Draft consolidated baseline and monitoring methodology ACM00XX

"Consolidated baseline methodology for fuel switching from coal and/or petroleum fuels to natural gas in existing power plants for electricity generation"

I. SOURCE AND APPLICABILITY

Source

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

- NM0200 "Baseline methodology for fuel switching from coal and/or petroleum fuel (high carbon intensive) to natural gas (low carbon intensive) in a grid connected/stand alone power generation facility" prepared by Lanco Kondapally Power Private Limited, India.
- NM0213 "Fuel Switch to less carbon content fuel for power generation which is used for captive power and is not connected to the grid " prepared by Asia Carbon Pte Ltd., Singapore.

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

This methodology refers to the latest version of the "Tool for the demonstration and assessment of additionality" and "Combined tool for identification of baseline scenario and demonstration of additionality" agreed by the Executive Board and available at the UNFCCC website". Please refer to: http://cdm.unfccc.int/goto/MPappmeth.

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

Project activity power plant (PAPP)- An existing power plant where the fuel switch project activity is implemented.

Captive consumer - captive consumer is defined as a consumer or multiple consumers, connected through a local grid, of electricity that are supplied electricity from PAPP alone.

Electricity grid - electricity grid is an electricity supply system to which many consumers and many power plants are connected, as defined in ACM0002. The power plants connected to the electricity supply system are dispatched by a dispatch center. Localized grids , i.e., grids in which a limited number of power plants, not dispatched by a dispatch center, are connected are excluded from this definition.

Applicability

This methodology is applicable to project activities that switch fuel from coal and/or petroleum fuels to natural gas in an existing power plant for electricity generation. The following conditions apply:

- The PAPP either supplies electricity to the electricity grid (refer to definition above) or to a captive consumer (refer to definition above);
- Prior to the implementation of the project activity, only coal and/or petroleum fuels (but not natural gas) was used in the PAPP to generate electricity;
- Coal/petroleum fuel is available in the country/region for electricity generation;
- Regulations/laws and programs do not restrain the facility from using the fossil fuels used prior to implementing the project activity neither require the use of natural gas or a specified fuel to generate electricity;
- The captive consumer or electricity grid, to which the electricity generated by the PAPP is sold, if applicable, is not restrained by regulations/law to purchase of electricity generated from different type of fuels, i.e., it is not prohibited to purchase electricity generated using a higher GHG intensity fuel during the crediting period of the project activity.
- The project activity does not involve major retrofits/modifications of the power plant other than the fuel switch, for instance, the removal of existing technology and installation of new technology, such as new gas turbines, new combine cycle gas power generation, etc.;
- The project activity does not result in a significant change in the capacity , i.e., not more than □5% of the installed capacity before the implementation of the project activity;
- The project activity does not result in an increase of the lifetime of the PAPP during the crediting period. If the lifetime of the PAPP is increased due to the project activity, the crediting period shall be limited to the estimated remaining lifetime of the power plant, i.e., the time when the existing power plant would need to be replaced in the absence of the project activity;
- This methodology is only applicable if the most plausible baseline scenario is the continuation of the use of high carbon intensive fuels like coal and/or petroleum fuels for electricity generation in the PAPP.

The methodology is **not** applicable in following situations:

- Greenfield power plants that would have used a higher GHG intensity fuel in absence of CDM benefits;[1]
- This methodology is neither applicable to fuel switch for cogeneration projects nor to energy efficiency improvement projects;

II. BASELINE METHODOLOGY

Project boundary

The project boundary encompasses the PAPP. Emissions sources and gases are listed in Table 1 and the project boundary is described in Figure 1.

[1] Such project activities may use approved methodology AM0029, if they meet the applicability requirements of the approved methodology.

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

	Source	Gas	Included?	Justification/Explanation
Baseline	Emissions due to the combustion of the baseline fuel (coal and/or petroleum fuels) for electricity production in the PAPP	CO_2	Yes	Main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
Project Activity	Emissions due to the combustion of natural gas for electricity production in the PAPP	CO_2	Yes	Main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source
	Emissions due to the use of energy (auxiliary fuel, purchased electricity etc) for the operation of the PAPP	CO_2	Yes	Main emission source
		CH_4	No	Minor source
		N_2O	No	Minor source

