Approved baseline and monitoring methodology AM0037

"Flare (or vent) reduction and utilization of gas from oil wells as a feedstock"

I. SOURCE AND APPLICABILITY

Source

This methodology is based on the project activity "Reduction of Flaring and Use of Recovered Gas for Methanol Production", whose baseline and monitoring methodology and project design document were prepared by MDL Ambiente.

For more information regarding the proposal and its consideration by the Executive Board please refer to case NM0145: "Flare reduction and gas utilization at oil and gas processing facilities" on <http://cdm.unfccc.int/goto/MPappmeth>.

This methodology also refers to the latest version of the following tools[1]:

- "Tool for the demonstration and assessment of additionality";
- "Tool to calculate the emission factor for an electricity system";
- "Tool to calculate project or leakage CO2 emissions from electricity consumption";
- "Tool to calculate project emissions from electricity consumption".

Selected approach from paragraph 48 of the CDM modalities and procedures

"Actual or historical emissions, as applicable"

Definitions

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

Associated gas. Natural gas found in association with oil, either dissolved in the oil or as a cap of free gas above the oil.

End-use facility. The industrial facility where the associated gas is used as feedstock under the project activity.

Existing facility. An end-use facility that has been operational for at least three years prior to implementation of the project activity.

New facility. A greenfield end-use facility that is constructed with the implementation of the project activity.

Useful chemical product. Chemical substance produced using the associated gas in the end-use facility, e.g., methanol, ethylene, or ammonia, which has a market value.

[1] Please refer to:<http://cdm.unfccc.int/goto/MPappmeth>

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 CH_4 / m^3.

Applicability

The methodology is applicable to project activities that recover associated gas from oil wells. which was previously flared, and utilize this associated gas in an existing or a new end-use facility, to produce a useful chemical product.

The following conditions apply to the methodology:

- The associated gas from the oil well, which is used by the project activity, was flared or vented for the last 3 years prior to the start of the project activity;
- Under the project activity, the previously flared associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene, or ammonia).
- ~~If the tail gas is used as a feedstock in a new facility, the production of the useful products (e.g. methanol, ethylene, etc.) by the project activity does not lead to displacement of production in a new plant that would be built in the absence of the project activity in an Annex I country; and would emit more than 1% of the emissions due to flaring of the tail gas in the baseline situation. The project participants can use market studies of the useful product, interviews with appropriate experts, analysis from research institutes with expertise the market for that useful product, etc. to demonstrate that such a displacement of production in Annex I country is highly unlikely to occur.~~
- ~~The use of the tail gas by the project activity will not lead to an increase in fuel consumption outside of the project boundary.~~[2]
- ~~Energy requirements for the project activity are primarily met using the previously-flared tail gas. If additional fossil fuel is required for the project activity, these emissions should be counted as project emissions.~~
- ~~Accurate data on the quantity and carbon content on the tail gas are available.~~

II. BASELINE METHODOLOGY

Project boundary

The project boundary for this methodology includes:

- The site where the associated gas would be flared in the absence of the project activity;
- The pipeline from the site of the previous associated gas flaring to the end-use facility;
- The end-use facility using the associated gas in the project activity;
- The facility(ies) where the useful product would be produced in the absence of the project activity.

Table 1: Summary of gases and sources included in the project boundary, and justification / explanation where gases and sources are not included

	Source	Gas	Included?	Justification / Explanation
Baseline	Flaring	CO_2	Yes	Main source of emissions in the baseline
		CH_4	No	It is assumed that flaring results in complete oxidation of carbon in associated gas, resulting in a conservative baseline.
		N_2O	No	Assumed negligible
	Fuel consumption for associated gas transport	CO_2	Yes	If fossil fuels (other than associated gas) or electricity are used (e.g., in pipeline compressors)
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
	Fugitives emissions resulting from associated gas transport	CO_2	No	Assumed negligible
		CH_4	Yes	CH_4 emissions may occur if gas is transported to a flare in the baseline scenario
		N_2O	No	Assumed negligible
	Emissions associated with the production of the useful product in the absence of the project activity	CO_2	Yes	Main emission source
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
Project Activity	Fuel consumption for associated gas transport	CO_2	Yes	If fossil fuels (other than previously flared associated gas) are used (e.g., in pipeline compressors)
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
	Fugitive emissions resulting from associated gas transport	CO_2	No	Assumed negligible
		CH_4	Yes	Fugitive CH_4 emissions may occur if associated gas is transported to the end use facility in the project scenario
		N_2O	No	Assumed negligible
	Fugitive emissions from accidents	CO_2	No	Assumed negligible
		CH_4	Yes	Fugitive CH_4 emissions may occur if there is an equipment failure in equipment transporting associated gas to the end use facility in the project scenario
		N_2O	No	Assumed negligible
	(Additional) energy used by end-use facility	CO_2	Yes	This includes fossil fuel use and electricity consumption in the end use facility
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible

Procedure for the selection of the most plausible baseline scenario

The most plausible baseline scenario is identified in three steps:

Step 1: Identify all realistic and credible alternative scenarios to the proposed project activity and eliminate alternative that do not comply with legal or regulatory requirements;
Step 2: Assess the alternative scenarios to the proposed project activity and eliminate alternative scenarios that face prohibitive barriers;
Step 3: Determine the most likely alternative (baseline scenario).

The most plausible baseline scenario should be determined regarding:

(a) What would happen to the associated gas from the oil well in the absence of the CDM project activity; and
(b) How the useful chemical product produced with the associated gas would be produced in the absence of the CDM project activity.

Step 1: Identify all realistic and credible alternative scenarios to the proposed project activity and eliminate alternative that do not comply with legal or regulatory requirements

Plausible alternative baseline scenarios for the use of the associated gas could include, *inter alia:*

T1 The continuation of the current situation: Flaring of the associated gas at or nearby the oil well;
T2 On-site consumption of the associated gas for the purpose of energy generation;
T3 Injection of the associated gas into an oil or gas reservoir;
T4 Recovery, transportation, processing and distribution of the associated gas to end-users;
T5 The proposed project activity without the CDM: The associated gas is used as a feedstock at an off-site facility;
T6 The associated gas is used and transported to other consumers for the purpose of energy generation.

For the use of the associated gas under the project activity as feedstock and, where applicable, partly as energy source in a chemical production process at a specific facility, plausible alternative scenarios for the production of the useful product (e.g. methanol, ethylene, or ammonia) may include, *inter alia*:

P1 The proposed project activity without the CDM: the product is (partly) produced using the associated gas from the oil well;
P2 The product is produced in the same **existing** production facility and natural gas, as used historically during the last three years, is used as feedstock and energy source instead of the associated gas;
P3 The product is produced in the same **existing** production facility and another fuel (e.g. naphtha) as the one used historically during the last three years is used as feedstock and energy source instead of the associated gas;

P4 The product is produced in a **new** production facility that is established at the same site and that has the same or a larger production capacity as the project plant but that uses fossil fuel(s) (e.g. natural gas) instead of the associated gas as feedstock and, where applicable, as energy source (this may apply if a new production facility would also be established at the same site in the absence of the project activity);

P5 The product is produced in existing and / or new production facilities at other sites (this may apply if the associated gas is used in a new production facility which is established as a result of the project activity and would not be established at the same site in the absence of the project activity).

