Draft approved baseline and monitoring methodology AM00XX

"Methodology for new grid connected power plants using permeate gas previously flared and/or vented"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

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

- NM0270 "Methodology for new grid connected power plants utilizing permeate or associated gas, previously flared (or vented)" prepared by Grue & Hornstrup Consulting Engineers A/S on behalf of Engro Chemical Pakistan Ltd.;
- AM0029 "Baseline Methodology for Grid Connected Electricity Generation Plants using Natural Gas";
- AM0037 "Flare reduction and gas utilization at oil and gas processing facilities".

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

- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption;
- Tool for the demonstration and assessment of additionality;
- Tool to calculate the emission factor for an electricity system.

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

Selected approach from paragraph 48 of the CDM modalities and procedures

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

Definitions

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

- **Permeate gas:** a low heating value off-gas from the treatment of natural gas in membrane gas separation processing facilities;
- **Booster station:** the process unit that decreases the permeate gas pressure drop within the transportation pipeline and assures the required gas pressure at the inlet of the permeate gas power plant.

Applicability

This methodology is applicable to project activities where the permeate gas, previously flared and/or vented at the existing natural gas processing facility, is used as fuel in a new grid connected power plant.

The methodology can be used in the following two cases:

(i) Only the operator of the new power plant is a project participant; or

(ii) Both the operator of the new power plant and the operator of the natural gas processing facility are project participants.

This methodology is applicable under the following conditions:

- It can be verified that the total amount of permeate gas from the gas processing facility was flared and/or vented for at least 3 years prior to the start of the project activity;
- The transportation of the permeate gas from the natural gas processing facility to the new power plant occurs through a dedicated pipeline that is established as part of the project activity and not used for the transportation of any other gases;
- The new power plant is constructed for the purpose of the project activity and uses as fuel the permeate gas recovered from the natural gas processing facility from the start of its commercial operation;
- All power produced in the grid connected new power plant is exported to the power grid;
- The new power plant primarily fires the previously flared and/or vented permeate gas. The use of other fuels for operating the power plant shall be limited to auxiliary purposes such as starting-up the power plant.

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

Finally, this methodology is only applicable if the most plausible baseline scenario identified as per the "Procedure to select the most plausible baseline scenario and assess additionality" is:

(a) The continuation of the current practice of flaring and/or venting of the permeate gas (scenario G1);

(b) Power would have been produced as per scenario P3, P4 or P5 (as specified in the section on the identification of the baseline scenario).

II. BASELINE METHODOLOGY PROCEDURE

Procedure to select the most plausible baseline scenario and demonstrate additionality

This methodology provides two different procedures to select the most plausible baseline scenario and demonstrate additionality. Procedure 1 should be applied in the case when only the operator of the new power plant is a project participant (case (i) in the applicability conditions section). Procedure 2 should be applied in the case when both the operator of the new power plant and the operator of the natural gas processing facility are project participants (case (ii) in the applicability conditions section).

Procedure 1: Only the operator of the new power plant is a project participant

Step 1: Select the most plausible baseline scenario for the permeate gas

To confirm that the continuation of the current practice of venting and/or flaring of the permeate gas is the most plausible baseline scenario project participants shall:

(a) Confirm that venting and/or flaring of the permeate gas is the common practice in the host country by demonstrating that more than 50% of the natural gas processing facilities in the host country, which generate permeate gas, do not use the permeate gas for productive purposes, including as fuel or feedstock, but flare or vent it;

(b) Obtain a written confirmation from the natural gas processing facility that (i) the permeate gas would not have been used for productive purposes, (ii) no other potential users of the permeate gas are interested in it as feedstock or fuel, and (iii) the gas processing facility would have continued the current practice of venting and/or flaring the permeate gas in the absence of the project activity; and

(c) Provide documentation that the continuation of the current practice of flaring and/or venting of the permeate gas is in compliance with all mandatory applicable legal and regulatory requirements, even if these laws and regulations have objectives other than GHG reductions. This does not include national and local policies that do not have a legally-binding status.

The continuation of the current practice of venting or flaring of the permeate gas can only be considered the most plausible baseline scenario if all three conditions above are met.

