Draft revision to the approved consolidated baseline methodology ACM0004

"Consolidated baseline methodology for waste gas and/or heat and/or pressure for power generation"

Sources

This consolidated baseline methodology is based on elements from the following methodologies:

- NM0031-rev: "OSIL - 10 MW Waste Heat Recovery Based Captive Power Project, India," whose baseline study, monitoring and verification plan and project design document were prepared by Experts and Consultants of OSIL;
- NM0087: "Baseline methodology for electricity generation using waste heat recovery in sponge iron plants", prepared by Agrienergy Ltd, Shri Bajrang Power and Ispat Ltd;
- NM0088: "Baseline methodology for electricity production from waste energy recovery in an industrial manufacturing process", prepared by EcoSecurities B.V. and Groupe Office Cherifien des Phosphates.

For more information regarding the proposals and their consideration by the Executive Board please refer to http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html.

This methodology also refers to ACM0002 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" and the latest version of the "*Tool for the demonstration and assessment of additionality*".

Applicability

This methodology applies to project activities that generate electricity from waste heat or the combustion of waste gases in industrial facilities.

The methodology applies to electricity generation project activities:

- that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels;
- where no fuel switch is done in the process, where the waste heat or pressure or the waste gas is produced, after the implementation of the project activity

The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity, as well as to planned increases in capacity during the crediting period. If capacity expansion is planned, the added capacity must be treated as a new facility.

This consolidated baseline methodology shall be used in conjunction with the approved consolidated monitoring methodology ACM0004 ("Consolidated monitoring methodology for waste gas and/or heat and/or pressure for power generation").

Project boundary

For the purpose of determining GHG emissions of the **project activity**, project participants shall include:

- CO_2 emissions from combustion from auxiliary fossil fuels

For the purpose of determining **baseline emissions**, project participants shall include the following emission sources:

- CO_2 emissions from fossil fuel fired power plants connected to the electricity system;
- CO_2 emissions from fossil fuel fired captive power plants supplying the project site facility;

The **spatial extent** of the project boundary comprises the waste heat or gas sources, captive power generating equipment, any equipment used to provide auxiliary heat to the waste heat recovery process, and the power plants connected physically to the electricity grid that the proposed project activity will affect.

The combined margin will be calculated as described in ACM0002, both in terms of the relevant grid definitions and the emissions factors.

Table 1 illustrates which emissions sources are included and which are excluded from the project boundary for determination of both baseline and project emissions.

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

	Source	Gas		Justification / Explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Captive electricity generation	CO_2	Included	Main emission source
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project Activity	On-site fossil fuel consumption due to the project activity	CO_2	Included	May be an important emission source
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Combustion of waste gas for electricity generation	CO_2	Excluded	It is assumed that this gas would have been burned in the baseline scenario.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

Identification of alternative baseline scenarios

The baseline scenario alternatives should include all possible options that provide or produce electricity for in-house consumption and/or sale to grid and/or other consumers. The project participant shall exclude baseline options that:

- do not comply with legal and regulatory requirements; or
- depend on key resources such as fuels, materials or technology that are not available at the project site

The project participant shall provide evidence and supporting documents to exclude baseline options that meet the above mentioned criteria.

The possible alternative scenarios in absence of the CDM project activity would be as follows:

(a) The proposed project activity not undertaken as a CDM project activity;
(b) Import of electricity from the grid;
(c) Existing or new captive power generation on-site, using other energy sources than waste heat and/or gas, such as coal, diesel, natural gas, hydro, wind, etc;
(d) A mix of options (b) and (c), in which case the mix of grid and captive power should be specified
(e) Other uses of the waste heat and waste gas
(f) The continuation of the current situation, whether this is captive or grid-based power supply (if not already included in the options above).

Among the alternatives that do not face any prohibitive barriers, the most economically attractive alternative should be considered as the baseline scenario.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the ***"Tool for the demonstration and assessment of additionality"*** *agreed by the CDM Executive Board, available at the UNFCCC CDM web site* [1].

Project Emissions

Project Emissions are applicable only if auxiliary fuels are fired for generation startup, in emergencies, or to provide additional heat gain before entering the Waste Heat Recovery Boiler.