Project participants should identify all realistic and credible **combinations** of baseline scenarios for the fate of the associated gas (T1 to T6) and the production of the useful product (P1 to P5). These combinations should be considered in applying the following steps of the tool.

All baseline alternatives shall be in compliance with all applicable legal and regulatory requirements, even if these laws have objectives other than GHG reductions.

If an alternative does not comply with all applicable legislation and regulations, eliminate this alternative unless it is demonstrated, based on an examination of current practice in the country or region in which the law or regulation applies, that applicable legal or regulatory requirements are systematically not enforced and that non-compliance is widespread.

Step 2: Assess the alternatives to the proposed project activity and eliminate alternatives that face prohibitive barriers

Establish a complete list of barriers that would prevent alternative scenarios. Since the "proposed project activity not being registered as a CDM project activity" shall be one of the considered alternatives, any barrier that may prevent the project activity to occur shall be included in that list. Show which alternatives are prevented by at least one of the barriers previously identified and eliminate those alternatives from further consideration. All alternatives shall be evaluated for a common set of barriers.

If only one alternative remains, it shall be the baseline scenario.

Step 3: Determine the most likely alternative (baseline scenario)

Where more than one credible and plausible alternative remains after Steps 1 and 2, the alternative that results in the lowest baseline emissions shall be the baseline scenario.

The methodology is only applicable if the procedure to select the baseline scenario results in that flaring of the associated gas is (T1) is the most plausible baseline scenario. Furthermore, the methodology is only applicable if one of the scenarios described in Table 2 below results to be the most plausible baseline scenario. Explain in the CDM-PDD the specific situation of the project activity and demonstrate that the project activity and the most plausible baseline scenario corresponds to the "description of the situation" in Table 2 and to the relevant baseline scenarios for the production of the useful product (P1 to P5), as indicated under the respective scenario in Table 2 below. In addition, project participants should check whether the procedures to calculate emission reductions work appropriately for the project specific context. If the equations do not fully fit with the context of the project, a revision or deviation to this methodology should be requested following the guidance provided by the Board in latest version of "Clarifications to project participants on when to request revision, clarification to an approved methodology or a deviation".

Table 2: Combinations of project types and baseline scenarios applicable to this methodology

Scenario	Baseline scenarios	Description
1	P2	Under the project activity, the previously flared associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene, or ammonia) in an existing end-use facility. At the start of the project activity, the end-use facility has an operation history of at least three years. Prior to the implementation of the project activity the end-use facility has used natural gas as feedstock and energy source for the chemical process and would in the absence of the project activity continue to do so throughout the crediting period. The use of the associated gas instead of natural gas does not result in a different quality of the useful product and does not result in a lower efficiency in the process of producing the useful product (i.e. the quantity of feedstock and energy required per quantity of useful product produced is not increased), apart from energy required to treat the associated gas prior to its use in the process.
2	P3	Under the project activity, the previously flared associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene, or ammonia) in an existing end-use facility. At the start of the project activity, the end-use facility has an operation history of at least three years. Prior to the implementation of the project activity the end-use facility has used a fossil fuel (e.g., natural gas, naphtha) as feedstock and energy source for the chemical process and would in the absence of the project activity continue to do so throughout the crediting period. The use of the associated gas instead of the fossil fuel does not result in a different quality of the useful product but may result in a different efficiency in the process of producing the useful product (i.e. the quantity of feedstock and energy required per quantity of useful product produced is not the same as under the project activity). Moreover, additional energy may be required to treat the associated gas prior to its use in the process.
3	P4	Under the project activity, the previously flared associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene, or ammonia) in a newly established end-use facility. In the absence of the project activity, the useful product would be produced in a new production facility that would be established at the same site and that would have the same production capacity as the project plant but that would use fossil fuel(s) (e.g. natural gas) instead of the associated gas as feedstock and energy source.

4	P5	Under the project activity, the previously flared associated gas is used as feedstock and, where applicable, partly as energy source in a chemical process to produce a useful product (e.g. methanol, ethylene, or ammonia) in a newly established end-use facility. The new end-use facility is established as a result of the project activity and would not be established in the absence of the project activity. Therefore, the useful product would in the absence of the project activity be produced in existing and/or new production facilities at other sites.

Additionality

The additionality of the project activity should be assessed using the latest approved version of the "Tool for the Demonstration and Assessment of Additionality". Specific guidance in using the tool with this methodology is provided below. All the scenarios identified in Step 1 of the baseline scenario selection procedure, described in previous section, shall be used for evaluating the additionality of the project activity.

If Step 2 of the Tool (Investment Analysis) is used, then an IRR analysis of the entire project is required, i.e. it should not be limited to use of associated gas but include both any investment in the infrastructure and operation costs to use the associated gas instead of flaring as well as the costs and revenues for the scenarios for production processes (P1 to P5). IRR analysis shall be performed if Step 2 (Substep 2b – Option 2, Investment Comparison Analysis) is chosen.

Steps 3 and 4 of the Tool should be completed as specified in the latest approved version of the "Tool for the Demonstration and Assessment of Additionality".

Baseline emissions

In the absence of the project activity, the associated gas would be transported to a flare, and be flared, or vented.[3] Baseline emissions therefore include emissions associated with the transportation and flaring of the associated gas ($BE_{CO2,flaring,y}$, $BE_{T,CO2,y}$ and $BE_{T,CH4,y}$). In the absence of the project activity, the useful product would be generated using other fossil based feed stock. Hence, baseline emissions also include CO_2 emissions from the production of the useful product in the absence of the project activity ($BE_{CO2,product,y}$). Baseline emissions are calculated as follows:

$$BE_y = BE_{CO2,flaring,y} + BE_{T,CO2,y} + BE_{T,CH4,y} + BE_{CO2,product,y} \quad (1)$$

[3] Please note that in the situation where the associated gas was vented in the baseline, the baseline emissions are still estimated as under the assumption that the gas is flared.

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2/yr)
$BE_{CO2,flaring,y}$	=	Baseline CO_2 emissions from flaring of the associated gas in year *y* (tCO_2/yr)
$BE_{T,CO2,y}$	=	Baseline emissions of CO_2 from energy required for transportation of the associated gas to the flare in year *y* (tCO_2/yr)
$BE_{T,CH4,y}$	=	Fugitive CH_4 baseline emissions from transportation of the associated gas to the flare in year *y* (tCO_2e/yr)
$BE_{CO2,product,y}$	=	Baseline CO_2 emissions from production of the useful product in the absence of the project activity in year *y* (tCO_2/yr)

These emission sources are calculated in the following steps:

Step 1: Calculation of CO_2 emissions from flaring;
Step 2: Calculation of CO_2 emissions from fuel combustion for the transportation of the associated gas to the flare;
Step 3: Calculation of fugitive CH_4 emissions from transportation of the associated gas to the flare;
Step 4: Calculation of CO_2 emissions from the production of the useful product in the absence of the project activity.