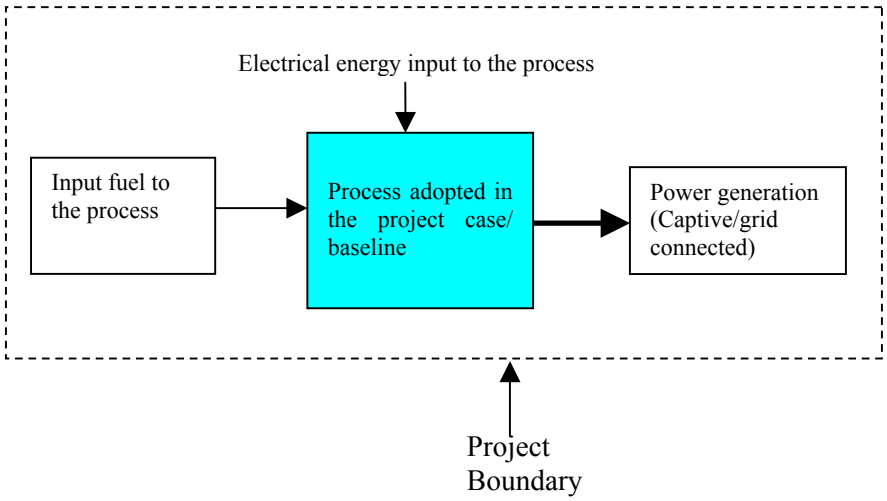

Figure 1 - Diagram of the project boundary

Procedure for estimating lifetime and to determine installed capacity/generation of the power plant

The following approaches shall be taken into account to estimate the remaining lifetime of the PAPP, i.e. the time when the PAPP would need to be replaced in the absence of the project activity:

a) The typical average technical lifetime of the type of the power plant 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 schedules may be evaluated and documented (e.g. based on historical replacement records for similar equipment);

The time to replacement of the existing power plant 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 lifetime of the power plant is increased due to the project activity, the crediting period has to be limited to the estimated remaining lifetime of the power plant, i.e., the time when the existing power plant would need to be replaced in the absence of the project activity.

The installed capacity of the PAPP before and after the fuel switch activity shall be tested using internationally approved standard or equivalent national standards. The DOE shall validate the report on capacity assessment. If the change in capacity is more than □5% of the installed capacity/output of PAPP, then this methodology is not applicable.

Procedure for the selection of the most plausible baseline scenario

Project proponents shall determine the most plausible baseline scenario through the application of the following steps:

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

Identify all alternative scenarios that are available to the project participants and that provide outputs or services with comparable quality, properties and application areas as the proposed CDM project activity i.e., all type of options that could provide generate electricity with lower GHG intensity.
These alternative scenarios shall include, inter alia:

- The proposed project activity undertaken without being registered as a CDM project activity;
- Power generation using the same fossil fuel, but technologies measures other than that are currently used in PAPP that could reduce the emissions intensity of electricity generation;
- Power generation using energy sources other than that used in the project activity;
- Power generation using current energy source (coal and/or petroleum fuels), i.e., the current practice;
- The "proposed project activity undertaken without being registered as a CDM project activity" undertaken at a later point in time (e.g. due to change in fuel prices, existing regulations, end-of-life of existing equipment, financing aspects).

For the purpose of identifying relevant alternative scenarios, provide an overview of other technologies or practices used in power generation and that have been implemented previously or are currently underway in the relevant geographical area. The relevant geographical area should in principle be the host country of the proposed CDM project activity. A region within the country could be the relevant geographical area if the framework conditions vary significantly within the country. However, the relevant geographical area should include preferably ten power generation facilities. If less than ten power generation facilities are found in the region the geographical area may be expanded to an area that covers if possible, ten such power generation facilities within the national grid boundary. In cases where the above described

definition of geographical area is not suitable, the project proponents should provide an alternative definition of geographical area. Other registered CDM project activities are not to be included in this analysis. Provide relevant documentation to support the results of the analysis.

Outcome of Step 1a: List of plausible alternative scenarios to the project activity

Step 1b. Consistency with applicable laws and regulations

The alternative(s) shall be in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions, e.g. to mitigate local air pollution. (This sub-step does not consider national and local policies that do not have legally-binding status.).

If an alternative does not comply with all mandatory applicable legislation and regulations, then show that, based on an examination of current practice in the country or region in which the mandatory law or regulation applies, those applicable mandatory legal or regulatory requirements are systematically not enforced and that non-compliance with those requirements is widespread in the country. If this cannot be shown, then eliminate the alternative from further consideration.

Outcome of Step 1b: List of alternative scenarios to the project activity that are in compliance with mandatory legislation and regulations taking into account the enforcement in the region or country and EB decisions on national and/or sectoral policies and regulations.