Project Emissions are given as:

$$PE_y = \sum_i Q_i \times NCV_i \times EF_i \times \frac{44}{12} \times OXID_i \qquad \textbf{(1)}$$

[1] Please refer to: < http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html>

where:

PE_y	Project emissions in year y (tCO_2)
Q_i	Mass or volume unit of fuel *i* consumed (t or m^3)
NCV_i	Net calorific value per mass or volume unit of fuel *i* (TJ/t or m^3)
EF_i	Carbon emissions factor per unit of energy of the fuel *i* (tC/TJ)
$OXID_i$	Oxidation factor of the fuel *i* (%)

The oxidation factor of the fuel is taken from page 1.29 in the 1996 Revised IPCC Guidelines for default values. For the other factors, local values should be used wherever possible. If no such values are available, country-specific values (see, e.g., IPCC Good Practice Guidance) are preferable to IPCC world-wide default values.

Baseline Emissions

Baseline emissions are given as:

$$BE_{electricity,y} = EG_y \cdot EF_{electricity,y} \quad \textbf{(2)}$$

where:

EG_y	Net quantity of electricity supplied to the manufacturing facility by the project during the year *y* in MWh, and
EF_y	CO_2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2/MWh).

In determining the *net* quantity of electricity supplied, project participants shall subtract the quantity of electricity required for the operation of the power plant.

In the particular case of use of waste gas in generating units supplied by other fuels, where is not possible to determine by directly measuring the amount of electricity generated by using the waste gas, EG_y will be calculated by using equation (7).[2]

Option 1. If baseline scenario is captive power generation

If the baseline scenario is determined to be captive power generation (either existing or new), the Emissions Factor for displaced electricity is calculated as follows:

[2] In project case where pressure of waste gas is used to generate electricity, the electricity generated from use of waste gas pressure should be measureable.

$$EF_{captive,y} = \frac{EF_{CO2,i}}{Eff_{captive}} \times \frac{44}{12} \times \frac{3.6TJ}{1000MWh} \quad \textbf{(3)}$$

where:

$EF_{captive,y}$	Emissions factor for captive power generation (tCO_2/MWh)
$EF_{CO2,i}$	CO_2 emissions factor of fuel used in captive power generation (tC/TJ)
$Eff_{captive}$	Efficiency of the captive power generation (%)
44/12	Carbon to Carbon Dioxide conversion factor
3.6/1000	TJ to MWh conversion factor

To estimate boiler efficiency, project participants may choose between the following two options:

Option A

Use the highest value among the following three values as a conservative approach:

1. Measured efficiency prior to project implementation;
2. Measured efficiency during monitoring;
3. Manufacturer nameplate data for efficiency of the existing boilers.

Option B

Assume a boiler efficiency of 100% based on the net calorific values as a conservative approach.

Option 2. If baseline scenario is grid power imports

If the baseline scenario is determined to be grid power supply, the Emissions Factor for displaced electricity is calculated as in ACM0002.

Option 3. If baseline scenario includes both captive and imported power

$$EF_y = s_{grid} \cdot EF_{grid,y} + s_{captive} \cdot EF_{captive,y} \quad \textbf{(4)}$$

If the baseline scenario selection determines that both captive and grid power would be used, then the emissions factor for the baseline is the weighted average of the emissions factor for grid power and captive power.

EF_y	CO_2 baseline emission factor for the electricity displaced due to the project activity during the year *y* (tCO_2/MWh).
$EF_{grid,y}$	CO_2 baseline emission factor for the grid electricity displaced due to the project activity during the year *y* (tCO_2/MWh).
$EF_{captive,y}$	CO_2 baseline emission factor for the captive electricity displaced due to the project activity during the year *y* (tCO_2/MWh).

s_{grid} Share of facility electricity demand supplied by grid imports over the last 3 years (%)[3]
$s_{captive}$ Share of facility electricity demand supplied by captive power over the last 3 years (%)[2]

Leakage

No leakage is considered.

Emission Reduction

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions though substitution of electricity generation with fossil fuels (BE_y) and project emissions (PE_y), as follows:

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

where:

ER_y are the emissions reductions of the project activity during the year y in tons of CO_2,
$BE_{,y}$ are the baseline emissions due to displacement of electricity during the year y in tons of CO_2,
PE_y are the project emissions during the year y in tons of $CO_{2,}$ and

In determining emission coefficients, emission factors or net calorific values in this methodology, guidance by the 2000 IPCC Good Practice Guidance should be followed where appropriate. Project participants may either conduct regular measurements or they may use accurate and reliable local or national data where available. Where such data is not available, IPCC default emission factors (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances. All values should be chosen in a conservative manner and the choice should be justified.