Step 1: Calculation of CO_2 emissions from flaring ($BE_{CO2,flaring,y}$)

In calculating baseline emissions from flaring, it is assumed that all carbon in the associated gas (i.e. in methane and other gases including other hydrocarbons, CO, and CO_2) is completely oxidized to carbon dioxide. Baseline emissions from flaring are calculated as follows:

$$BE_{CO2,flaring,y} = V_y \times w_{carbon,y} \times \frac{44}{12} \quad \textbf{(2)}$$

Where:

$BE_{CO2,flaring,y}$	=	Baseline CO_2 emissions from flaring of the associated gas in year *y* (tCO_2/yr)
V_y	=	Quantity of associated gas utilized in year *y* *as feedstock*(m^3/yr). This is equal to the quantity of associated gas that enters the pipeline for transport to the end use facility ~~and is measured at the custody meters~~[4] less the quantity of associated gas used for energy purpose, if any, in the project activity, less any quantity of associated gas that is flared or vented at the end-use facility.[5]
$w_{carbon,y}$	=	Average carbon content of the associated gas in year *y* ($t\,C/m^3$)

Step 2: Calculation of CO_2 emissions from fuel combustion for the transportation of the associated gas to the flare ($BE_{T,CO2,y}$)

[4] ~~Custody meters refer to the metering that is used by both parties (oil and gas processing plant and end use plant) to officially measure the volume of gas being transferred to the end-use facility. These custody meters are used to determine how much the end-use facility must pay to the oil and gas processing facility and are regularly calibrated to the satisfaction of both parties.~~

[5] The reason this component of gas is omitted because the baseline emissions for associated gas used as energy in project activity is estimated as the fossil fuel used for energy purpose in baseline using step 4.

As a conservative simplification, project participants may assume this emission source as zero ($BE_{T,CO2,y} = 0$).

If project participants wish to estimate this emission source, it is calculated based on the actual monitored quantity of associated gas supplied under the project activity for production of useful chemical product and an emission factor for the transportation of this associated gas to the flare, as follows:

$$BE_{T,CO2,y} = V_y \times EF_{T,CO2} \qquad \textbf{(3)}$$

Where:

$BE_{T,CO2,y}$	=	Baseline emissions of CO_2 from energy required for transportation of the associated gas to the flare in year *y* (tCO_2/yr)
V_y	=	Same as defined in equation 2 above (m^3/yr)
$EF_{T,CO2}$	=	CO_2 emission factor for energy required for transportation of the associated gas to the flare ($t\ CO_2/m^3$)

The emission factor for energy required for transportation of the associated gas to the flare is calculated based on CO_2 emissions from fuel consumption and electricity in the historical year *x* prior to the start of the project activity, as follows:

$$EF_{T,CO2} = \frac{\left[\sum_i FC_{BL,T,flare,i,x} \times NCV_{i,x} \times EF_{CO2,i,x}\right] + EC_{T,flare,x} \times EF_{EL,T,x}}{V_x} \qquad \textbf{(4)}$$

Where:

$EF_{T,CO2}$	=	CO_2 emission factor for energy required for transportation of the associated gas to the flare (tCO_2/m^3)
$FC_{BL,T,flare,i,x}$	=	Quantity of fossil fuel type *i* combusted in year *x* for transportation of the associated gas to the flare (mass or volume unit)
$NCV_{i,x}$	=	Average net calorific value of fossil fuel type *i* in year *x* (GJ / mass or volume unit)
$EF_{CO2,i,x}$	=	Average CO_2 emission factor of fossil fuel type *i* in year *x* (tCO_2/GJ)
$EC_{T,flare,x}$	=	Quantity of electricity consumed in year *x* for transportation of the associated gas to the flare (MWh)
$EF_{EL,T,x}$	=	Average CO_2 emission factor for electricity consumed for transportation of the associated gas to the flare in year *x* (tCO_2/MWh), estimated as per procedure defined in the monitoring table
V_x	=	Quantity of associated gas flared in year *x* (m^3)
x	=	Year prior to the start of the project activity
i	=	Fossil fuel types combusted for transportation of the associated gas to the flare in year *x*

Step 3: Calculation of fugitive CH_4 emissions from transportation of the associated gas to the point of flaring ($BE_{T,CH4,y}$)

Fugitive CH_4 emissions occurring during the transport of the associated gas to the flare can be expected to be small. As a conservative simplification, project participants may assume this emission source as zero ($BE_{T,CH4,y} = 0$).

Emission factors are taken from the 1995 Protocol for Equipment Leak Emission Estimates, published by U.S. EPA.[6] 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). Methane emissions are calculated by multiplying the methane fraction in the in the associated gas with the appropriate emission factors from Table 3 and then summing across all pieces of equipment, as follows:

$$BE_{T,CH4,y} = GWP_{CH4} \times 1/1000 \times w_{CH4,y} \times \sum_{equipment} \left[EF_{equipment} \times t_{equipment} \right] \quad (5)$$

Where:

$BE_{T,CH4,y}$	=	Fugitive CH_4 baseline emissions from transportation of the associated gas to the flare in year *y* (tCO_2e/yr)
GWP_{CH4}	=	Global Warming Potential for methane
$w_{CH4,y}$	=	Average mass fraction of methane in the associated gas in year *y* (t CH_4/t associated gas)
$EF_{equipment}$	=	The emission factor for the relevant equipment type, taken from Table 3 or the 2006 IPCC Guidelines (kg CH_4 / hour / equipment)
$t_{equipment}$	=	The operation time of the equipment (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 CH_4 / m^3.

It is recommended to group the equipment according to the different types listed in the Table 3.

Table 3: 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

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

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.

Step 4: Calculation of CO_2 emissions from the production of the useful product in the absence of the project activity ($BE_{CO2,product,y}$)

The calculation of CO_2 emissions from the production of the useful chemical product in the absence of the project activity depends on the scenario listed in Table 2 that is applicable to the specific project activity.

Scenario 1

In case of scenario 1, the emissions associated with the production of the useful product are the same in the project situation and the baseline situation because the production occurs in the same plant, the same quality of product is produced and the efficiency of the production process is not affected by the project activity – apart from energy required to treat the associated gas prior to its use in the process. Therefore, baseline ($BE_{CO2,product,y} = 0$) and project emissions from electricity and fossil fuel energy used for production of the useful chemical product are not considered. Additional energy required to treat the associated gas, to enable its use as feedstock, is considered as part of project emissions. If no additional energy is used to treat the associated gas then $PE_{CO2,facility,y} = 0$

Scenarios 2 and 3

In case of scenarios 2 and 3, in the absence of the project activity, the useful product would be produced in an existing (scenario 2) or a new (scenario 3) production facility at the same site but possibly with a different efficiency. The baseline emissions from that production are calculated based on the monitored quantity of the useful product produced in the end-use project facility (P_y) and an emission factor for the baseline CO_2 emissions associated with the production of the useful product in the baseline situation ($EF_{CO2,BL,p}$), as follows:

$$BE_{CO2,product,y} = P_y \times EF_{CO2,BL,product} \quad \textbf{(6)}$$

Where:

$BE_{CO2,product,y}$	=	Baseline CO_2 emissions from production of the useful product in the absence of the project activity in year *y* (tCO_2/yr)
P_y	=	Quantity of useful product produced in the end-use facility in year *y* (t useful product)
$EF_{CO2,BL,product}$	=	CO_2 emission factor for the production of the useful product in the baseline situation (tCO_2 / t useful product)

Scenario 2

Where scenario 2 is applicable to the proposed project activity, $EF_{CO2,BL,product}$ is calculated based on the historical performance of the existing facility to produce the useful product during the most recent three years prior to the start of the project activity. As a conservative approach, the lowest emission factor from the most recent three historical years prior to the start of the project activity should be chosen, as follows:

$$EF_{CO2,BL,product} = MIN\left(EF_{CO2,BL,product,x}; EF_{CO2,BL,product,x-1}; EF_{CO2,BL,product,x-2}\right) \quad \textbf{(7)}$$

Where the $EF_{CO2,BL,product,x}$ is estimated as follows:

$$EF_{CO2,BL,product,x} = \frac{EC_{product,x} \times EF_{EL,P,x} + \frac{44}{12} \times \left[\sum_i FF_{product,i,x} \times w_{C,i,x} - P_x \times w_{C,product}\right]}{P_x} \quad \textbf{(8)}$$

Where:

$EF_{CO2,BL,product}$	=	CO_2 emission factor for the production of the useful chemical product in the baseline situation (tCO_2 / t useful product)
$EC_{product,x}$	=	Electricity consumption for the production of the useful chemical product in year *x* in existing facility (MWh)
$EF_{EL,P,x}$	=	Emission factor for electricity consumption from producing the useful product in year *x* (tCO_2/MWh) estimated as per procedure provided in the monitoring tables
$FF_{product,i,x}$	=	Quantity of fossil fuel type *i* used as feedstock or for combustion for the production of the useful chemical product in year *x* (tons) in the existing facility
$w_{C,i,x}$	=	Mass fraction of carbon in fossil fuel / feedstock type *i* in year *x* (tons C / tons of fuel)
P_x	=	Quantity of useful product produced in year *x* (t useful product)
$w_{C,product}$	=	Mass fraction of carbon of the useful chemical product (tons C / tons of useful product)
i	=	All fossil fuel types used in year *x* to produce the useful product
x	=	Year prior to the start of the project activity

Scenario 3

Where scenario 3 is applicable to proposed project activity, $EF_{CO2,BL,product}$ is the emission factor of the new facility that would be constructed in the absence of the project activity. $EF_{CO2,BL,product}$ should be calculated according to the alternative design that would be chosen by the project participant in the absence of the project activity as described in the baseline selection section.

The project participant shall demonstrate that the level of $EF_{CO2,BL,product}$ is consistent or lower compared with the emissions intensity of commonly installed modern state-of-the-art plants. The emission factor should be chosen in a conservative manner, in case of several plausible design options or fuel types the least carbon intensive design option or fuel should be chosen to estimate as baseline scenario.

Scenario 4

In case of scenario 4, in the absence of the project activity, the useful product would be produced in existing and / or new production facilities at other sites. The baseline emissions from that production are calculated based on the monitored quantity of the useful product produced in the end-use facility (P_y) and an emission factor for the baseline CO_2 emissions associated with the production of the useful product in other facilities ($EF_{CO2,BL,product}$), as follows:

$$BE_{CO2,product,y} = P_y \times EF_{CO2,BL,product} \quad \textbf{(9)}$$

Where:

$BE_{CO2,product,y}$	=	Baseline CO_2 emissions from production of the useful product in the absence of the project activity in year *y* (tCO_2/yr)
P_y	=	Quantity of useful product produced in the end-use facility in year *y* (t useful product)
$EF_{CO2,BL,product}$	=	CO_2 emission factor for the production of the useful product in the baseline situation (tCO_2 / t useful product)

Project participants can estimate $EF_{CO2,BL,product}$ based on either conservative default values from Table 4 below or the emissions intensity of the top 20% performing plants established in the most recent five years prior to the start of the project activity in the defined geographical region, as per the following procedure:

Step 1: Determination of the geographical area

The geographical area should be chosen in a manner that it includes at least 5 plants that produce the same useful chemical product and that have been established in the most recent five years prior to the start of the project activity. If there are less than 5 plants in the host country, the geographical area should be extended to all neighboring countries. If the number remains to be less than 5, all countries should be considered as the appropriate geographical area. If the useful chemical product is regionally traded, the host country may be used as a default area. If the product is globally traded[7] then geographical area is considered to be all countries.

Step 2: Determination of the production capacity in non-Annex I countries[8]

Determine the fraction of the production capacity for producing the useful product within the geographical area, as identified in Step 1, located in non-Annex I countries (x_{NAI}). If the geographical area, as identified in Step 1, only includes non-Annex I countries, $x_{NAI} = 1$. If the geographical area includes Annex I countries, identify all plants within the geographical area that produce the same useful chemical product and started commercial production in the most recent five years prior to the start of the project activity. Use the following procedure to estimate the fraction of the production capacity that is located in non-Annex I countries (x_{NAI}):

[7] A globally traded product is defined as follows: (i) a significant portion of the production in host country is exported or its consumption is imported; and (ii) important /export is not limited to the neighboring countries in the region.

[8] This step is necessary because in case of globally traded products the displacement of production in Annex I countries cannot be accounted towards emission reductions.

$$x_{NAI} = \frac{\sum_i P_{NAI,i}}{\sum_i P_{NAI,i} + \sum_j P_{AI,j}} \qquad \textbf{(10)}$$

Where:

x_{NAI}	=	Fraction of production capacity for the production of the useful product that is located in non-Annex I countries within the defined geographical area (estimated in step 2 above)
$P_{NAI,i}$	=	Production capacity of plant *i* located in non-Annex I country (t useful product)
$P_{AI,j}$	=	Production capacity of plant *j* located in Annex I country (t useful product)
i	=	Plants located in non-Annex I countries that started commercial production in the most recent five years prior to the start of the project activity
j	=	Plants located in Annex I countries that started commercial production in the most recent five years prior to the start of the project activity
$P_{NAI,i}$	=	production capacity of ith plant located in non-Annex I country (t useful product)
$P_{AI,j}$	=	production capacity of jth plant located in Annex I country (t useful product)

Step 3: Determination of $EF_{CO2,BL,product}$

The emission factor can be estimated using either one of the following two options:

Option 1: $EF_{CO2,BL,product}$ is calculated by multiplying the fraction of production capacity in non-Annex I countries (x_{NAI}) and the applicable default value from Table 4, as follows:

$$EF_{CO2,BL,product} = x_{NAI} \times EF_{CO2,BL,default} \qquad \textbf{(11)}$$

Where:

$EF_{CO2,BL,product}$	=	CO_2 emission factor for the production of the useful product in the baseline situation (tCO_2 / t useful product)
x_{NAI}	=	Fraction of production capacity for the production of the useful product that is located in non-Annex I countries within the defined geographical area (estimated in Step 2 above)
$EF_{CO2,BL,default}$	=	CO_2 default emission factor for the production of the useful product (tCO_2 / t useful product), as provided in table 4 below.