Step 2. Eliminate alternatives that face prohibitive barriers

Scenarios that face prohibitive barriers should be eliminated by applying "Step 2 - Barrier analysis" of the latest version of the "Combined tool for identification of baseline scenario and demonstrate additionality" agreed by the CDM Executive Board.

- ***If there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario.***
- ***If there are still several alternative scenarios remaining project participants may choose to either:***

  - ***Option 1: go to step 3 (investment analysis),***

or

  - ***Option 2: identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario.***

Step 3. Comparison of economic attractiveness of the remaining alternatives

Compare the economic attractiveness without revenues from CERs for alternatives that are remaining by applying "Step 3 - Investment analysis" of the latest version of the "Combined tool for identification of baseline scenario and demonstrate of additionality" agreed by the CDM Executive Board.

The economic investment analysis shall use the net present value (NPV) analysis, and explicitly state the following parameters:

- Investment requirements (incl. break-up into major equipment cost, required construction work, installation);
- A discount rate appropriate to the country and sector (Use government bond rates, increased by a suitable risk premium to reflect private investment in fuel switching projects, as substantiated by an independent (financial) expert);
- Efficiency of each element process, taking into account any differences between fuels;
- Current price and expected future price (variable costs) of each fuel. Estimates of the future prices have to be substantiated by a public and official publication from a governmental body or an intergovernmental institution). If such publications are not available, highlight the key logical assumptions and quantitative factors for determining the development of costs of each fuel (e.g. international market price, transport costs, level of taxes/subsidies, local price). State clearly which assumptions and factors have significant uncertainty associated with them, and include these uncertainties in the sensitivity analysis in "Step 3 – investment analysis";
- Operating costs for each fuel (especially, handling/treatment costs for coal);
- Lifetime of the project, equal to the remaining lifetime of the existing electricity generation facility; and,
- Other operation and maintenance costs, e.g. of slag and ash disposal, environmental pollution fees etc.

The NPV calculation should take into account the residual value of the new equipment at the end of the lifetime of the project activity. Provide all the assumptions in the CDM-PDD.

Outcome of step 3: Ranking of the short list of alternative scenarios according to the NPV taking into account the results of the sensitivity analysis.

□¨ ***If the sensitivity analysis is not conclusive, identify the alternative with the lowest emissions (i.e. the most conservative).***
□¨ ***If the sensitivity analysis is conclusive and confirms the result of the investment comparison analysis, then the most economically or financially attractive alternative scenario is considered as baseline scenario.***

This methodology is only applicable if the most plausible baseline scenario is identified as continuation of the current practice of using coal and/or petroleum fuels in the existing power plant;
Additionality

[*Text option 1:*
Step 1: Investment & sensitivity analysis [text taken from NM200]

Demonstrate that the project activity undertaken without the CDM is economically less attractive than the most plausible baseline scenario, by following the instructions given in step 3 of the chapter "Identification of the baseline scenario" above. Include a sensitivity analysis applying Sub-step 2d of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board. The investment analysis provides a valid argument in favour of additionality only if it consistently supports (for a realistic range of assumptions) the conclusion that the project activity is unlikely to be the most financially attractive.

[*Text option 2:*

Following steps may be used to assess additionality or project participants may use the latest "Tool for the demonstration and assessment of additionality" approved by the CDM Executive Board.

Step 1: Analysis of outcome of identification of baseline scenario procedure

1. ***If the proposed project activity is the only alternative amongst the ones considered by the project participants that is in compliance with all mandatory regulations, as identified by applying Step 1a of baseline scenario identification procedure described in section above, with which there is general compliance, then the proposed CDM project activity is not additional.***
2. ***If Barrier analysis is used to identify the baseline scenario, as described in previous section, then:***
   - ***a. If there*** is ***only one alternative scenario that is not prevented by any barrier, and if this alternative is the proposed project activity undertaken without being registered as a CDM project activity, then the project activity is not additional.***
   - b. ***If the proposed project activity undertaken without being registered as a CDM project activity is prevented by any barrier, then explain – using qualitative or quantitative arguments – how the registration of the CDM project activity will alleviate the barriers that prevent the proposed project activity from occurring in the absence of the CDM. If the CDM alleviates the identified barriers that prevent the proposed project activity from occurring, proceed to common practice analysis step, otherwise the project activity is not additional.***

