# Draft baseline and monitoring methodology AM00XX

## "Recovery of gas from oil wells that would otherwise be vented or flared and its delivery to specific end-users"

## I. SOURCE, DEFINITIONS AND APPLICABILITY

### Sources

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

- AM0009 "Recovery and utilisation of gas from oil wells that would otherwise be flared or vented";
- AM0037 "Flare (or vent) reduction and utilization of gas from oil wells as a feedstock"; and
- NM0268 "Recovery and utilisation of associated gas that would otherwise be flared or vented".

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 or leakage emissions from electricity consumption;
- Tool for the assessment and demonstration of additionality;
- Combined tool to identify the baseline scenario and demonstrate additionality.

For more information regarding the proposed new methodology, approved methodologies 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

"Existing 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 the oil, either dissolved in the oil or as a cap of free gas above the oil.

**Non-associated gas.** Natural gas found freely occurring in subterranean reservoirs where crude oil is absent.

**Combined gas.** A gas stream consisting of associated and non-associated gas.

**Gas processing plant.** A facility that separates or processes the associated gas, non-associated gas and, if applicable, combined gas from the project through chemical, physical or physical-chemical procedures in order to produce marketable hydrocarbon and other (e.g. sulphur) products.

**Processed gas.** The marketable natural gas that is produced in a gas processing plant.

**Compressed Natural Gas (CNG).** The processed gas that has been compressed to high pressure (typically > 200 bar) for the purpose of storage and / or transportation.

**CNG mobile units.** High strength pressure vessels designed to transport CNG from CNG mother station to one or more CNG daughter stations.

**CNG mother station.** A facility where natural processed gas is compressed to high pressure and loaded onto CNG mobile units for the purposes of transportation.

**CNG daughter station.** A facility where CNG is received from CNG mobile units and its pressure is reduced for delivery to a natural gas pipeline or to an end-user.

**Specific end-user.** A clearly identifiable facility, which uses the CNG after reducing its pressure, thereby displacing the use of other fossil fuels.

**Gas utilizer(s).** Specific equipment (i.e. generator, boiler) where the processed gas displaces other fossil fuels.

**Gas transportation.** Transportation of the processed gas by means of a pipeline, CNG mobile units or any combination thereof.

**Heat** is the heat contained in the following heat carriers: steam, hot water or thermic fluids. Other forms of heat carriers, such as air, are excluded from this methodology.

**Heat generation equipment** is equipment in which fuels are combusted for the purpose of generating heat. The heat is used in industrial, commercial or residential applications for processing or heating purposes other than for generation of electric power or mechanical energy.

**Applicability**

The methodology is applicable to project activities that recover associated gas from oil wells that would otherwise be flared or vented. A new gas processing plant is installed in which the associated gas and, optionally, non-associated gas and/or combined gas are processed. The processed gas is (i) delivered to clearly identifiable specific end-user(s) by means of CNG mobile units and/or (ii) delivered into an existing natural gas pipeline in the host country(ies).

The methodology is applicable under the following conditions:

- All recovered associated gas comes from existing oil wells that are in operation and are producing oil at the time of the recovery of the associated gas;
- The project oil wells have the records of flaring or venting of the associated gas for at least three years. These records should be presented to the DOE during the validation;
- The processed gas will be consumed in the host country(ies) only;
- In the case the processed gas is delivered by CNG mobile units to specific end-user(s) the following applies:
    - The end-users were existing and were generating heat in existing heat generation equipment prior to the start of the project activity;
    - The heat was generated on-site. Those facilities where heat was imported are not eligible for inclusion in the project activity;

  - All end-users included in the project activity shall be identified before the submission of the project activity for validation, and no new end-users can be included within the project activity during the crediting period;
  - An agreement between the supplier of the processed gas and each end-user shall include a requirement to allow access to monitor the use of the delivered gas and a confirmation that the end-user will not claim credits from the utilization of the processed gas.

- Data (quantity and fraction of carbon) are accessible on the associated and non-associated gas;
- If the project oil wells include gas-lift systems, the gas-lift gas has to be associated gas from the oil wells within the project boundary.