Table 4: Conservative default values for the production of useful products in the baseline in cases where scenario 4 applies[9]

Useful product	Geographical applicability	Value to be applied	Source
Ammonia	Global	1.666 t CO_2 / t NH_3	2006 IPCC Guidelines, Vol. 3, Ch. 3, Table 3.1, page 3.15

Option 2:

For each plant *j* (*j* belongs to set J, where J is all the Non-Annex I plants identified in step 2) collect the necessary data to determine the emission factor of the plant. This includes data on the quantities and types of fuels used, the quantity of electricity consumed and the quantity of useful chemical product produced during the most year for which data is available. As a simplification, project participants may neglect electricity consumption. Calculate for each plan an emission factor $EF_{CO2,BL,n}$, applying equation 8 above.

Sort all plants *j* from the plants with the lowest to the highest emission factor. Identify the first plants j starting from lowest efficiency such that the total capacity of these plants is at least 20% of the total capacity of all plants (J).

The baseline emission factor $EF_{CO2,BL,product}$ is then calculated as follows:

$$EF_{CO2,BL,product} = x_{NAI} \times \frac{\sum_j P_{j,x} \times EF_{CO2,BL,j,x}}{\sum_j P_{j,x}} \quad \textbf{(12)}$$

Where:

$EF_{CO2,BL,product}$ = CO_2 emission factor for the production of the useful product in the baseline situation (tCO_2 / t useful product)
x_{NAI} = Fraction of production capacity for the production of the useful product that is located in non-Annex I countries within the defined geographical area
$P_{j,x}$ = Quantity of useful product produced in plant *j* in year *x* (t useful product)
$EF_{CO2,BL,j,x}$ = CO_2 emission factor for the production of the useful product in plant *j* in year *x* (tCO_2 / t useful product)
j = Top 20% performer plants
x = Year prior to the start of the project activity

All steps should be documented transparently, including a list of the plants identified in Steps 2 and 3, as well as relevant data on fuel consumption, electricity consumption and production for all identified plants. Reference to all the sources used in collecting all the data should be provided.

[9] Project participants may propose amendments to this table by requesting for a revision to this methodology. The proposed default values should be estimated in a conservative manner. The proposed revision/deviation should provide detailed information on source of data used in estimating the default value and also the geographical applicability of the default value.

Project Emissions

Project emissions include CO_2 emissions from energy required for transporting the associated gas to the end-use facility ($PE_{CO2,T,y}$), fugitive CH_4 emissions from transportation of the associated gas to the end-use facility ($PE_{CH4,T,y}$), including any accidental release, and CO_2 emissions at the end-use facility as a result of the project activity ($PE_{CO2,facility,y}$). These are estimated as follows:

$$PE_y = PE_{CO2,T,y} + PE_{CH4,T,y} + PE_{CO2,facility,y} \quad \textbf{(13)}$$

Where:

PE_y	=	Project emissions in year *y* (tCO_2/yr)
$PE_{CO2,T,y}$	=	Project CO_2 emissions from energy required for transportation of the associated gas to the end-use facility (tCO_2)
$PE_{CH4,T,y}$	=	Fugitive CH_4 emissions from transportation of the associated gas to the end-use facility (tCO_2e)
$PE_{CO2,facility,y}$	=	Project CO_2 emissions that occur at the end-use facility as a result of the project activity (tCO_2)

CO_2 emissions from energy required for transportation of the associated gas to the end-use facility

To estimate CO_2 emissions from energy required for transportation of the associated gas to the end-use facility, project participants should monitor the quantity of fossil fuels and / or electricity that are required in year *y* for that purpose ($FC_{PJ,T,facility,i,y}$ and $EC_{PJ,T,facility,y}$) and apply the latest approved versions of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" and the "Tool to calculate project emissions from electricity consumption". The element process *j* in the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" corresponds to the combustion of fossil fuels for the purpose of transportation of the associated gas to the end-use facility ($FC_{PJ,T,facility,i,y}$ corresponds to $FC_{i,j,y}$ in the tool). In applying the "Tool to calculate project emissions from electricity consumption", $EC_{PJ,T,facility,y}$ corresponds to $EC_{PJ,y}$ in the tool.

Fugitive CH_4 emissions from transportation of the associated gas to the end-use facility ($PE_{CH4,T,y}$)

Note: Project participants may ignore this emission source if the pipeline transporting the associated gas to the end-use facility is identical (in terms of length, design, and other characteristics likely to affect fugitive emissions and energy demands for compressors) to the pipeline used to transport the associated gas to the flare in the baseline scenario or if fugitive CH_4 emissions can clearly be expected to be lower in the project case. In this case, both baseline ($BE_{T,CH4,y}$) and project ($PE_{CH4,T,y}$) emissions should be ignored.

If transport of the associated gas to the end use facility only requires an extension of the pipeline to the flare in the baseline scenario, then baseline emissions along the existing pipeline[10] can be ignored and project emissions only need to be estimated for the pipeline extension.

The fugitive CH_4 emissions will be estimated using the same procedure as provided in the baseline emissions section for $BE_{T,CH4,y}$.

[10] In other words, emissions from $\left(FCT_{flare,x} \times V_y \times EFFCT_{flare,x}\right) + FE$

In addition, in case of accidents, the relevant fugitive CH_4 emissions should be calculated. When an accident causes gas leakage from the pipeline, the gas volume is calculated as the sum of (1) the total amount of gas flow from the time the accident occurred until gas flow was shut off, and (2) the total amount of gas remaining in the pipeline at time of shut off. Accidental release of methane from the pipeline should be calculated as:

$$PE_{CH4,T,y} = GWP_{CH4} \times \frac{1}{1000}\left(V_{accident} + V_{remain,accident}\right) \times w_{CH4,pipeline,accident} \quad (14)$$

with

$$V_{accident} = t_{accident} \times F = (t_2 - t_1) \times F \quad \text{and} \quad (15)$$

$$V_{remain,accident} = d^2 \times \pi \times L \times \frac{P_p}{P_s} \times \frac{T_s}{T_p} \times \frac{V_{d,accident}}{\sum_i V_{Xi,d,accident} + V_{d,accident}} \quad (16)$$

Where:

EFA_y	=	Methane emissions from the transport pipeline due to an accidental event (t CO_2-e)
Vaccident	=	The volume of associated gas supplied to the pipeline from the oil and natural gas processing plant from the time the gas leakage started until the shutdown valves were closed (m^3)
Vremain,accident	=	The volume of associated gas remaining in the pipeline after the shutdown valves have been closed (m^3)
wCH4, pipeline, accident	=	The fraction of methane in the associated gas on a mass basis (kg CH_4/m^3)
$t_{accident}$	=	Duration of accident (Sec)
t_1	=	The time the gas leakage caused by the accident occurred (in the hour of incident occurred)
t_2	=	The time that the shutdown valves closed both the upstream and downstream pipeline (the hour when the pipe was shut)
F	=	The flow rate of associated gas supplied from the oil and natural gas processing plant (m^3/sec)
d	=	The radius of the pipeline (meters)
π	=	The ratio of the circumference of a circle to its diameter (unitless)
L	=	The length of the pipeline (meters)
P_P	=	The pressure in the pipeline when the shutdown valves close both the upstream and downstream of the pipeline (atm)
P_S	=	Standard pressure (atm)
T_P	=	The temperature in the pipeline when the shutdown valves close both the upstream and downstream of the pipeline (ºC)
T_S	=	Standard temperature (ºK)
$V_{d,accident}$	=	The volume of associated gas supplied to the pipeline from the oil and natural gas processing plant before the accident occurs during the period (m^3)
$V_{xi,d,accident}$	=	The volume of gas supplied to the pipeline from other sources, if any, before the accident occurs during the period (m^3)

CO_2 emissions occurring at the end-use facility as a result of the project activity ($PE_{CO2,facility,y}$)

The calculation of this emission source depends on the applicable scenario.

Scenario 1

The use of the associated gas in the end-use facility instead of natural gas may be associated with an increased combustion of fossil fuels or electricity, for example, for cleaning the associated gas. Therefore only emissions from such use of additional energy in the project activity is accounted for. The respective fossil fuel and electricity consumption ($FF_{PJ,facility,i,y}$ and $EG_{PJ,y}$) should be monitored and project emissions from such energy requirements ($PE_{CO2,facility,y}$) should be estimated using the latest approved versions of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" and the "Tool to calculate project emissions from electricity consumption".

Scenarios 2, 3 and 4

In these scenarios, the end-use facility is established as a result of the project activity and the useful product would be produced in other facilities in the absence of the project activity. Therefore, all fossil fuel use or electricity consumption by the end-use facility should be included in $PE_{CO2,facility,y}$. Note that the associated gas should be considered as one of the fossil fuel sources $FF_{PJ,facility,i,y}$. The quantity of carbon in the useful product is subtracted from the CO_2 emissions associated with the use of fossil fuels at the facility.

$$PE_{CO2,facility,y} = PE_{EC,facility,y} + \frac{44}{12} \times \left[\sum_i FF_{PJ,facility,i,y} \times w_{C,i,y} - P_y \times w_{C,product} \right] \quad \textbf{(17)}$$

Where:

$PE_{CO2,facility,y}$	=	Project CO_2 emissions that occur at the end-use facility as a result of the project activity (tCO_2) in year y
$PE_{EC,facility,y}$	=	Project emissions from the consumption of electricity by the end-use facility in year y (tCO_2) as a result of project activity. It is estimated using "Tool to calculate project from consumption of electricity.
$FF_{PJ,facility,i,y}$	=	Quantity of fossil fuel type i used in the end-use facility, as feedstock or for combustion, in year y (tons)
$w_{C,i,y}$	=	Mass fraction of carbon in fossil fuel type i in year y (tons C / tons of fuel)
P_y	=	Quantity of useful product produced in the end-use facility in year y (t useful product)
$w_{C,product}$	=	Mass fraction of carbon in the useful product (tons C / tons of useful product)
i	=	All fossil fuel types used in the end-use facility in year y, including the associated gas

The latest approved versions of the "Tool to calculate project emissions from electricity consumption" should be applied to determine $PE_{EC,facility,y}$. In applying the "Tool to calculate project emissions from electricity consumption", $EC_{PJ,y}$ in the tool corresponds to the overall electricity consumption by the end-use facility.

Leakage

No leakage emissions are considered.

Emission reductions

Emission reductions are calculated as the difference between baseline and project emissions, taking into account any adjustments for leakage:

$$ER_y = BE_y - PE_y \tag{18}$$

Where:

ER_y	=	Emission reductions during the year *y* (tCO_2/yr)
BE_y	=	Baseline emissions in year *y* (tCO_2/yr)
PE_y	=	Project emissions in year *y* (tCO_2/yr)

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

Consistent with guidance by the Executive Board, project participants shall assess the continued validity of the baseline and update the baseline.

Data and parameters not monitored

Data / parameter:	$NCV_{i,x}$
Data unit:	GJ/mass or volume unit
Description:	Average net calorific value of fossil fuel type *i* in year *x*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default net calorific values (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the values in a conservative manner and justify the choice.
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant national or international standards
Any comment:	Applicable if project participants choose to estimate $BE_{T,CO2,y}$

Data / parameter:	$EF_{CO2,i,x}$
Data unit:	tCO_2/GJ
Description:	Average CO_2 emission factor of fossil fuel type *i* in year *x*
Source of data:	Either conduct measurements or use accurate and reliable local or national data where available. Where such data is not available, use IPCC default emission factors (country-specific, if available) if they are deemed to reasonably represent local circumstances. Choose the value in a conservative manner and justify the choice.
Measurement procedures (if any):	Measurements shall be carried out at reputed laboratories and according to relevant national or international standards
Any comment:	Applicable if project participants choose to estimate $BE_{T,CO2,y}$

Data / parameter:	$FC_{BL,T,flare,i,x}$
Data unit:	mass or volume unit
Description:	Quantity of fossil fuel type *i* combusted in year *x* for transportation of the associated

	gas to the flare
Source of data:	Measurements or fuel purchase or usage records
Measurement procedures (if any):	
Any comment:	Applicable if project participants choose to estimate $BE_{T,CO2,y}$

Data / parameter:	$EC_{T,flare,x}$
Data unit:	MWh
Description:	Quantity of electricity consumed in year *x* for transportation of the associated gas to the flare
Source of data:	Measurements
Measurement procedures (if any):	Use electricity meters
Any comment:	Applicable if project participants choose to estimate $BE_{T,CO2,y}$

Data / parameter:	$EF_{EL,T,x}$
Data unit:	tCO_2/MWh
Description:	Average CO_2 emission factor for electricity consumed for transportation of the associated gas to the flare in year *x*
Source of data:	Where self-generation occurs the emission factor should be calculated based on actual fuel consumption and electricity generation data. Where grid electricity is used, the latest approved version of the "Tool to calculate the emission factor for an electricity system" should be applied.
Measurement procedures (if any):	As per the "Tool to calculate the emission factor for an electricity system"
Any comment:	Applicable if project participants choose to estimate $BE_{T,CO2,y}$

Data / parameter:	Equipment (index)
Data unit:	Number of equipment items for each equipment type
Description:	Type and number of valves, pump seals, connectors flanges, open-ended lines, as defined in Table 2
Source of data:	Pipeline schematics, or audit of pertinent sections of pipeline
Measurement procedures (if any):	None
Any comment:	Prior to project validation, the pertinent sections of pipelines will be examined for any of the likely locations of leaks as outlined by U.S. EPA