Calculation of the electricity generated in units supplied by waste gas and other fuels

The procedure specified below, should be applied when the direct measurement of the electricity generated by using the waste gas is not possible as other fossil fuel(s) along with waste gas are used for electricity generation. The relative share of the total generation from waste gas is calculated by considering the total electricity produced, the amount and caloric values of the other fuels and of the waste gas used, and the average efficiency of the plants where the electricity is produced.

The average efficiency is given as:

$$H_r = \frac{\sum_{h=1}^{8760}\sum_{i=1}^{I} Q_{i,h} * NCV_i}{EG_{total,year}} \quad (6)$$

[3] If the facility is a new facility, then the share of grid versus import power determined to be the most likely baseline scenario should be used.

where:

H_r = Average Power Plants Efficiency (TJ/MWh)
$Q_{i,h}$ = Amount of individual fuel (waste gas and other fuel(s)) I consumed at the power plants during hour h (Nm3/h)
NCV_i = Net Calorific Value annual average for each individual consumed fuel and the waste gas (TJ/Nm3)
$EG_{total,year}$ = Total annual energy produced at the power plants. (MWh/year)

The electricity produced by the project activity is calculated as follows:

$$EG_{year} = \frac{\sum_{h=1}^{8760} Q_{WG,h} * NCV_{WG}}{H_r} \quad (7)$$

where:
Q_{WG} = Amount of WG recovered (Nm3/h)
NCV_{WG} = Net Calorific Value of Waste Gas (TJ/Nm3)
Hr = Average Power Plants Efficiency (TJ/MW)

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Applicability

This methodology applies to project activities that generate electricity from waste heat or pressure, or the combustion of waste gases in industrial facilities.

The methodology applies to electricity generation project activities:

- that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels, electricity;
- where no fuel switch is done in the process where the waste heat or the waste gas is produced after the implementation of the project activity

The methodology covers both new and existing facilities. For existing facilities, the methodology applies to existing capacity, as well as to planned increases in capacity during the crediting period. If capacity expansion is planned, the added capacity must be treated as a new facility.

This consolidated baseline methodology shall be used in conjunction with the approved consolidated monitoring methodology ACM0004 ("Consolidated baseline methodology for waste gas and/or heat and/ or pressure for power generation").

Monitoring Methodology

The methodology requires monitoring of the following:

- Net electricity generation from the proposed project activity;
- Data needed to calculate carbon dioxide emissions from fossil fuel consumption due to the project activity;
- Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin (OM), consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to recalculate the build margin emission factor, if needed, consistent with "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002);
- Data needed to calculate the emissions factor of captive power generation

For the particular case of generating units, supplied by waste gas and by other fuels, when the direct measurement of the electricity generated by using the waste gas is not possible the following parameters should also be monitored:

- Quantity of each fuel consumed at the power plants
- Quantity of waste gas consumed at the power plants
- Net calorific value of each fuel
- Net calorific value of waste gas

For Project Emissions

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
1. Q_i	Quantitative	Volume of the auxiliary fuel used by project activity	tonnes or m^3	measured	Continuously	100%	Electronic/ Paper	Credit period + 2 yrs	To be measured and used for estimation of project emissions.
2. NCV_f	Quantitative	Net Calorific Value of Fuel (if any)	TJ per t or m^3	measured	Monthly	Random	Electronic/ Paper	Credit period + 2 yrs	To be measured and used for estimation of project emissions.
3. EF_i	Quantitative	Carbon emissions factor of fuel	tC/TJ	National sources or IPCC defaults	Monthly	Random	Electronic/ Paper	Credit period + 2 yrs	To be measured and used for estimation of project emissions.