Under this methodology no credits can be claimed for displacement of fossil fuels by the associated or combined gas.[1]

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

Finally, the methodology is only applicable if the identified baseline scenario is the following situation: The current practice of either flaring or venting of the associated gas would continue. The non-associated gas would not be explored but remain in its reservoir and the gas processing plant would not be constructed. If the project activity delivers CNG to end-users, the end-users would continue to use fossil fuels in the baseline situation. These fossil fuels would be delivered from other sources (other gas processing plants, oil refineries) and have either the same or a higher carbon content than the processed gas. If the project activity delivers processed gas to a natural gas pipeline, it is assumed that the processed gas displaces either natural gas from other sources or a more carbon intensive fuel in the market.

Only those end-users are eligible to be included in the project activity, whose identified baseline scenario is the use of fossil fuel(s) of equal or higher carbon content than the processed gas.

**Projection and adjustment of project and baseline emissions on the basis of oil production**

Project as well as baseline emissions depend on the quantity of the associated gas recovered, which is linked to the oil production. Oil production may be projected with the help of a reservoir simulator, reflecting the rock and fluid properties in the oil reservoir. As projections of the oil production, the methane content of the gas and other parameters involve a considerable degree of uncertainty, the quantity and composition of the recovered gas are monitored ex post and baseline and project emissions are adjusted respectively during monitoring.

The validating DOE shall confirm that estimated emission reductions reported in the CDM-PDD are based on estimates provided in the survey used for defining the terms of the underlying oil production project as per the production contract.

At verification the verifying DOE shall check the production data for oil and associated gas and compare them with the initial production target as per the information provided in survey used for defining the terms of the underlying oil production project. If the oil production differs significantly from the initial production target, then it should be checked that this is not intentional, and that such a scenario is properly addressed by the production contract between the contracted party(ies).

[1] If an end-user wishes to claim credits for the fuel switch, the associated or combined gas shall be considered as natural gas and relevant methodologies for fuel switch shall be applied.

## II. BASELINE METHODOLOGY PROCEDURE

### Identification of the baseline scenario

Identification of the baseline scenario for the use of associated gas, non-associated gas and the processing plant

Project participants shall apply the following procedure.

***Step 1: Identify plausible alternative scenarios***

The project activity involves different components. Plausible alternative scenarios should include alternatives for the following different components:

For the associated gas, *inter alia*:

(1) Release of the associated gas into the atmosphere at the oil production site (venting);
(2) Flaring of the associated gas at the oil production site;
(3) On-site use of the associated gas for useful purposes, such as power generation, generation of mechanical energy or heat generation;
(4) Injection of the associated gas into an oil or gas reservoir (e.g. use as gas-lift);
(5) Recovery and use of the associated gas in a gas processing plant without being registered as a CDM project activity.

For the non-associated gas, *inter alia*:

(1) On-site use of the non-associated gas for useful purposes, such as power generation, generation of mechanical energy or heat generation;
(2) Injection of the non-associated gas into an oil or gas reservoir (e.g. use as gas-lift);
(3) No use of the non-associated gas (i.e. it would remain in its reservoir);
(4) Exploration of the non-associated gas and use in a gas processing plant without being registered as a CDM project activity.

For the processing plant, *inter alia*:

(1) Construction of a processing facility, in the same way as in the project activity, without being registered as a CDM project activity;
(2) Construction of a processing facility of a lower capacity corresponding to the amount of non-associated gas in the project activity;
(3) No construction of a gas processing facility.

Realistic combinations of these components should be identified and considered as possible alternative scenarios to the proposed project activity in the following steps. Step 2 provides the main procedure to identify the baseline scenario for the applicable combinations. Step 3 provides a procedure to confirm for dedicated end-user(s) supplied by CNG the continued use of the same fossil fuel is the most plausible baseline scenario.

***Step 2: Identification of the baseline scenario for the associated and non-associated gas and the infrastructure established under the project***

***Step 2.1: Consistency with applicable laws and regulations***

In evaluating legal aspects, the following issues should be addressed:

- Are the alternatives permitted by law or other (industrial) agreements and standards?
- Are there laws or other regulations (e.g. environmental regulations), which implicitly restrict certain alternatives?

