activity
Source of Data	Project activity
Measurement procedures (if any)	Production data logs
Any comment	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes

Parameter	$\eta_{BL,optm}$
Data Unit	Non-dimensional
Description	Optimal efficiency of the project activity power plant prior to implementation of the project activity
Source of Data	Project activity site
Measurement procedures (if any)	The energy efficiency of the project activity power plant has to be determined prior to the implementation of the project activity. Due to different operation conditions the load factor of the project activity power plant may be different in the baseline and project situations. To ensure a conservative approach η_{BL} the <u>maximum</u> of the following shall be chosen: • Maximum observed energy efficiency of the project activity power plant based on historical records for the past 5 years. The maximum observed energy efficiency of the power plant shall be estimated using historic data collected at least monthly; • Average energy efficiency of the project activity power plant plus two times its standard deviation based on historical records for the past 5 years. The average energy efficiency of the power plant shall be estimated using historic data collected either at least annually or at the most monthly. The estimated points minimum 5 and maximum 60 values shall be used to estimate the standard deviation of energy efficiency; • Optimal energy efficiency of the project activity power plant, determined through a test of the power plant, considering optimal operational conditions (i.e. optimal load, optimal oxygen content in flue gases, adequate fuel viscosity, representative or favourable ambient conditions, including temperature and humidity, etc.). Also, the best possible fuel mix (i.e. the fuel mix resulting in the highest efficiency) should be considered. The best possible fuel mix shall be chosen amongst all possible fuel mixes, including the possible fuel mixes with which the project activity power plant can operate after the implementation of the project activity. To calculate the efficiencies: • Use the direct method (dividing the net electricity generation by the energy content of the fuels fired during a representative time period) and not the indirect method (determination of fuel supply or heat generation and estimation of the losses); • Use recognized standards for the measurement of the power plant efficiency; • The measurement should be supervised by a competent independent third party (e.g. the DOE). The measurement should be conducted immediately after scheduled preventive maintenance has been undertaken. Document the measurement procedures and results transparently in the CDM-PDD or, if undertaken during the crediting period, in the monitoring report. The efficiency has to be referred in terms of the net calorific values of the fuels used and the net electricity produced, i.e. total electricity produced minus internal consumption of electricity. This parameter should be documented in the CDM-PDD and shall remain fixed throughout the crediting period.
Any comment	-

Parameter	$\Delta\eta_{reg}$
Data Unit	Non-dimensional
Description	Energy efficiency improvement resulting from regular maintenance as defined in the 5 years prior to the project activity
Source of Data	Project site
Measurement procedures (if any)	Estimate the impact of energy efficiency improvement resulting from regular maintenance as defined in the 5 years prior to the project activity using recognized standards and engineering best practices
Any comment	---

Parameter	$\Delta\eta_{non\text{-}add}$
Data Unit	Non-dimensional
Description	Energy efficiency improvement resulting from non-additional measures implemented jointly with the proposed CDM project activity
Source of Data	Project site
Measurement procedures (if any)	Estimate the impact of energy efficiency improvement resulting from non-additional measures implemented jointly with the proposed CDM project activity using recognized standards and engineering best practices
Any comment	---

Parameter:	$COEF_{BL}$
Data unit:	tCO_2/TJ
Description:	Fuel emission coefficient for the fuel identified as the most likely baseline scenario as per the "Procedure for the selection of the most plausible baseline scenario and assessment of additionality"
Source of data:	Based on national average fuel data, if available, otherwise IPCC defaults can be used
Measurement procedures (if any):	---
Monitoring frequency:	---
Any comment:	---

Parameter:	η_{BL}
Data unit:	Non-dimensional
Description:	Energy efficiency of the technology identified as the most likely baseline scenario as per the "Procedure for the selection of the most plausible baseline scenario and assessment of additionality"
Source of data:	Estimated based on national statistics, IPCC defaults or manufacturer data
Measurement procedures (if any):	---
Monitoring frequency:	---
Any comment:	---

III. MONITORING METHODOLOGY

Monitoring procedures

The project participants must clearly describe in the CDM-PDD who is responsible for the monitoring and how the management and operating structure for the monitoring is organised.

All monitored data should be stored in the electronic database. A complete extract of the database should be made available to the DOE and the EB with each monitoring report.

All measurement equipment should be calibrated and regularly maintained and checked for its functioning according to manufacturer's specification and relevant national or international standards. Measurement accuracies or other uncertainties in all of the variables need to be taken into account in calculating emission reductions through applying the 'least square method'.

In addition, the provisions in the monitoring methodology of the latest approved version of the following tools apply:

- "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";
- "Tool to calculate emission factor for electricity system".