Data / parameter:	d and L
Data unit:	meters
Description:	d: The radius of the pipeline used in the project activity L: The length of the pipeline used in the project activity
Source of data:	Pipeline schematics, or audit of pertinent sections of pipeline
Measurement procedures (if any):	Can be measured in conjunction with equipment counts
Any comment:	This information is used for estimate accidental fugitive emissions from pipeline transporting associated gas

Data / parameter:	$EF_{equipment}$
Data unit:	kg CH_4 /hour / equipment
Description:	The emission factor for the relevant equipment type, taken from Table 3 or the 2006 IPCC Guidelines
Source of data:	Table 3 of this methodology or 2006 IPCC Guidelines
Measurement procedures (if any):	-
Any comment:	Applicable if project participants choose to estimate $BE_{T,CH4,y}$

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

Data / parameter:	$EC_{product,x}$
Data unit:	MWh
Description:	Electricity consumption for the production of the useful product in year *x*
Source of data:	Plant records prior to implementation of CDM project activity
Measurement procedures (if any):	
Any comment:	Applicable in case of scenarios 2 or 3

Data / parameter:	$EF_{EL,P,x}$
Data unit:	tCO_2/MWh
Description:	Emission factor for electricity consumption from producing the useful product in year *x*
Source of data:	Where self-generation occurs the emission factor should be calculated based on actual fuel consumption and electricity generation data. Where grid electricity is used, the latest approved version of the “Tool to calculate the emission factor for an electricity system” should be applied.
Measurement procedures (if any):	As per the “Tool to calculate the emission factor for an electricity system”
Any comment:	Applicable in case of scenarios 2 or 3

Data / parameter:	$FF_{product,i,x}$
Data unit:	tons
Description:	Quantity of fossil fuel type *i* used as feedstock or for combustion for the production of the useful product in year *x*
Source of data:	Plant records
Measurement procedures (if any):	
Any comment:	Applicable in case of scenarios 2 or 3

Data / parameter:	$w_{C,i,x}$
Data unit:	tons C / tons of fuel
Description:	Mass fraction of carbon in fossil fuel / feedstock type *i* in year *x*
Source of data:	Actual measurement
Measurement procedures (if any):	Chemical analysis (e.g., gas chromatography)
Any comment:	Applicable in case of scenarios 2 or 3

Data / parameter:	$w_{C,product}$
Data unit:	tons C / tons of useful product
Description:	Mass fraction of carbon in the useful product
Source of data:	Based on the molecular composition of the product
Measurement procedures (if any):	-
Any comment:	

Data / parameter:	x_{NAI}
Data unit:	-
Description:	Fraction of production capacity for the production of the useful product that is located in non-Annex I countries within the defined geographical area
Source of data:	Based on most recent available production statistics or reliable literature
Measurement procedures (if any):	-
Any comment:	Applicable in case of scenario 4

Data / parameter:	$EF_{CO2,BL,default}$
Data unit:	tCO_2 / t useful product
Description:	CO_2 default emission factor for the production of the useful product
Source of data:	Table 4 of this methodology
Measurement procedures (if any):	
Any comment:	Applicable in case of scenario 4 and if project participants choose to use default values to determine $EF_{CO2,BL,product}$

Data / parameter:	$P_{j,x}$
Data unit:	t useful product
Description:	Quantity of useful product produced in plant *j* in year *x*
Source of data:	Production records by the plant operators or authentic statistics by industry or governmental organizations
Measurement procedures (if any):	
Any comment:	Applicable in case of scenario 4 and if project participants choose to determine $EF_{CO2,BL,product}$ based on the top 20% performer plants

Data / parameter:	$EF_{CO2,BL,j,x}$
Data unit:	tCO_2 / t useful product
Description:	CO_2 emission factor for the production of the useful product in plant *j* in year *x*

Source of data:	Production and energy consumption records of the plant operators or authentic statistics by industry or governmental organizations
Measurement procedures (if any):	
Any comment:	Applicable in case of scenario 4 and if project participants choose to determine $EF_{CO2,BL,product}$ based on the top 20% performer plants

Data / parameter:	*Ts*
Data unit:	º Kelvin
Description:	Standard temperature 273 degree Kelvin
Source of data:	
Measurement procedures (if any):	
Any comment:	

Data / parameter:	*Ps*
Data unit:	atm
Description:	Standard pressure, 1 atmosphere
Source of data:	
Measurement procedures (if any):	
Any comment:	

III. MONITORING METHODOLOGY

Monitoring procedures

The monitoring methodology involves monitoring of the following:

- The composition and quantity of associated gas produced by oil and natural gas processing facility;
- The quantity and carbon intensity of any additional energy consumed for transportation purposes or for the processing of the associated gas as a feedstock material by the end use facility;
- Any fugitive emissions of methane along the associated gas transport pipeline (including from accident events).

Baseline emissions from flaring are calculated *ex post* using measured data on associated gas end use facility (versus to flare). Baseline emissions from energy use and fugitive releases of methane are calculated using *ex ante* data on energy use for transport (e.g., for compressors) and fugitive methane emissions along the pipeline.

Project emissions are all calculated *ex post* based on actual energy use and fugitive emissions data.

Meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards, or, if these are not available, international standards (e.g. IEC, ISO). 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 differently in the comments in the tables below.

Data and parameters monitored

Data / parameter:	V_y
Data unit:	m^3/yr
Description:	Quantity of associated gas utilized in year *y*, i.e. the quantity of associated gas that enters the pipeline for transport to the end use facility and is measured at the custody meters
Source of data:	Measurements with a flow meter (can be obtained from oil or natural gas processing plant that supplies the associated gas)
Measurement procedures (if any):	Data should be measured using accurate and calibrated flow meters. Measurements should be taken at the point the associated gas enters the pipeline for transport to the end use facility that produces the useful product. Furthermore, it should be monitored that the associated gas is actually used by the end use facility for the production of the useful product. Note also that this amount shall not include the amount of associated gas possibly used ~~to clean up the associated gas used as a feedstock and, where applicable, partly~~ as energy source in the process of producing the useful product. Data can be collected in conjunction with *F*.

Monitoring frequency:	Continuous
QA/QC procedures:	
Any comment:	Custody meters refer to the metering that is used by both parties (oil and gas processing plant and end use plant) to officially measure the volume of gas being transferred to the end-use facility. These custody meters are used to determine how much the end-use facility must pay to the oil and gas processing facility and are regularly calibrated to the satisfaction of both parties.