3. ***If Investment analysis step is used to identify the baseline scenario, and if the proposed project activity undertaken without being registered as a CDM project activity is not prevented by any barrier, then:***
   - ***a. If the sensitivity analysis confirms the result of the investment comparison analysis, and it cannot be ruled out that the most economically or financially attractive alternative scenario is the "proposed project activity undertaken without being registered as a CDM project activity", then the project activity is not additional.***
   - b. ***else, proceed to common practice analysis step.***

Step 2. Common practice analysis

Demonstrate that the project activity is not common practice in the relevant country and sector by applying "Step 4 - Common practice analysis" of the latest version of the "Tool for demonstration assessment and of additionality" agreed by the CDM Executive Board. To determine the considered country/region the definition of "relevant geographical area" given in section "Procedure for the selection of the most plausible baseline scenario", Step 1a above, should be used.

Baseline emissions

Baseline emissions are calculated as:

$$BE_y = EL_{BL,y} \cdot EF_{elec,BL} \quad \textbf{(1)}$$

$BE_{elec,y}$ Baseline emissions due to the generation of electricity supplied to the captive consumer/electricity grid in year *y* of the crediting period (tCO_2).

$EL_{,BL,y}$ Electricity supplied to the captive consumer/electricity grid in year *y* of the crediting period, not exceeding the supply in absence of the project activity (MWh).

$EF_{elec,BL}$ Emission factor for the baseline source of electricity supplied to the captive consumer/electricity (tCO_2/MWh).

Project proponents shall quantify the amount of electricity that would be supplied to the captive consumer/electricity grid in the absence of the project activity (EL_{his}), as the maximum historic annual amount of electricity over three most recent years prior to implementation of project activity. If three year data is not available, then the electricity supplied during the most recent one year prior to implementation of the project activity could be used.

$$EL_{BL,y} = \begin{cases} EL_{PR,y} & \text{if} \quad EL_{PR,y} < EL_{his} \\ EL_{his} & \text{if} \quad EL_{PR,y} \geq EL_{his} \end{cases} \quad \textbf{(2)}$$

$EL_{PR,y}$ Total electricity supplied to the captive consumer/electricity grid by PAPP in the project case in year *y* of the crediting period (MWh).

$$EF_{elec,BL} = \frac{44}{12} \cdot \frac{3.6}{1000} \cdot \frac{EF_{FF,BL}}{NCV_{FF,BL} * \eta_{BL}} \quad \textbf{(3)}$$

$EF_{FF,BL}$ CO_2 emission factor for the coal or petroleum fuel used in the PAPP prior to the implementation of the project activity (tC/mass or volume unit).

$NCV_{FF,BL}$ Net calorific value of fossil fuel used in the PAPP prior to implementation of the project activity. (TJ/mass or volume unit)

η_{BL} Efficiency of the power plant prior to implementation of the project activity.

Treatment of different fuels being used in the baseline scenario

Note that the most plausible baseline scenario may be that several fuel types would be used in the baseline power plant. Where the use of several fuel types is the most plausible baseline scenario, project participants should for estimating baseline emission factor, as a conservative approach, select emission factor of the fuel type with the lowest CO_2 emission factor from the fuels used in the power plant during the most recent three years prior to the implementation of the project activity.

Procedure for determining the efficiency of the power plant

The energy efficiencies have to be determined, based on measurements, for the power plants for the baseline scenario ($\eta_{BL,i}$). Efficiencies for the baseline scenario (η_{BL}) could be either measured or project participants may use manufacturer's specification of efficiency at optimum load.

If the efficiency is measured, all measurements should be conducted at a range of load factor (or operation mode) that is representative of the situation during the project activity. Measurements should be carried out following national or international standards. Where a representative load factor (or operation mode) can not 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 values determined for η_{BL} should be documented in the CDM-PDD and shall remain fixed throughout the crediting period.

Project Emissions

Project emissions are calculated as follows:

$$PE_y = PE_{NG,y} + PE_{aux,y} \quad \textbf{(4)}$$

$PE_{NG,y}$ Emissions due to the combustion of natural gas for the production of electricity in year *y* of the crediting period (tCO_2).

$PE_{aux,y}$ Emissions due to the use of energy (fuel other than natural gas and/or electricity) in year *y* of the crediting period (tCO_2).

Emissions due to the combustion of natural gas for the production of electricity are calculated as:

$$\mathrm{PE}_{\mathrm{NG,y}} = \frac{44}{12} \cdot \mathrm{NG}_{\mathrm{y}} \cdot \mathrm{EF}_{\mathrm{NG,y}} \quad \textbf{(5)}$$

NG_y Total amount of natural gas used in the project power plant in year *y* of the crediting period (mass or volume units).