Data and parameters monitored

Data / Parameter:	$CAP_{PJ,y}$
Data unit:	MW
Description:	Installed power generation capacity of the project activity power plant in year y
Source of data:	Project activity site
Measurement procedures (if any):	This parameter has to be monitored every year y throughout the crediting period using internationally approved standards or equivalent national standards
	To comply with the applicability conditions, the following condition shall be verified every year y of the crediting period:
	$\cancel{CAP_{PJ,y} \leq 1.05 \cdot CAP_{design}}\ CAP_{PJ,y} \leq 1.15 \cdot CAP_{design}$
	The emissions reductions of the project activity shall be made zero from the point in time when the condition above is no longer true.
Monitoring frequency:	Yearly
QA/QC procedures:	-
Any comment:	This parameter refers to net capacity, i.e. total capacity minus capacity required to meet internal loads

Data / Parameter:	$\eta_{PJ,y}$
Data unit:	-
Description:	Average energy efficiency of the project activity power plant in year *y* of the crediting period
Source of data:	Project activity site
Measurement procedures (if any):	To calculate the efficiencies: - Use the direct method (dividing the net electricity generation by the energy content of the fuels fired during a representative time period) and not the indirect method (determination of fuel supply or heat generation and estimation of the losses); - Use recognized standards for the measurement of the power plant efficiency; - All measurements should be carried out at a load factor (or operation mode) that is representative of the situation during the project activity. Where a representative load factor (or operation mode) cannot be determined, measurements should be conducted for different load factors (or operation modes) and be weighted by the time these load factors (or operation modes) are typically operated; - The measurement should be supervised by a competent independent third party (e.g. the DOE). The measurement should be conducted immediately after scheduled preventive maintenance has been undertaken. Document the measurement procedures and results transparently in the CDM-PDD or, if undertaken during the crediting period, in the monitoring report. The efficiency has to be referred in terms of the net calorific values of the fuels used and the net electricity produced, i.e. total electricity produced minus internal consumption of electricity. This parameter should be documented in the CDM-PDD and shall remain fixed throughout the crediting period.
Monitoring frequency:	Annually. The first estimate shall be made immediately after implementing the project activity
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EL_{PJ,y}$
Data unit:	MWh
Description:	Total amount of electricity supplied to the electricity grid by the project activity power plant year *y* of the crediting period
Source of data:	Project activity site
Measurement procedures (if any):	Use electricity meters
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Cross check measurement results with invoices for purchased electricity if relevant
Any comment:	-

Data / Parameter:	$EL_{aux,grid,y}$
Data unit:	MWh
Description:	Grid electricity used in the project activity power plant in year y of the crediting period to serve auxiliary and back-loads, if any
Source of data:	On-site measurements
Measurement procedures (if any):	Use electricity meters
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Crosscheck measurement results with invoices for purchased electricity if relevant
Any comment:	-

Data / Parameter:	$F_{i,y}$
Data unit:	Mass or volume units
Description:	Amount of fossil fuel type i used in the project activity power plant in year y of the crediting period
Source of data:	On-site measurements
Measurement procedures (if any):	Use mass or volume meters
Monitoring frequency:	Continuously
QA/QC procedures:	The consistency of metered fuel consumption quantities should be crosschecked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be crosschecked with available purchase invoices from the financial records.
Any comment:	-

Data / Parameter:	$PE_{FC,i,y}$
Data unit:	tCO_2
Description:	Project emissions due to the combustion of fossil fuels for the production of electricity and to serve auxiliary and back-up loads in year y of the crediting period
Source of data:	-
Measurement procedures (if any):	This parameter should be determined using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" for all fossil fuels used in the project activity power plant
Monitoring frequency:	As per the procedures provided in the Tool
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor of the electricity grid to which the project activity power plant is connected
Source of data:	-
Measurement procedures (if any):	Calculated as per the latest approved version of "Tool to calculate emission factor for electricity system"
Monitoring frequency:	As per the procedures provided in the Tool
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$EF_{i,y}$
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor for the fossil fuel type i used in the project activity power plant in year y of the crediting period
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a. Values provided by the fuel supplier in invoices	This is the preferred source
b. Measurements by the project participants	If a) is not available
c. Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
d. IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a): If the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options b), c) or d) should be used.
Monitoring frequency:	For a) and b): The emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	-
Any comment:	-

Data / Parameter:	$NCV_{i,y}$
Data unit:	TJ/mass or volume units
Description:	Weighted average net calorific value for natural gas / fossil fuel type *i* in year *y* of the crediting period
Source of data:	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
a) Values provided by the fuel supplier in invoices	This is the preferred source
b) Measurements by the project participants	If a) is not available
c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
d) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If a) is not available

Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency:	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account
QA/QC procedures:	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	Note that for the NCV the same basis (pressure and temperature) should be used as for the fuel consumption

References and any other information

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History of the document

Version	Date	Nature of revision
02	EB 39, Annex 4 16 May 2008	To expand the methodology's applicability to project activities that result in an increase in the nameplate capacity up to 15%. The previous limit was set at 5%. As a consequnce: • The definition of rehabilitation and the applicability conditions were revised to cover those type of projects. • The baseline selection was revised to have the increase in capacity included. • The baseline emissions factor for the capacity increase has been made more conservative in line with AM0029.
01	EB 36, Annex 2 30 November 2007	Initial adoption