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, such an alternative should be eliminated 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 2.2: Evaluate the economic attractiveness of alternatives***

The economic attractiveness is assessed for those alternative scenarios that are feasible in technical terms and that are identified as permitted by law or other (industrial) agreements and standards in Step 2.1. The economic attractiveness is assessed by determining an expected Internal Rate of Return (IRR) of each alternative scenario, following the guidance for the investment analysis in the latest approved version of the "Tool for the assessment and demonstration of additionality". The IRR should be determined using, *inter alia*, the following parameters as applicable to the relevant scenario:

- Overall projected production of associated, non-associated gas, combined gas and processed gas;
- The projected quantity of gas recovered, gas flared, vented or consumed on-site;
- The agreed price for the delivery of processed gas to end-users or to the natural gas pipeline;
- The properties (such as net calorific value) of all relevant gases;
- Total capital expenditure for all equipment used in the relevant scenario, such as expenditure for the construction of gas recovery facilities, pipelines, the gas processing plant, the CNG infrastructure (mother stations, daughter stations), etc.;
- Operational expenditure for all equipment used in the relevant scenario;
- Revenues from the operation of the alternative scenario, such as revenues from selling processed gas or other products of the gas processing plant or electricity;
- Any profit sharing agreements and cost recovery, such as cost savings through the substitution of products by the recovered gas, if applicable.

If flaring of the associated gas at a given location is not outright banned but instead is subject to taxes or fines, the impact of these taxes and fines should be considered in the IRR calculation.

The alternative scenario that is economically the most attractive course of action is considered as the baseline scenario.

The methodology is only applicable if the identified baseline scenario for associated gas is the continuation of the current practice of flaring or venting of the associated gas.

Identification of baseline scenarios for end-user(s)

A baseline scenario shall be identified for each potential end-user of the processed gas prior to its inclusion in the project activity. The objective of the baseline scenario identification for an end- user is to ensure that the processed gas will be used to displace fossil fuel(s) with equal or higher carbon intensity and not renewable biomass, other renewable energy sources, waste gas or other fuels with lower carbon intensity. This procedure is not applicable if the processed gas is fed into an existing natural gas pipeline, which supplies natural gas to final consumers.

Realistic and credible alternatives for the use of fuels at a potential end-user may include, *inter alia*:

(1) Continuation of the current practice of using fossil fuel(s) from other sources in the existing equipment;
(2) Change from the use of a fuel with a higher carbon content to a fuel with a lower carbon content;
(3) Change from the use of a fuel with a lower carbon content to fuel with a higher carbon content;
(4) Import of heat from third parties or the grid.

The identification of baseline scenario for a potential end-user shall be made through interviews and/or surveys with the end-user(s) and a site inspection to assess the end-user's current practice, existing equipment and future energy planning (e.g. plans for switching to a less carbon-intensive fuel, etc). Relevant national/regional/local policies and regulations as well as the prevailing practice of the fuel use in similar facilities within the applicable geographical area shall also be taken into account in this assessment.

The DOE, undertaking the validation of the project activity, shall validate the identified baseline scenarios for all identified specific end-users by assessing, *inter alia*, the following data:

- Historical records on which fuel types have been used at the end-user facility in the most recent three years prior to the implementation of the project activity;
- A record of the equipments using fossil fuels at the end-user;
- Business plans of the end-user, if available;
- Reference data in the public domain.

The DOE is required to visit all potential end-users during the validation of the project activity to ensure the adequate selection of their baseline scenarios.

Only those potential end-users, whose identified baseline scenario is the continuation of the current practice of using fossil fuel(s) with the same or a higher carbon content than the processed gas, can be included in the project activity.

**Additionality demonstration**

The additionality of the project activity shall be demonstrated using the latest approved version of the "Tool for the assessment and demonstration of additionality". The tool should be applied consistently with the guidance procedure to identify the most plausible baseline scenario. The investment analysis should be applied, following the guidance above respectively.