Data / parameter:	$w_{carbon,y}$
Data unit:	t C/m^3
Description:	Average carbon content of associated gas in year *y*
Source of data:	Measurement of the chemical analysis (e.g., gas chromatography)
Measurement procedures (if any):	Analysis can be performed in conjunction with measurement of the methane content of the associated gas ($w_{CH4,pipeline}$)
Monitoring frequency:	Weekly (minimum)
QA/QC procedures:	Carbon 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:	$w_{CH4,y}$
Data unit:	kg CH_4/kg
Description:	Average mass fraction of methane in the associated gas in year *y* (kg CH_4/kg associated gas)
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 hours (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 associated gas to the flare 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

Data / parameter:	P_y
Data unit:	t of useful product
Description:	Quantity of useful product produced in the end-use facility in year *y*
Source of data:	Production records for the useful products (e.g. methanol)
Measurement procedures (if any):	-
Monitoring frequency:	Annually
QA/QC procedures:	-
Any comment:	-

Data / parameter:	$w_{CH4,pipeline,accident}$
Data unit:	kg CH_4/m^3
Description:	The fraction of methane in the associated gas on a mass basis
Source of data:	Chemical analysis (e.g., gas chromatography)
Measurement procedures (if any):	Analysis can be performed in conjunction with measurement of the methane content of the associated gas ($w_{CH4,pipeline}$)
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:	None

Data / parameter:	t_1 and t_2
Data unit:	sec
Description:	t_1: The time the gas leakage caused by the accident occurred. t_2:The time that the shutdown valves closed both the upstream and downstream pipeline.
Source of data:	Plant records
Measurement	None

procedures (if any):	
Monitoring frequency:	Once per event
QA/QC procedures:	None
Any comment:	None

Data / parameter:	F
Data unit:	m^3/sec
Description:	The flow rate of associated gas supplied from the oil and natural gas processing plant
Source of data:	Flow meter data (can be obtained from oil or natural gas processing plant that supplies the associated gas)
Measurement procedures (if any):	Data should be measured using accurate and calibrated flow meters. Measurements should be taken at the point that associated gas enters the pipeline for transport to the flare (in the baseline scenario) or enters the pipeline for transport to the end use facility (in the case of the project scenario). Data can be collected in conjunction with V_y.
Monitoring frequency:	Continuous
QA/QC procedures:	Volume of gas should be completely metered with regular calibration of metering equipment, similar to what is called for in other approved methodologies
Any comment:	

Data / parameter:	*Tp*
Data unit:	ºC
Description:	The temperature in the pipeline when the shutdown valves close both the upstream and downstream of the pipeline
Source of data:	Temperature meter
Measurement procedures (if any):	Reading of meter by operational staff and recording into log and database
Monitoring frequency:	When an accident causes gas leakage from a pipeline, the gas leakage volume is less than the sum of (1) the total amount of gas that flowed during the time the accident occurred until the gas flow is shut and (2) the total amount of gas remaining in the pipeline. Therefore, the temperature of the gas in the pipeline needs to be measured only when the shutdown valves close.
QA/QC procedures:	Consistency checks of measurement with operation data – same as AM0009
Any comment:	

Data / parameter:	*Pp*
Data unit:	Atm
Description:	*Pp* is the pressure in the pipeline when the shutdown valves close both the upstream and downstream of the pipeline in atmospheres (atm)
Source of data:	Pressure meter
Measurement procedures (if any):	Reading of meter by operational staff and recording into log and database
Monitoring frequency:	Once when the shutdown valves close
QA/QC procedures:	Consistency checks of measurement with operation data – same as AM0009
Any comment:	

Data / parameter:	*Ts*
Data unit:	º Kelvin
Description:	Standard temperature 273 degree Kelvin
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Data / parameter:	*Ps*
Data unit:	atm
Description:	Standard pressure, 1 atmosphere
Source of data:	
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	

Data / parameter:	*Vd, accident*
Data unit:	m^3
Description:	The volume of associated gas supplied to the pipeline from the oil and natural gas processing plant before the accident occurs during the period day
Source of data:	Orifice meter
Measurement procedures (if any):	Reading of meter by operational staff and recording into log and database
Monitoring frequency:	Continuously
QA/QC procedures:	Consistency checks of measurements with commercial data – same as AM0009
Any comment:	

Data / parameter:	*Vxi,d accident*
Data unit:	m^3
Description:	The volume of gas supplied to the pipeline from other sources if any before the accident occurs during the period day
Source of data:	Orifice meter
Measurement procedures (if any):	Reading of meter by operational staff and recording into log and database
Monitoring frequency:	Continuously
QA/QC procedures:	Consistency checks of measurements with commercial data – same as AM0009
Any comment:	

Data / parameter:	$PE_{EC,facility,y}$
Data unit:	t CO_2
Description:	Project emissions from the consumption of electricity by the end-use facility in year *y*
Source of data:	As per the latest approved version of the "Tool to calculate project emissions from electricity consumption"
Measurement procedures (if any):	As per the latest approved version of the "Tool to calculate project emissions from electricity consumption"
Monitoring frequency:	As per the latest approved version of the "Tool to calculate project emissions from electricity consumption"
QA/QC procedures:	As per the latest approved version of the "Tool to calculate project emissions from electricity consumption"
Any comment:	Use $EC_{PJ,y}$ as specified below in applying the tool

Data / parameter:	$EC_{PJ,y}$
Data unit:	MWh
Description:	Electricity consumption by the end-use facility in year *y*
Source of data:	Measurements
Measurement procedures (if any):	Use electricity meters
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Cross check measurement results with invoices for purchased electricity if relevant
Any comment:	Scenario 1: $EG_{PJ,y}$ corresponds to the incremental increase of electricity consumption associated with the use of the associated gas at the end-use facility Scenarios 2, 3 and 4: $EG_{PJ,y}$ corresponds to the overall electricity consumption by the end-use facility.

Data / parameter:	$FF_{PJ,facility,i,y}$
Data unit:	tons
Description:	Quantity of fossil fuel type *i* used in the end-use facility, as feedstock or for combustion, in year *y*
Source of data:	Onsite measurements
Measurement procedures (if any):	Use mass or volume meters
Monitoring frequency:	Continuously
QA/QC procedures:	The consistency of metered fuel consumption quantities should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. Where the purchased fuel invoices can be identified specifically for the CDM project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.
Any comment:	Scenario 1: $FF_{PJ,facility,i,y}$ corresponds to the incremental increase of fossil fuel use associated with the use of the associated gas at the end-use facility Scenarios 2, 3 and 4: $FF_{PJ,facility,i,y}$ corresponds to the overall fossil fuel use by the end-use facility

Data / parameter:	$w_{C,i,y}$
Data unit:	tons C / tons of fuel
Description:	Mass fraction of carbon in fossil fuel type *i* 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** (a) Values provided by the fuel supplier in invoices — This is the preferred source. (b) Measurements by the project participants — If (a) is not available
Measurement procedures (if any):	Measurements should be undertaken in line with national or international fuel standards.
Monitoring frequency:	The mass fraction of carbon should be obtained for each fuel delivery, from which weighted average annual values should be calculated.
QA/QC procedures:	Verify if the values under (a) and (b) 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 (b) should have ISO17025 accreditation or justify that they can comply with similar quality standards.
Any comment:	

- - - - -

History of the document

Version	**Date**	**Nature of revision(s)**
02	EB 38, Annex 4 14 March 2008	1. Removal of the third applicability condition and introduction to procedures in the methodology to discount emissions reductions by the amount that would have occurred in an Annex I country. 2. Expansion of methodology to project activities that vent in the baseline. 3. Limiting of the applicability of the methodology to cases where the associated gas substitutes feed stocks. 4. The references to new EB approved tools. 5. All the changes in text linked with above key points.
01	EB 26, Annex 4 29 September 2006	Initial adoption