$EF_{NG,y}$ CO_2 emission factor of natural gas (tC/mass or volume).

If small amounts of other fossil fuels and/or the grid electricity is used in project activity to serve auxiliary and back-up loads, corresponding emissions shall be accounted as follows.

$$\mathrm{PE}_{\mathrm{aux,y}} = \frac{44}{12} \cdot \sum_{\mathrm{i}} \left(\mathrm{FF}_{\mathrm{aux,i,y}} \cdot \mathrm{EF}_{\mathrm{i}}\right) + \mathrm{EL}_{\mathrm{aux,grid,y}} \cdot \mathrm{EF}_{\mathrm{elec,y}} \quad \textbf{(6)}$$

$FF_{aux,i,y}$ Total amount of fossil fuel *i* used in the project power plant to serve auxiliary and back-up loads in year *y* of the crediting period (mass or volume units).

EF_i CO_2 emission factor of fossil fuel *i* (tC/mass or volume unit).

$EL_{aux,grid,y}$ Electricity used in the project power plant to serve auxiliary and back-loads that is obtained from the grid, if any (MWh).

$EF_{elec,y}$ Combined margin emission factor for the grid electricity to which the project activity is connected calculated as per the latest version of ACM0002, using 50/50 OM/BM weight (tCO_2/MWh), or a conservative default value of 1.3 tCO2/MWh may be used.

Leakage

Leakage may result from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary. This includes mainly fugitive CH_4 emissions and CO_2 emissions from associated fuel combustion and flaring. In this methodology, the following leakage emission sources shall be considered:[2]

- Fugitive CH_4 emissions associated with fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of natural gas used in the project plant and fossil fuels used in the grid in the absence of the project activity.
- In the case LNG is used in the project plant: CO_2 emissions from fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

Thus, leakage emissions are calculated as follows:

$$LE_y = LE_{CH4,y} + LE_{LNG,CO2,y} \quad \textbf{(7)}$$

LE_y Leakage emissions during the year y (tCO_2).

$LE_{CH4,y}$ Leakage emissions due to fugitive upstream CH_4 emissions in the year y (tCO_2).

$LE_{LNG,CO2,y}$ Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y (tCO_2).

Note that to the extent that upstream emissions occur in Annex I countries that have ratified the Kyoto Protocol, from 1 January 2008 onwards, these emissions should be excluded, if technically possible, in the leakage calculations.

Fugitive methane emissions

For the purpose of determining fugitive methane emissions associated with the production – and in case of natural gas, the transportation and distribution of the fuels – project participants should multiply the quantity of natural gas consumed in the project power plant with a methane emission factor for these

[2] The Meth Panel is undertaking further work on the estimation of leakage emission sources in case of fuel switch project activities. This approach may be revised based on outcome of this work.

upstream emissions, and subtract, for all fuel types *i* which would be used in the absence of the project activity, the fuel quantities multiplied with respective methane emission factors, as follows:

$$LE_{CH4,y} = \left[NG_y \cdot NCV_{NG,y} \cdot EF_{NG,upstream,CH4} - \frac{EL_{BL,y}}{\eta_{BL}} \cdot NCV_{FF,y} \cdot EF_{FF,upstream,CH4} \right] \cdot GWP_{CH4} \quad \textbf{(8)}$$

$L_{CH4,y}$	Leakage emissions due to upstream fugitive CH_4 emissions in the year *y* (tCO_2).
NG_y	Total amount of natural gas used in the project power plant in year *y* of the crediting period (mass or volume units).
$NCV_{NG,y}$	Net calorific value of natural gas, referred to in the same basis (pressure and temperature) as NG_y (TJ/mass or volume units).
$EF_{NG,upstream,CH4}$	Emission factor for upstream fugitive methane emissions from production, transportation and distribution of natural gas (tCH_4/TJ).
$EL_{elec,BL,y}$	Electricity supplied to the captive consumer/electricity grid in year *y* of the crediting perido up to the level of baseline supply (MWh).
$\eta_{BL,y}$	Efficiency of the power plant in the baseline as function of the load factor of the project activity power plant in year *y* of the crediting period.
$NCV_{i,y}$	Net calorific value of fossil fuel *i* (TJ/mass or volume units).
$EF_{i,upstream,CH4}$	Emission factor for upstream fugitive methane emissions from production of the fuel type *i* (a coal or petroleum fuel type) (tCH_4/TJ).
GWP_{CH4}	Global warming potential of methane valid for the relevant commitment period.