**Project boundary**

The **spatial extent** of the project boundary encompasses:

- Project oil wells where the associated gas is collected;
- Natural gas wells where the non-associated gas is produced;
- The site where the associated gas was flared or vented in the absence of the project activity;
- The gas recovery infrastructure;
- The gas treatment and transportation infrastructure;
- The gas processing plant;
- If applicable: CNG mother and daughter stations;
- If applicable: Specific end-user(s) and gas utilizer(s) of the associated or combined gas.

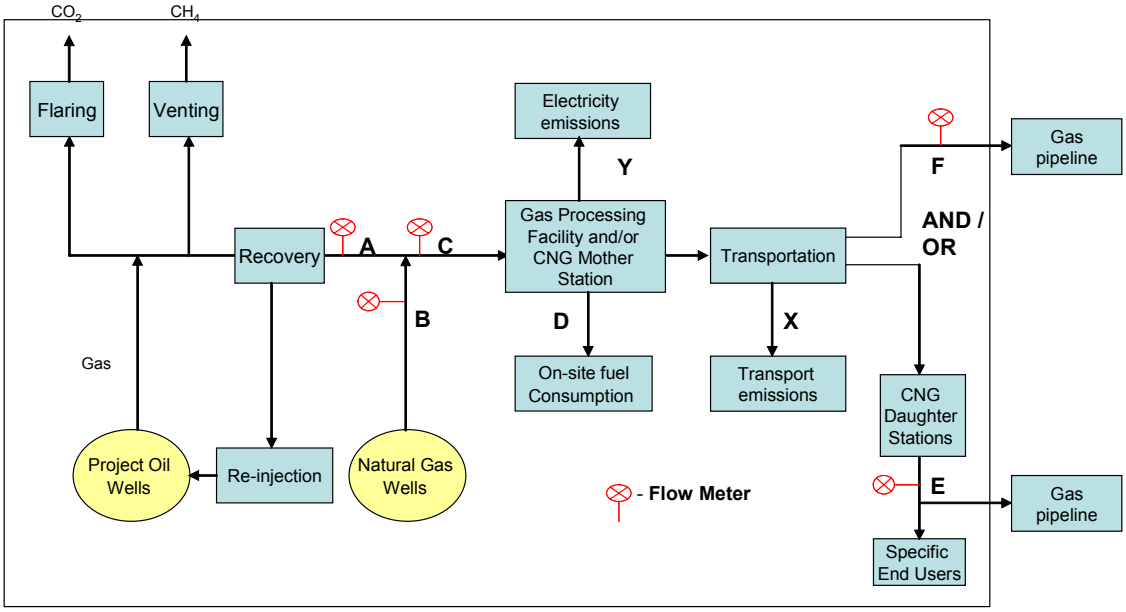


**Figure 1: Schematic illustration of the project activity**

Both the gas recovery infrastructure and the gas treatment and transportation infrastructure may include (but not be limited to) new collection and transmission pipelines, reservoirs and/or CNG transport system, control and measurement equipment, CO2 separation, dryers, compressors etc.

The points in Figure 1 correspond to the following:

Point A – Measurement point of the recovered associated gas at the entry to the processing facility/CNG mother station or at the location closest possible to the entry to the processing facility.

Point B – Measurement point of the non - associated gas at the entry to the processing facility/CNG mother station or at the location closest possible to the entry to the processing facility.

Point $D_p$ – Measurement point at the inlet of the on-site power generation facility *p* using, inter alia, the associated or combined gas.

Point $E_i$ – Measurement point corresponding to the discharge point of CNG product at a CNG daughter station *i*.

Point F – Measurement point corresponding to the point, where the associated gas or combined gas enters the existing natural gas pipeline.

Point X – Emissions that result from the transport of the associated gas or combined gas in mobile units by means of trucks etc.

Point Y – Electricity emissions from the collection, recovery, treatment and transportation of the associated gas and combined gas.

The gas may be transported to specific end-user(s) by means of CNG mobile unit(s).

The greenhouse gases included in or excluded from the project boundary are shown in Table 1.