Step 2: Select the most plausible baseline scenario for power generation

Step 2.1: Identify realistic and credible alternative scenarios for power generation

The alternatives should include all possible options that are technically feasible for generating electricity with similar output characteristics as the project activity. These options should include, *inter alia*:

P1: The proposed project activity undertaken without being registered as a CDM project activity;

P2: Power generation using the permeate gas, but employing other power generation technologies than the project activity;

P3: Power generation using the processed natural gas, from the gas processing facility that provides the permeate gas, with similar and other technologies than the project activity;

P4: Power generation using other energy sources than the permeate gas and the natural gas from the gas processing facility that provides the permeate gas;

P5: Power generation in existing and/or new plants in the electricity grid;

P6: Import of electricity from connected grids, including the possibility of new interconnections.

These alternatives consist not 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). The baseline scenario candidates identified may not be available to project participants, but could be available to other stakeholders within the grid boundary (e.g. other companies investing in power capacity expansions). Ensure that all relevant technologies used in power plants that have recently been constructed, are under construction or are being planned (e.g. documented in official power expansion plans) are included as plausible alternatives. A clear description of each baseline scenario alternative, including information on the technology, such as the efficiency and technical lifetime, shall be provided in the CDM-PDD.

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

If one or more scenarios are excluded, an appropriate explanation and documentation to support the exclusion of such a scenario shall be provided.

Step 2.2: Eliminate baseline alternatives that face prohibitive barriers

Step 2.2.1: Identify potential barriers

Based on the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers preventing these alternatives from being implemented in the absence of the CDM revenues. These barriers may include, among others:

- Investment barriers, *inter alia*:
  - Debt funding is not available for this type of a project activity;
  - Domestic or international capital markets are not accessible due to real or perceived risks associated with domestic or foreign direct investment in the host country.
- Technological barriers, *inter alia*:
  - Technical and operational risks of implementing alternatives;
  - Non-availability of the respective technology;
  - Non-availability of the respective fuel or other resources;
  - Lack of infrastructure for the implementation of the technology;
  - Lack of skilled and/or properly trained labour to operate and maintain the technology;
  - Lack of demand for the useful product, outcome or effect of the alternative scenario;
- Barriers due to prevailing practice, *inter alia*:
  - The project activity is the "first of its kind". Currently no other project activity of this type is operational in the host country or region.

Provide transparent and documented evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. The type of evidence should at least include one the following:

(a) Relevant legislation, regulatory information or industry norms;

(b) Relevant (sectoral) studies or surveys (*e.g.* market surveys, technology studies, *etc*) undertaken by universities, research institutions, industry associations, companies, bilateral/multilateral institutions *etc*;

(c) Relevant statistical data from national or international statistics;

(d) Documentation of relevant market data (*e.g.* market prices, tariffs, rules);

(e) Written documentation from the company or institution developing or implementing the CDM project activity or the CDM project developer, such as minutes from Board meetings, correspondence, feasibility studies, financial or budgetary information, *etc*;

(f) Documents prepared by the project developer, contractors or project partners in the context of the proposed project activity or similar previous project implementations;

(g) Written documentation of independent expert judgements from industry, educational institutions (e.g. universities, technical schools, and training centres), industry associations and others.

Step 2.2.2: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity)

If any of the baseline scenario alternatives face barriers that would prohibit them from being implemented, then these should be eliminated.

- 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;
- 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. 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 Step 3, otherwise the project activity is not additional;
- If there are still several alternative scenarios remaining, including the proposed project activity undertaken without being registered as a CDM project activity, proceed to Step 2.3 (investment analysis);
- If there are still several alternative scenarios remaining, but which do not include the proposed project activity undertaken without being registered as a CDM project activity, 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, project participants may choose to either:

  Option 1: Go to Step 2.3 (investment analysis); or
  Option 2: Identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario, and proceed to Step 3.

Step 2.3: Select the most plausible baseline scenario by identifying the economically most attractive alternative using investment analysis

This step serves to determine which of the alternative scenarios remaining after Step 2.2 is the most economically or financially attractive. For this purpose, an investment comparison analysis is conducted for the remaining alternative scenarios.

Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh) most suitable for the project type and the decision-making context.

Calculate the suitable financial indicator for all alternatives remaining after Step 2.2. Include all relevant capital and operational costs (including the investment cost for the power plant, the cost for recovering the permeate gas, the permeate gas prices, other fuel costs and operation and maintenance costs) and revenues (including subsidies/fiscal incentives,[1] ODA, etc. where applicable), and, as appropriate, non-market costs and benefits in the case of public investors.