Where reliable and accurate national data on fugitive CH_4 emissions associated with the production, and in case of natural gas, the transportation and distribution of the fuels is available, project participants should use this data to determine average emission factors by dividing the total quantity of CH_4 emissions by the quantity of fuel produced or supplied respectively[3]. Where such data is not available, project participants may use the default values provided in Table 2 below. In this case, the natural gas emission factor for the location of the project should be used, except in cases where it can be shown that the relevant system element (gas production and/or processing/transmission/distribution) is predominantly of recent vintage and built and operated to international standards, in which case the US/Canada values may be used.

Note that the emission factor for fugitive upstream emissions for natural gas ($EF_{NG,upstream,CH4}$) should include fugitive emissions from production, processing, transport and distribution of natural gas, as indicated in the Table 2 below. Note further that in case of coal the emission factor is provided based on a mass unit and needs to be converted in an energy unit, taking into account the net calorific value of the coal.

[3] GHG inventory data reported to the UNFCCC as part of national communications can be used where country-specific approaches (and not IPCC Tier 1 default values) have been used to estimate emissions.

Table 2: Default emission factors for fugitive CH_4 upstream emissions

Activity	Unit	Default emission factor	Reference for the underlying emission factor range in Volume 3 of the *1996 Revised IPCC Guidelines*
Coal			
Underground mining	t CH4 / kt coal	13.4	Equations 1 and 4, p. 1.105 and 1.110
Surface mining	t CH4 / kt coal	0.8	Equations 2 and 4, p.1.108 and 1.110
Oil			
Production	t CH4 / PJ	2.5	Tables 1-60 to 1-64, p. 1.129 - 1.131
Transport, refining and storage	t CH4 / PJ	1.6	Tables 1-60 to 1-64, p. 1.129 - 1.131
Total	t CH4 / PJ	4.1	
Natural gas			
USA and Canada			
Production	t CH4 / PJ	72	Table 1-60, p. 1.129
Processing, transport and distribution	t CH4 / PJ	88	Table 1-60, p. 1.129
Total	t CH4 / PJ	160	
Eastern Europe and former USSR			
Production	t CH4 / PJ	393	Table 1-61, p. 1.129
Processing, transport and distribution	t CH4 / PJ	528	Table 1-61, p. 1.129
Total	t CH4 / PJ	921	
Western Europe			
Production	t CH4 / PJ	21	Table 1-62, p. 1.130
Processing, transport and distribution	t CH4 / PJ	85	Table 1-62, p. 1.130
Total	t CH4 / PJ	105	
Other oil exporting countries / Rest of world			
Production	t CH4 / PJ	68	Table 1-63 and 1-64, p. 1.130 and 1.131
Processing, transport and distribution	t CH4 / PJ	228	Table 1-63 and 1-64, p. 1.130 and 1.131
Total	t CH4 / PJ	296	

Note: The emission factors in this table have been derived from IPCC default Tier 1 emission factors provided in Volume 3 of the 1996 Revised IPCC Guidelines, by calculating the average of the provided default emission factor range.

CO_2 emissions from LNG

Where applicable, CO_2 emissions from fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system ($LE_{LNG,CO2,y}$) should be estimated by multiplying the quantity of natural gas combusted in the project with an appropriate emission factor, as follows:

$$LE_{LNG,CO2,y} = NG_y \cdot NCV_{NG,y} \cdot EF_{CO2,upstream,LNG} \quad \textbf{(9)}$$

$LE_{LNG,CO2,y}$ Leakage emissions due to fossil fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system during the year y (tCO_2).

NG_y Total amount of natural gas used in the project power plant in year y of the crediting period (mass or volume units).

$NCV_{NG,y}$ Net calorific value of natural gas, referred to in the same basis (pressure and temperature) as NG_y (TJ/mass or volume units).

$EF_{CO2,upstream,LNG}$ Emission factor for upstream CO_2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system (tCO_2/TJ)

Where reliable and accurate data on upstream CO_2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is available, project participants should use this data to determine an average emission factor. Where such data is not available, project participants may assume a default value of 6 tCO_2/TJ as a rough approximation[4].

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:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(10)}$$

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* (tCO_2/yr)

LE_y Leakage emissions during the year *y* (tCO_2/yr)

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

At the start of the second and third crediting period project proponets 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

[4] This value has been derived on data published for North American LNG systems. "Barclay, M. and N. Denton, 2005. Selecting offshore LNG process. http://www.fwc.com/publications/tech_papers/files/LNJ091105p34-36.pdf (10th April 2006)".

baseline for the project activity should take this into account. This assessment will be undertaken by the verifying DOE.