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

| | Source | Gas | Included? | Justification / Explanation |
|---|---|---|---|---|
| **Baseline** | Venting of associated gas (if applicable) | $CO_2$ | Yes | For conservativeness it is assumed that the associated gas was flared in the baseline scenario even if it was actually vented prior to the start of the project activity |
| | | $CH_4$ | No | For conservativeness it is assumed that the associated gas was flared in the baseline scenario even if it was actually vented prior to the start of the project activity |
| | | $N_2O$ | No | Assumed negligible |
| | Flaring of associated gas (if applicable) | $CO_2$ | 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 |
| | Consumption of other fossil fuels in place of the processed gas | $CO_2$ | No | The processed gas replaces an equivalent amount of natural gas or a fuel with a higher carbon intensity at the specific end-user(s) or the final consumers of the natural gas pipeline. Neglecting this emission source is conservative. |
| | | $CH_4$ | No | |
| | | $N_2O$ | No | |
| | Upstream fugitive and energy related emissions from natural gas or other fuels consumed in place of the processed gas | $CO_2$ | No | The processed gas replaces an equivalent amount of natural gas or a fuel with a higher carbon intensity at the specific end-user(s) or the final consumers of the natural gas pipeline. Neglecting this emission source is conservative. |
| | | $CH_4$ | No | |
| | | $N_2O$ | No | |
| **Project Activity** | Fugitive emissions during treatment and transportation of the associated gas, non- | $CO_2$ | No | Assumed negligible |
| | | $CH_4$ | Yes | Assumed negligible |

| | | | | |
|---|---|---|---|---|
| | associated gas, combined gas or processed gas | $N_2O$ | No | Assumed negligible |
| | Energy use for recovery, treatment, transportation and processing of associated gas, or combined gas and end-use delivery of the processed gas. | $CO_2$ | Yes | Energy is produced from the associated or combined gas and/or the combustion of fossil fuels and import of electricity from the grid |
| | | $CH_4$ | No | Assumed negligible |
| | | $N_2O$ | No | Assumed negligible |

**Baseline emissions**

It is assumed that all associated gas is flared (and not vented) in the baseline scenario and carbon is converted into carbon dioxide. This is a conservative assumption, as accounting of methane emissions from flaring or venting would increase the total amount of baseline emissions. The baseline emissions are calculated as follows:

$$BE_y = (\sum_i V_{E_i,y} * w_{carbon,E_i,y} + V_{F,y} * w_{carbon,F,y}) * \lambda_y * \frac{44}{12} * \frac{1}{1000} \quad \textbf{(1)}$$

Where:

$BE_y$ = Baseline emissions in year $y$ ($tCO_2e$/year)
$V_{Ei,y}$ = Volume of the processed gas measured at point $E_i$ in Figure 1 in year $y$ ($m^3$)
$V_{F,y}$ = Volume of the processed gas measured at point F in Figure 1 in year $y$ ($m^3$)
$w_{carbon,Ei,y}$ = Average content of carbon in the processed gas measured at point $E_i$ in Figure 1 in year $y$ ($kgC/m^3$)
$w_{carbon,F,y}$ = Average content of carbon in the processed gas measured at point F in Figure 1 in year $y$ ($kgC/m^3$)
$\lambda_y$ = Fraction of the associated gas used in the project activity in year $y$

If only associated gas is used in the project activity (without mixing it with non-associated gas), then $\lambda_y$=1.

If both associated gas and non-associated gas is used in the project activity, $\lambda_y$ should be determined as follows:

$$\lambda_y = \frac{V_{A,y} * w_{carbon,A,y}}{V_{NA,y} * w_{carbon,NA,y} + V_{A,y} * w_{carbon,A,y}} \quad \textbf{(2)}$$

Where:

$\lambda_y$ = Fraction of the associated gas used in the project activity in year *y*
$V_{A,y}$ = Volume of the associated gas recovered and used in year *y* (m³)
$V_{NA,y}$ = Volume of the non-associated gas produced in year *y* (m³)
$w_{carbon,A,y}$ = Average content of carbon in the associated gas recovered and used in year *y* (kgC/m³)
$w_{carbon,NA,y}$ = Average content of carbon in the non-associated gas produced in year *y* (kgC/m³)

**Project emissions**

The following sources of project emissions are accounted for in this methodology:

- $CO_2$ emissions due to fuel combustion or electricity consumption for recovery, treatment, transportation ad processing of the associated or combined gas;
- $CO_2$ emissions from fuel combustion or electricity consumption due to compression and transportation of the processed gas to end-users.