In these calculations, either a price of zero for the permeate gas should be assumed or the price of the permeate gas contractually agreed between the project participant and the natural gas processing facility should be used. The DOE shall validate this price. For this purpose, the DOE should validate that the price assumed in the calculation is consistent with the contractual arrangements between the project participant and the operator of the natural gas processing facility and seek a written confirmation of any applicable contractual arrangements between the project participant and the operator of the natural gas processing facility. Moreover, the DOE should validate that the price is within a realistic and plausible range, taking into account the composition of the gas (e.g. the price per net calorific value should by no means be higher than the price for the natural gas).

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

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

A sensitivity analysis shall be performed for all alternatives, to confirm that the conclusion regarding the financial attractiveness is robust to reasonable variations in the critical assumptions (e.g. permeate gas price, other fuel prices and the load factor). The range of the sensitivity analysis should cover, in a realistic way, the possible variations of all key parameters that are related to the analysis and that could change over the crediting period. Project participants should assess in the sensitivity analysis, the impact on the financial attractiveness of the project activity in the case that the permeate gas price negotiated between the permeate gas supplier and the power plant operator is equal to zero.

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

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

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

Step 3: Demonstrate additionality of the project activity

The assessment and demonstration of additionality comprises the following steps:

Step 3.1: Benchmark investment analysis

Demonstrate that that the proposed project activity is unlikely to be financially attractive by applying Sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of the latest approved version of the "Tool for the demonstration and assessment of additionality" . The same provisions as in Step 2.3 apply with respect to the price of the permeate gas.

Step 3.2: Common practice analysis

Demonstrate that the project activity is not common practice in the host country and sector by applying Step 4 (common practice analysis) of the latest approved version of the "Tool for the demonstration and assessment of additionality".

Procedure 2: Both the operator of the new power plant and the operator of the natural gas processing facility are project participants

Step 1: Identify technically feasible alternative scenarios

The baseline scenario alternatives should include all technically feasible options that are considered realistic and credible with regard to (a) the use of the permeate gas in the absence of the project activity, and (b) power generation in absence of the project activity.

For the permeate gas, the alternative baseline scenarios should include, *inter alia*:

G1: The continuation of the current practice of flaring and/or venting of the permeate gas;

G2: The permeate gas is used as feedstock for chemical industry at an off-site facility;

G3: Injection of the permeate gas into an oil or gas reservoir;

G4: Recovery, transportation, processing and distribution of the permeated gas to end-users;

G5: Purification of the permeate gas to pipeline or bottle gas quality;

G6: Use of the permeate gas as fuel for thermal energy production and/or power generation at the site of the natural gas processing plant;

G7: The proposed project activity undertaken without being registered as a CDM project activity (use of the permeate gas as fuel in a newly constructed power plant).

For the power generation, the alternative baseline scenarios should include all possible options that are technically feasible for generating electricity with similar output characteristics as the project activity. These alternatives should include, *inter alia*:

P1: The proposed project activity undertaken without being registered as a CDM project activity (use of the permeate gas as fuel in a newly constructed power plant).

P2: Power generation using the permeate gas, but employing other power generation technologies than that used in the project activity;

P3: Power generation using the processed natural gas, from the gas processing facility that provides the permeate gas, with similar and other technologies than that used in the project activity;

P4: Power generation using other energy sources than the permeate gas and the natural gas from the gas processing facility that provides the permeate gas;

P5: Power generation in existing and/or new plants in the electricity grid;

P6: Import of electricity from connected grids, including the possibility of new interconnections.

These alternatives consist not 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). 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 technologies used in power plants that have recently been constructed, are under construction or are being planned (e.g. documented in official power expansion plans) are included as plausible alternatives. A clear description of each baseline scenario alternative, including information on the technology, such as the efficiency and technical lifetime, shall be provided in the CDM-PDD.

If one or more scenarios are excluded, an appropriate explanation and documentation to support the exclusion of such scenario shall be provided.

Project participants should identify all realistic and credible baseline scenarios for the fate of the permeate gas (G1 to G7) and the power production (P1 to P6). Realistic combinations of these should be considered as possible alternative scenarios to the proposed project activity in the following steps.