For Electricity Generation by Project Activity

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
4. EG_{GEN}	Quantitative	Total Electricity Generated	MWh/ yr	online measurement	Continuously	100%	Electronic	Credit period + 2 yrs	Monitoring location: meters at plant and DCS will measure the data. Manager In-charge would be responsible for regular calibration of the meter.
5. EG_{AUX}	Quantitative	Auxiliary Electricity[4]	MWh/ yr	online measurement	Continuously	100%	Electronic	Credit period + 2 yrs	Monitoring location: meters at plant and DCS will measure the data. Manager In-charge would be responsible for regular calibration.
6. EG_y	Quantitative	Net Electricity supplied to facility	MWh/ yr	calculated (EG_{GEN} - EG_{AUX})	Continuously	100%	Electronic	Credit period + 2 yrs	Calculated from the above measured parameters. Algorithm for project emission calculations given in baseline methodology.

[4] This will include electrical energy utilized by the power generating equipment in the project boundary.

ID number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment
7. Q_{WG}	Quantitative	Flow rate of waste gas	Nm^3	measured	Continuously and logged on hourly basis	100%	Electronic	Credit period + 2 yrs	
8. NCV_{WG}	Quantitative	Net calorific value of the waste gas	TJ/Nm^3	measured	Continuously	100%	Electronic	Credit period + 2 yrs	
9. Hr	Quantitative	Average plant efficiency	TJ/ MWh	calculated	Yearly		Electronic	Credit period + 2 yrs	
10. Q_i	Quantitative	Flow rate of fuel i	Nm^3/h	measured	Continuously and logged on hourly basis	100%	Electronic	Credit period + 2 yrs	
11. NCV_i	Quantitative	Net calorific value of fuel i	TJ/Nm^3	measured	Continuously	100%	Electronic	Credit period + 2 yrs	

For Baseline emission factor: grid power

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
12. EF_y	Emission factor	CO2 emission factor of the grid	tCO_2 /MWh	calculated	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as a weighted sum of the OM and BM emission factors
13. $EF_{OM,y}$	Emission factor	CO2 Operating Margin emission factor of the grid	tCO_2 /MWh	calculated	Simple OM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as indicated in the relevant OM baseline method above
14. $EF_{BM,y}$	Emission factor	CO2 Build Margin emission factor of the grid	tCO_2 /MWh	calculated	BM	Yearly	100%	Electronic	During the crediting period and two years after	Calculated as $[\sum i\ Fi,y*COEFi] / [\sum m\ GENm,y]$ over recently built power plants defined in the baseline methodology
15. $F_{i,j,y}$	Fuel quantity	Amount of each fossil fuel consumed by each power source / plant	t or m_3/yr	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from the power producers, dispatch centers or latest local statistics.

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
16. $COEF_{i,k}$	Emission factor coefficient	CO2 emission coefficient of each fuel type and each power source / plant	tCO_2 / t or m^3	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Plant or country-specific values to calculate COEF are preferred to IPCC default values.
17. $GEN_{j,y}$	Electricity quantity	Electricity generation of each power source / plant	MWh/ yr	measured	Simple OM BM	Yearly	100%	Electronic	During the crediting period and two years after	Obtained from the power producers, dispatch centers or latest local statistics.

For Baseline emission factor: captive power

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
13. $EF_{CO2,i}$	Emission factor	CO2 emission factor of fuel used for captive power generation	tC/TJ	National sources or IPCC defaults	Yearly	100%	Electronic	During the crediting period and two years after	
14. $Eff_{captive}$	Efficiency of captive power plant	Energy efficiency of captive power plant	%	measured	Yearly	100%	Electronic	During the crediting period and two years after	Depending on option chosen in baseline, measured before or after project implementation

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

All measurements should use calibrated measurement equipment that is maintained regularly and checked for its functioning. QA/QC procedures for the parameters to be monitored are illustrated in the following table.

Data	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1., 2.	Low	Yes	This data will be required for the calculation of project emissions.
4.-6.	Low	Yes	This data will be used for the calculation of project electricity generation.
7.-8.	Low	Yes	This data will be used for the calculation of project electricity generation.
9	Low	No	This data is calculated, so does not need QA procedures
10.-11.	Low	Yes	This data will be used for the calculation of project electricity generation.
12.-14..	Low	No	This data is calculated, so does not need QA procedures
15-17.	Low	No	This data will be required for the calculation of baseline emissions (from grid electricity) and will be obtained through published and official sources.
18.-19.	Low	Yes	This data will be required for the calculation of baseline emissions (from captive power plant electricity).

Note on QA/QC: The parameters related to the performance of the project will be monitored using meters and standard testing equipment, which will be regularly calibrated following standard industry practices.