If these emission sources are under the control of the project participants, they should be included and considered as project emissions within the project boundary. This is for example the case, if the transportation system is operated by the project participants.

If these emission sources are not under control of the project participants, they should be considered and calculated as leakage effects. This is the case if project participants do not operate the transportation system. However, in both cases the methodological approach described below has to be followed to calculate emissions.

Project emissions are calculated as follows:

$$PE_Y = PE_{CO_2,fossilfuels,y} + PE_{CO_2,elec,y} + PE_{CO_2,transport,y} \quad \textbf{(3)}$$

Where:

$PE_y$ = Project emissions in year *y* (t $CO_2$/yr)
$PE_{CO2,fossilfuels,y}$ = $CO_2$ emissions due to consumption of fossil fuels for the project activity in year *y* (t$CO_2$e/year).
$PE_{CO2,elec,y}$ = $CO_2$ emissions due to the use of electricity for the project activity in year *y* (t$CO_2$e/year).
$PE_{CO2,transport,y}$ = $CO_2$ emissions from transport of the processed gas in CNG mobile units in year *y* (tCO2e/year)

*Project emissions from the consumption of fossil fuels*

Project emissions $PE_{CO2,fossilfuels,y}$ from the use of fossil fuels for the collection, recovery, treatment, transportation and processing of the associated gas, non-associated gas or combined gas and, if applicable, compressing the processed gas to CNG are calculated applying the latest approved version of the "Tool to calculate project or leakage $CO_2$ emissions from fossil fuel combustion" where the processes *j* should correspond to each single emission source considered for the project activity. Project participants should document each emission source transparently in the CDM-PDD.

In case when a part of the associated gas or combined gas is used as fuel within the project boundary, related project emissions should be included in $PE_{CO2,fossilfuels,y}$ .

*Project emissions from electricity consumption*

Project emissions $PE_{CO2,elec,y}$ from the use of electricity should include electricity consumption for the collection, recovery, treatment, transportation and processing of the associated gas, non-associated gas and combined gas and, as applicable, electricity consumption from compressing the processed gas to CNG and/or compression of natural gas into a pipeline. They are calculated applying the latest approved version of the "Tool to calculate baseline, project or leakage emissions from electricity consumption".

*Project emissions from the transportation of the associated or combined gas in mobile units by means of trucks*

Project participants may choose between two different approaches to determine emissions: an approach based on distance and vehicle type (option 1) or on fuel consumption (option 2). This is monitored at point X in Figure 1.

**Option 1**

Emissions are calculated on the basis of distance and the number of trips (or the average transport load):

$$PE_{CO_2,transport,y} = N_{transport,y} \cdot AVD_{transport,y} \cdot EF_{transport,km,CO_2,y} \quad \textbf{(4)}$$

Where:

| | | |
|---|---|---|
| $PE_{CO_2,transport,y}$ | = | CO2 emissions from transportation of the processed gas in year *y* (tCO2/year) |
| $N_{transport,y}$ | = | Number of trips during the year *y* |
| $AVD_{,transport,y}$ | = | Average round trip distance (from and to) between the CNG mother station and a daughter station at the CNG end-user during the year *y* (km) |
| $EF_{transport,km,CO_2,y}$ | = | Emission factor for transportation in year *y* (tCO2/GJ) |

**Option 2**

Emissions are calculated based on the actual quantity of fossil fuels consumed for transportation:

$$PE_{CO,transport.y} = \sum_i FC_{transport,TR,i,y} \cdot NCV_{transport,i} \cdot EF_{transport,CO,FF,i} \quad \textbf{(5)}$$

Where:

$PE_{CO_2,transport,y}$ = CO2 emissions from transportation of the processed gas in year *y* (tCO2/year)

$FC_{transport,TR,i,y}$ = Fuel consumption of fuel type *i* for transportation of processed gas during the year y (mass or volume unit)

$NCV_{transport,\ i}$ = Net calorific value of the fossil fuel type *i* (GJ/ mass or volume unit)

$EF_{transport,CO_2,FF,i}$ = CO2 emission factor for fossil fuel type *i* (tCO2/GJ)

**Leakage**

Project participants should assess:

- Whether the end-user(s) opted for a lower efficiency of the equipment as a result of the project activity;
- Whether the supply of the processed gas by the project activity to the market will lead to additional fuel consumption.