Step 2: Eliminate baseline alternatives that do not comply with legal or regulatory requirements

The baseline alternatives shall be in compliance with all applicable legal and regulatory requirements, even if these laws and regulations refer to objectives other than GHG reductions (CH_4, CO_2, etc.). National and local policies that do not have legally-binding status are excluded from this step. Eliminate all baseline alternatives that are not in compliance with the legal and regulatory requirements of the host country or respective region.

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

If the proposed project activity remains the only alternative that complies with all regulations, then the proposed project activity is the baseline scenario.

Step 3: Eliminate baseline alternatives that face prohibitive barriers

Step 3.1: Identify potential barriers

Based on the alternatives that are technically feasible and in compliance with all legal and regulatory requirements, the project participant should establish a complete list of barriers preventing alternatives from being implemented in the absence of the CDM revenues. These barriers may include, among others:

- Investment barriers, *inter alia*:
  - Debt funding is not available for this type of a project activity;
  - Domestic or international capital markets are not accessible due to real or perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be implemented.
- Technological barriers, *inter alia*:
  - Technical and operational risks of implementing the alternatives;
  - Non-availability of the respective technology;
  - Non-availability of the respective fuel or resources;
  - Lack of infrastructure for implementation of the technology;
  - Lack of skilled and/or properly trained labour to operate and maintain the technology;
  - Lack of demand for the useful product, outcome or effect of the alternative scenario;
- Barriers due to prevailing practice, *inter alia*:
  - The project activity is the "first of its kind". Currently no other project activity of this type is operational in the host country or region.

Provide transparent and documented evidence, and offer conservative interpretations of this documented evidence, as to how it demonstrates the existence and significance of the identified barriers. The type of evidence should at least include one the following:

(a) Relevant legislation, regulatory information or industry norms;

(b) Relevant (sectoral) studies or surveys (*e.g.* market surveys, technology studies) undertaken by universities, research institutions, industry associations, companies, bilateral/multilateral institutions, etc;

(c) Relevant statistical data from national or international statistics;

(d) Documentation of relevant market data (*e.g.* market prices, tariffs, rules);

(e) Written documentation from the company or institution developing or implementing the CDM project activity or the CDM project developer, such as minutes from Board meetings, correspondence, feasibility studies, financial or budgetary information, etc;

(f) Documents prepared by the project developer, contractors or project partners in the context of the proposed project activity or similar previous project implementations;

(g) Written documentation of independent expert judgements from industry, educational institutions (e.g. universities, technical schools, and training centres), industry associations and others.

Step 3.2: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed CDM project activity)

If any of the baseline scenario alternatives face barriers that would prohibit them from being implemented, then these should be eliminated.

- 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;
- 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. 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 Step 5, otherwise the project activity is not additional.
- If there are still several alternative scenarios remaining, including the proposed project activity undertaken without being registered as a CDM project activity, proceed to Step 4 (investment analysis).
- If there are still several alternative scenarios remaining, but which do not include the proposed project activity undertaken without being registered as a CDM project activity, 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, project participants may choose to either:

  Option 1: Go to step 4 (investment analysis), or

  Option 2: Identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario, and proceed to Step 5.

Step 4: Identify the economically most attractive baseline scenario alternative

This step serves to determine which of the alternative scenarios remaining after Step 3 is the most economically or financially attractive. For this purpose, an investment comparison analysis is conducted for the remaining alternative scenarios.

Identify the financial indicator, such as IRR, NPV, cost benefit ratio, or unit cost of service (e.g., levelized cost of electricity production in $/kWh) most suitable for the project type and the decision-making context.

Calculate the financial indicator for all alternatives remaining after Step 3. Include all relevant costs (including, for example, the investment cost, fuel costs and operation and maintenance costs), and revenues (including subsidies/fiscal incentives,[2] ODA, etc. where applicable), and, as appropriate, non-market costs and benefits in the case of public investors. The investment analysis should cover all costs and revenues of the alternative scenarios for both the operator of the new power plant and the operator of the natural gas processing facility.

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

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

The CDM-PDD submitted for validation shall present a clear comparison of the financial indicator for all scenario alternatives. The baseline scenario alternative that has the best indicator can be pre-selected as the most plausible baseline scenario; then a sensitivity analysis shall be performed for all alternatives. The range of the sensitivity analysis should cover, in a realistic way, the possible variations of all key parameters that are related to the analysis and that could change over the crediting period.