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.

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

Data and parameters not monitored

Parameter:	EL_{his}
Data unit:	MWh
Description	Electricity supplied to the captive consumer/electricity grid in the absence of the project activity
Source of data:	Electricity meters at the project site.
Measurement procedures (if any):	Read electricity meters and record information.
Any comment:	Defined as the maximum historic annual electricity supplied to the grid/captive consumer over three most recent years prior to implementation of project activity. If three year data is not available, then the electricity supplied during the most recent one year prior to implementation of the project activity could be used.

Parameter:	η_{BL}
Data unit:	fraction
Description	efficiency of the PAPP prior to the implementation of the project activity
Source of data:	Based on either (i) measurement of efficiency of the PAPP (ii) Manufacturer's specification of efficiency at optimum load
Measurement procedures (if any):	
Any comment:	If the efficiency is measured, all measurements should be conducted at a range of load factor (or operation mode) that is representative of the situation during the project activity. Measurements should be carried out following national or international standards. Where a representative load factor (or operation mode) can not 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.

<table>
<tr><td>parameter:</td><td>$EF_{FF,BL}$</td></tr>
<tr><td>Data unit:</td><td>tC / mass or volume unit</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of the coal or petroleum fuel used in the PAPP prior to the implementation of the project activity</td></tr>
<tr><td>Source of data:</td><td>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 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>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.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

<table>
<tr><td>Data / parameter:</td><td>$NCV_{FF,BL}$</td></tr>
<tr><td>Data unit:</td><td>GJ / mass or volume unit</td></tr>
<tr><td>Description:</td><td>Net calorific value of fossil fuel used in the PAPP prior to implementation of the project activity</td></tr>
<tr><td>Source of data:</td><td>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 if the carbon fraction of the fuel is not provided (option A).</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>
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</table>
</td></tr>
<tr><td>Measurement procedures (if any):</td><td>For a) and b): Measurements should be undertaken in line with national or international fuel standards.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Parameter:	$EF_{CO2,upstream,LNG}$
Data unit:	tCO_2/TJ
Description	Emission factor for upstream CO_2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system.
Source of data:	Where reliable and accurate data on upstream CO_2 emissions due to fossil fuel combustion / electricity consumption associated with the liquefaction, transportation, re-gasification and compression of LNG into a natural gas transmission or distribution system is available, project participants should use this data to determine an average emission factor. Where such data is not available, project participants may assume a default value of 6 tCO_2/TJ as a rough approximation[5].
Measurement procedures (if any):	
Any comment:	-

Parameter:	$EF_{FF,upstream,CH4}$
Data unit:	tCH_4/TJ
Description	Emission factor for upstream fugitive methane emissions from production of the fuel used in PAPP (coal or petroleum fuel type) prior to project implementation
Source of data:	Where reliable and accurate national data on fugitive CH_4 emissions associated with the production is available, project participants should use this data to determine average emission factors by dividing the total quantity of CH_4 emissions by the quantity of fuel produced or supplied respectively[6]. Where such data is not available, project participants may use the default values provided in Table 2 in the Leakage section of baseline methodology.
Measurement procedures (if any):	
Any comment:	-

[5] This value has been derived on data published for North American LNG systems. "Barclay, M. and N. Denton, 2005. Selecting offshore LNG process. http://www.fwc.com/publications/tech_papers/files/LNJ091105p34-36.pdf (10th April 2006)".

[6] GHG inventory data reported to the UNFCCC as part of national communications can be used where country-specific approaches (and not IPCC Tier 1 default values) have been used to estimate emissions.

Parameter:	$EF_{NG,upstream,CH4}$
Data unit:	tCH_4/TJ
Description	Emission factor for upstream fugitive methane emissions from production, transportation and distribution of natural gas.
Source of data:	Where reliable and accurate national data on fugitive CH_4 emissions associated with the production, and in case of natural gas, the transportation and distribution of the fuels is available, project participants should use this data to determine average emission factors by dividing the total quantity of CH_4 emissions by the quantity of fuel produced or supplied respectively[7]. Where such data is not available, project participants may use the default values provided in Table 2 given in Leakage section of the Baseline methodology.
Measurement procedures (if any):	See baseline methodology.
Any comment:	-

Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description	Global warming potential of methane valid for the relevant commitment period.
Source of data:	IPCC
Measurement procedures (if any):	Default value for the first commitment period = 21 tCO_2e/tCH_4
Any comment:	-

III. MONITORING METHODOLOGY

Monitoring procedures

The monitoring procedures are explained below in the respective tables of each parameter.