If such leakage effects result from the project activity, emission reductions should be adjusted respectively in a conservative manner.

Where the fuels of the project activity substitute fuels with higher carbon intensity, emission reductions should as a conservative assumption not be adjusted

**Emission reductions**

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \textbf{(6)}$$

Where:

$ER_y$ = Emission reductions in year *y* (t $CO_2$e/year)

$BE_y$ = Baseline emissions in year *y* (t $CO_2$e/year)

$PE_y$ = Project emissions in year *y* (t $CO_2$/year)

$LE_y$ = Leakage emissions in year *y* (t $CO_2$/year)

**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. In order to assess the continued validity of the baseline, project participants should apply the procedure to determine the most plausible baseline scenario, as outlined above. The crediting period may only be renewed if the application of the procedure shows that the baseline scenario determined in the registered CDM-PDD still applies.

It shall be demonstrated that the project activity is not a common practice using the procedure defined in the Common Practice step of the "Combined tool to identify the baseline scenario and demonstrate additionality". The DOE shall evaluate the common practice with the information provided regarding the practices applied to handling of the associated gas in the host country.

The introduction of laws and regulations requiring flaring or utilization of the associated gas and/or the rate of compliance with the existing relevant laws/regulations shall also be assessed to determine the continued validity of the baseline.

End-users can be removed, changed and added at the renewal of a crediting period. The selection of a baseline scenario for each new end-user to be included in the project activity shall be conducted in accordance with the procedure described in the section on the baseline scenario selection. The applicability conditions shall be met for all end-users to be included.

**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:** | $EF_{transport,CO2,FF,i}$ |
|---|---|
| Data unit: | tCO2/GJ |
| Description: | CO2 emission factor for fossil fuel type *i* for transport |
| 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): | |
| 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.

Access to data regarding the end use of the gas should be achieved with a contract that gives the right to monitor the fuel use of the specific end-user(s).

At the specific end-user(s) location, the main objective of validation is to determine the type, volume and typical composition of the fuel being used. The purpose of this is to confirm that the recovered gas will displace fuel with equal or higher carbon content when the project activity commences.

At the specific end–user(s) location, the main objective of verification will be to confirm that the gas is being used for the purposes intended (as set out in the PDD). The DOE shall also verify that the gas has displaced fuel with equal or higher carbon content. The CDM-PDD will have to include minimal procedures to ensure that the data collection and retention will be made properly.

Uncertainty assessment:

'Permissible uncertainty' shall be expressed as the 95% confidence interval around the measured value, for normally distributed measurements. The uncertainty associated with each parameter should be assessed, for example, by calculating the probable uncertainty as the mean deviation divided by the square root of the number of measurements. If this uncertainty is within the 95% confidence interval, than it is considered permissible uncertainty, and no action must be taken.

If not, then the uncertainty should be assessed as low (<10%), medium (10-60%) or high (>60%). Percent uncertainty may be calculated by dividing the mean of the parameter by the probable uncertainty and multiply by 100% to get percent uncertainty. If percent uncertainty is <10%, the uncertainty is considered low. A detailed explanation of quality assurance and quality control procedures must be described for parameters with medium or high uncertainty in an attempt to decrease uncertainty, and to ensure that emissions reductions calculations are not compromised. In the case of a parameter with medium or high uncertainty, a sensitivity analysis should be performed to determine the potential of the uncertainty of the parameter to affect the emissions reduction calculation. The authenticity of the uncertainty levels should be verified by the DOE at the project verification stage.