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

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

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

Step 5: Demonstration of additionality

The assessment and demonstration of additionality comprises the following steps:

Step 5.1: Benchmark investment analysis

Demonstrate that that the proposed project activity is unlikely to be financially attractive by applying Sub-steps 2b (Option III: Apply benchmark analysis), Sub-step 2c (Calculation and comparison of financial indicators), and 2d (Sensitivity Analysis) of the latest approved version of the "Tool for the demonstration and assessment of additionality" . The investment analysis should cover all costs and revenues of the alternative scenarios for both the operator of the new power plant and the operator of the natural gas processing facility.

Step 5.2: Common practice analysis

Demonstrate that the project activity is not common practice in the host country and sector by applying Step 4 (common practice analysis) of the latest approved version of the "Tool for the demonstration and assessment of additionality".

Project boundary

The **spatial extent** of the project boundary encompasses the new project power plant, the booster station, the permeate gas transportation from the booster station to the new project power plant, and the power grid. The greenhouse gases included in or excluded from the project boundary are shown in the following table.

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

	Source	**Gas**	**Included**	**Justification / Explanation**
Baseline	Production of electricity in the baseline	CO_2	Yes	Main emission sources
		CH_4	No	Excluded (conservative approach)
		N_2O	No	Excluded (conservative approach)
Project Activity	Combustion of other fossil fuels for auxiliary purposes in the new power plant	CO_2	Yes	May be a significant emission source
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
	Operation of the booster station	CO_2	Yes	May be a significant emission source
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
	Fugitive emissions from permeate gas transport	CO_2	No	Assumed negligible
		CH_4	Yes	May be a significant emission source
		N_2O	No	Assumed negligible

The methodology is based on the assumption that all carbon in the permeate gas both in the baseline and under the project activity is fully oxidized to CO_2. As a consequence, the use of the permeate gas under the project activity and its venting and/or flaring in the baseline is not included as emission source. This is a conservative simplification, as the permeate gas combustion in a power plant can be considered to cause significantly lower CH4 emissions than the flaring or venting of the permeate gas.

Project emissions

The project emissions consist of emissions from power generation in the new project power plant, from the operation of the permeate gas booster station(s), and from the permeate gas transportation. The Project emissions are calculated as follows:

$$PE_y = PE_{FC,elec,y} + PE_{BS,y} + PE_{TR,y} \quad \textbf{(1)}$$

Where:

PE_y	=	Project emissions in year y in tCO_2e
$PE_{FC,elec,y}$	=	Project emissions from firing fossil fuels for auxiliary purposes (e.g. start-up) in the new project power plant in year y in tCO_2
$PE_{BS,y}$	=	Project emissions from operation of the permeate gas booster station(s) in year y in tCO_2
$PE_{TR,y}$	=	Project fugitive emissions from permeate gas transportation in year y in tCO_2e

The procedures to calculate the emissions from each of the project emission sources are presented in the following sections.

Project emissions from firing fossil fuels for auxiliary purposes (e.g. starting-up) in the new project power plant ($PE_{FC,elec,y}$)

These emissions include CO_2 emissions from the combustion of fossil fuels fired in the power plant for auxiliary purposes such as starting-up the power generation unit. For the calculation of these emissions, project proponents shall apply the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" available in the UNFCCC website. The term $PE_{FC,elec,y}$ corresponds to the term $PE_{FC,j,y}$ in the tool. The tool is only applied to one element process *j* which corresponds to the new power plant constructed as part of the project activity. The index *i* in the tool corresponds to the fossil fuel types fired in the project power plant excluding the permeate gas.