Data and parameters monitored

Data / Parameter:	Installed capacity and electricity generation
Data unit:	MW and MWh, respectively
Description:	Installed capacity and electricity generation of the project power plant.
Source of data:	Project site
Measurement procedures (if any):	The installed capacity and actual generation of the power plant before and after the fuel switch activity needs to be tested using internationally approved standard methods available with the help of reputed players or manufacturers in the market. The test report for the same is needed to be submitted to DOE during the validation/verification to check the same. Changes in capacity and generation must remain within ±5% of the capacity/generation before the implementation of the project activity, as per the applicability conditions.
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

[7] GHG inventory data reported to the UNFCCC as part of national communications can be used where country-specific approaches (and not IPCC Tier 1 default values) have been used to estimate emissions.

Data / Parameter:	$EL_{aux,grid,y}$
Data unit:	MWh
Description:	Electricity used in the project power plant to serve auxiliary and back-loads that is obtained from the grid, if any.
Source of data:	Electricity meters at the project site.
Measurement procedures (if any):	Read electricity meters and record information.
Monitoring frequency:	Monthly
QA/QC procedures:	As per electricity meter databook.
Any comment:	-

Data / Parameter:	$EL_{PR,,y}$
Data unit:	MWh
Description:	Electricity supplied to the captive consumer/electricity grid in year *y* of the crediting period.
Source of data:	Electricity meters at the project site.
Measurement procedures (if any):	Read electricity meters and record information.
Monitoring frequency:	Monthly
QA/QC procedures:	As per electricity meter databook.
Any comment:	-

Data / parameter:	$FF_{aux,i,y}$
Data unit:	mass or volume units
Description:	Total amount of fossil fuel *i* used in the project power plant to serve auxiliary and back-up loads in year *y* of the crediting period.
Source of data:	Data logs at the project site.
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / parameter:	$\mathbf{EF_{elec,y}}$
Data unit:	tCO_2/MWh
Description:	Emission factor for the grid in year *y*
Source of data:	Choose one of the following options: • Calculate the combined margin emission factor, using the procedures in the latest approved version of the "Consolidated baseline methodology for grid-connected electricity generation from renewable sources" (ACM0002); • Use a conservative default value of 1.3 tCO_2/MWh.
Measurement procedures (if any):	-
Monitoring frequency:	Follow procedures as described in ACM0002
QA/QC procedures:	Follow procedures as described in ACM0002
Any comment:	

<table>
<tr><td>Parameter:</td><td>$EF_{NG,y}$</td></tr>
<tr><td>Data unit:</td><td>tC / mass or volume unit</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of the Natural gas used in the PAPP in year y</td></tr>
<tr><td>Source of data:</td><td>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>e) Values provided by the fuel supplier in invoices</td><td>This is the preferred source.</td></tr>
<tr><td>f) Measurements by the project participants</td><td>If a) is not available</td></tr>
<tr><td>g) 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>h) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr>
</table></td></tr>
<tr><td>Monitoring frequency:</td><td>For a) and b): The CO_2 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</td></tr>
<tr><td>Measurement procedures (if any):</td><td>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.</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

Parameter:	**$EF_{i,y}$**
Data unit:	tC / mass or volume unit
Description:	CO_2 emission factor of the fossil fuel, other than natural gas, used in the PAPP to serve auxiliary and back-up loads in year y
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** i) Values provided by the fuel supplier in invoices — This is the preferred source. j) Measurements by the project participants — If a) is not available k) 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). l) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories — If a) is not available
Monitoring frequency:	For a) and b): The CO_2 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
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:	

Data / parameter:	**$NCV_{NG,y}$**
Data unit:	GJ per mass or volume unit (e.g. GJ/m³, GJ/ton)
Description:	Weighted average net calorific value of natural gas in year *y*
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** e) Values provided by the fuel supplier in invoices — This is the preferred source if the carbon fraction of the fuel is not

		provided (option A).
	f) Measurements by the project participants	If a) is not available
	g) 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).
	h) 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:	Applicable where option B is used.	

Data / parameter:	NG_y
Data unit:	mass or volume units
Description:	Total amount of natural gas used in the project power plant in year *y* of the crediting period.
Source of data:	Data logs at the project site.
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

References and any other information

-.-