Project emissions from operation of the booster station(s) ($PE_{BS,y}$)

Under the project activity it is required to operate one or several booster station(s) in order to compensate the pressure drop within the permeate gas pipeline and assure the required gas pressure at the inlet of the new project power plant. The booster station(s) can be operated using fossil fuels, the permeate gas and/or electricity as energy source. The use of permeate gas in compressor/booster station(s) does not need to be included in the project emissions, as the permeate gas would in the baseline be flared and/or vented. The project emissions thus include emissions from using fossil fuels and electricity:

$$PE_{BS,y} = PE_{BS,FF,y} + PE_{BS,EL,y} \tag{2}$$

Where:

$PE_{BS,y}$	=	Project emissions from operation of the permeate gas booster station(s) in year *y* in tCO_2
$PE_{BS,FF,y}$	=	Project emissions from use of fossil fuels in permeate gas booster station(s) in year *y* in tCO_2
$PE_{BS,EL,y}$	=	Project emissions from use of electricity in permeate gas booster station(s) in year *y* in tCO_2

To calculate $PE_{BS,FF,y}$, the project participants shall apply the latest approved versions of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". The element processes *j* in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" should correspond to the fossil fuel combustion processes in the booster station(s) operated under the project activity. The term $PE_{BS,FF,y}$ in this methodology corresponds to the term $PE_{FC,j,y}$ in the tool.

To calculate $PE_{BS,EL,y}$, the project participants shall apply the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". The term $PE_{BS,EL,y}$ in this methodology corresponds to the term $PE_{EC,y}$ in the tool.

Project fugitive methane emissions from permeate gas transport ($PE_{TR,y}$)

The project emissions from permeate gas transport refer to fugitive methane emissions from all equipment used under the project activity to transport the permeate gas from the natural gas processing plant to the new project power plant, including emissions from the compressor/booster station(s) and the pipeline. Fugitive methane emissions occurring during the transport of the permeate gas may be small, but they should be estimated in order to be conservative.

Emission factors are taken from the 1995 Protocol for Equipment Leak Emission Estimates, published by U.S. EPA.[3] Emissions should be determined for all relevant activities and all equipment (such as valves, pump seals, connectors, flanges, open-ended lines, etc).

The U.S. EPA approach is based on average emission factors for total organic compounds (TOC). In the equation (3), methane emissions are calculated by multiplying the methane concentration in the permeate gas with the appropriate emission factor from the Table 2 and then summing up the contributions from all pieces of equipment.

The overall fugitive emissions from transportation of the permeate gas are calculated as follows:

$$PE_{TR,y} = \frac{1}{1000} \times GWP_{CH4} \times w_{CH4,PG,y} \times \sum_{equipment} \left[EF_{equipment} \times t_{equipment} \right] \quad \textbf{(3)}$$

Where:

$PE_{TR,y}$	=	Project fugitive emissions from permeate gas transportation during year y in tCO_2e
GWP_{CH4}	=	Global Warming Potential of methane
$w_{CH4,PG,y}$	=	Average mass fraction of methane in the permeate gas in year y in kg of CH4/kg of the permeate gas
$EF_{equipment}$	=	The emission factor for the relevant equipment type, taken from the Table 2 or the 2006 IPCC Guidelines in kg of permeate gas / hour
$t_{equipment}$	=	The operation time of the equipment in hours

All data for gas volumes in all equations should be converted to common standard temperature and pressure values. The default density of methane at 0 degree Celsius and 1 atm is 0.0007168 t CH4 / m3. It is recommended to group the equipment according to the different types listed in the Table 2.

Table 2: Oil and natural gas production average emission factors

Equipment Type	Service	Emission Factor (kg / hour / equipment item) for TOC
Valves	Gas	4.5E-03
Pump seals	Gas	2.4E-03
Others*	Gas	8.8E-03
Connectors	Gas	2.0E-04
Flanges	Gas	3.9E-04
Open-ended lines	Gas	2.0E-03

TOC: Total organic compounds;

Source: US EPA-453/R-95-017 Table 2.4, page 2-15;

*Other equipment type was derived from compressors, diaphragms, drains, dump arms, hatches, instruments, meters, pressure relief valves, polished rods, relief valves and vents. This "other" equipment type should be applied for any equipment type other than connectors, flanges, open-ended lines, pumps or valves.

[3] Please refer to document EPA-453/R-95-017 at <http://www.epa.gov/ttn/chief/efdocs/equiplks.pdf>.

Baseline emissions

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

$$BE_y = EG_{PJ,y} \cdot EF_{BL,CO2,y} \quad \textbf{(4)}$$

Where:

BE_y	=	Total baseline emissions during year y in tCO_2
$EG_{PJ,y}$	=	Electricity generated in the project plant in year y in MWh
$EF_{BL,CO2,y}$	=	Baseline CO_2 emission factor for electricity generation in year y in tCO_2/MWh

For construction of potentially large new power capacity additions under the CDM, there is a considerable uncertainty relating to which type of other power generation is substituted by the power generation of the project plant. As a result of the project, the construction of a power plant(s) using an alternative power generation technology(s) could be avoided, or the construction of a series of other power plants could simply be delayed. Furthermore, if the project were installed sooner than these other plants might have been constructed, its near-term impact could be largely to reduce electricity generation in existing plants. This depends on many factors and assumptions (e.g. whether there is a supply deficit) that are difficult to determine and that change over time.

In order to address this uncertainty in a conservative manner, project participants shall use as $EF_{BL,CO2,y}$ the lowest emission factor among the following three options:

Option 1	The build margin, calculated according to the latest approved version of the "Tool to calculate the emission factor for an electricity system";
Option 2	The combined margin, calculated according to the latest approved version of the "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 under the "Procedure to select the most plausible baseline scenario and demonstrate additionality" and calculated as follows:

$$EF_{BL,CO2,y} = 3.6 \cdot \frac{COEF_{BL}}{\eta_{BL}} \quad \textbf{(5)}$$

Where:

$EF_{BL,CO2,y}$	=	Baseline CO_2 emission factor for electricity generation in year y in tCO_2/MWh
$COEF_{BL}$	=	The fuel emission coefficient, based on national average fuel data, if available, otherwise IPCC defaults can be used, in tCO_2e/GJ
η_{BL}	=	The energy efficiency[4] of the technology identified as the baseline scenario

Leakage

No leakage emissions are considered under this methodology.

[4] DOEs may verify the efficiency of the baseline generation technology from scientific literature.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \tag{6}$$

Where:

ER_y	=	Emission reductions in year y in t CO_2/yr
BE_y	=	Baseline emissions in year y in t CO_2/yr
PE_y	=	Project emissions in year y in t CO_2/yr

Data and parameters not monitored

In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / parameter:	$EF_{equipment}$
Data unit:	kg gas / hour
Description:	As defined in the baseline methodology
Source of data:	Table 2 of this methodology or 2006 IPCC Guidelines
Measurement procedures (if any):	-
Any comment:	-

Data / parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global warming potential for CH_4 valid for the commitment period
Source of data:	IPCC
Value to be applied:	21 for the first commitment period. Shall be updated according to any future COP/MOP decisions
Any comment:	-

III. MONITORING METHODOLOGY

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

In addition, the monitoring provisions in the tools referred to in this methodology apply.

Data and parameters monitored

Data / Parameter:	$EG_{PJ,y}$
Data unit:	MWh/yr
Description:	Net quantity of electricity generated in the project plant in year *y*
Source of data:	Electricity meter
Measurement procedures (if any):	-
Monitoring frequency:	Continuous
QA/QC procedures:	Metered net electricity generation should be cross-checked with receipts from sales
Any comment:	-

Data / Parameter:	$EF_{BL,CO2,y}$
Data unit:	tCO_2/MWh
Description:	Baseline CO_2 emission factor for electricity generation in year *y*
Source of data:	As per the procedure presented in the baseline methodology
Measurement procedures (if any):	As per the procedure presented in the baseline methodology
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / parameter:	$w_{CH4,PG,y}$
Data unit:	kg CH_4/kg of permeate gas
Description:	Average mass fraction of methane in the permeate gas in year *y*
Source of data:	Actual measurements
Measurement procedures (if any):	Chemical analysis (e.g., gas chromatography)
Monitoring frequency:	Weekly (minimum)
QA/QC procedures:	Methane content of gas should be crossed checked with previous months' data as well as with the owners of the oil and gas processing plant
Any comment:	-

Data / parameter:	$t_{equipment}$
Data unit:	Time (hours of use)
Description:	The operation time of the equipment (in absence of further information, the monitoring period could be considered as a conservative approach)
Source of data:	Plant records or time of use meters
Measurement procedures (if any):	None
Monitoring frequency:	Annually
QA/QC procedures:	Time of use meters will be calibrated as often as required by manufacturing recommendations.
Any comment:	The pipeline taking the permeate gas to the new power plant will be measured for the hours of its operation providing the required data to estimate the fugitive emissions from the pipe over the course of the baseline year

IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

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History of the document

Version	**Date**	**Nature of revision(s)**
01	EB 44, Annex # 28 November 2008	Initial adoption.