For gas, CNG volume or mass measurement, the metering systems will be designed, installed and maintained to the requirements of the appropriate metering reference standards for the installed technology such that the uncertainty in measurement can be calculated in a fully traceable manner with reference to such standards.

For gas sampling, the sampling equipment and sampling procedure will comply with appropriate reference standards such that uncertainty in sample extraction can be calculated with reference to such standards.

For gas analysis, the gas analyser and analysis procedures shall also comply with appropriate reference standards and where laboratory analysis is used the laboratory shall comply with national accreditation standards.

Uncertainty associated with each parameter will be maintained through a calibration program designed to ensure individual parameter uncertainties are maintained at a level ensuring the combined overall uncertainty in emission reductions can be shown to be within a commonly acknowledged 5% verification materiality threshold.

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

**Data and parameters monitored**

| **Data** / **Parameter**: | $V_{A,y}$ |
|---|---|
| Data unit: | $m^3$ |
| Description: | Volume of the associated gas measured at point A in Figure 1 during the period *y* |
| Source of data: | Flow meter |
| Measurement procedures (if any): | The metering system shall be designed, installed and maintained to the requirements of the relevant metering technology reference standards. Metering instrumentation shall be calibrated at an appropriate frequency to ensure performance is maintained within design accuracy. |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | Calibration and maintenance of metering instrumentation will be carried out to manufacturer and reference standard requirements.<br>Internal audit of metering system calibrations prior to each monitoring report<br>Data trend and production cross checks prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $V_{NA,y}$ |
|---|---|
| Data unit: | $m^3$ |
| Description: | Volume of the non-associated gas from natural gas wells (prior to the mixing with the associated gas) measured at point B in Figure 1 during the period *y* |
| Source of data: | Flow meter |
| Measurement procedures (if any): | The metering system shall be designed, installed and maintained to the requirements of the relevant metering technology reference standards. Metering instrumentation shall be calibrated at an appropriate frequency to ensure performance is maintained within design accuracy. |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | Calibration and maintenance of metering instrumentation will be carried out to manufacturer and reference standard requirements.<br>Internal audit of metering system calibrations prior to each monitoring report<br>Data trend and production cross checks prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $V_{Dp,y}$ |
|---|---|
| Data unit: | m3 |
| Description: | Volume of the gas or other fossil fuel consumed on site (for example for electricity generation, gas compression, etc.) measured at inlet to such facilities at point $D_p$ in Figure 1 during the period *y* |
| Source of data: | Flow meter or Tank Level meter |
| Measurement procedures (if any): | The metering system shall be designed, installed and maintained to the requirements of the relevant metering technology reference standards. Metering instrumentation shall be calibrated at an appropriate frequency to ensure performance is maintained within design accuracy. |
| Monitoring frequency: | Continuously or weekly (depend on the measurement used) |
| QA/QC procedures: | Calibration and maintenance of metering instrumentation will be carried out to manufacturer and reference standard requirements.<br>Internal audit of metering system calibrations prior to each monitoring report<br>Data trend and production cross checks prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $V_{Ei,y}$ |
|---|---|
| Data unit: | m3 |
| Description: | Volume of the gas delivered to end-user *i* measured at point $E_i$ in Figure 1 during the year y |
| Source of data: | Flow meter and/or Pressure vessel metering |
| Measurement procedures (if any): | The metering system shall be designed, installed and maintained to the requirements of the relevant metering technology reference standards. Metering instrumentation shall be calibrated at an appropriate frequency to ensure performance is maintained within design accuracy. |
| Monitoring frequency: | Summed daily |
| QA/QC procedures: | Calibration and maintenance of metering instrumentation will be carried out to manufacturer and reference standard requirements.<br>Internal audit of metering system calibrations prior to each monitoring report<br>Data trend and production cross checks prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $V_{F,y}$ |
|---|---|
| Data unit: | m3 |
| Description: | Volume of the gas delivered to natural gas pipeline measured at point F in Figure 1 during the year *y* |
| Source of data: | Flow meter |
| Measurement procedures (if any): | The metering system shall be designed, installed and maintained to the requirements of the relevant metering technology reference standards. Metering instrumentation shall be calibrated at an appropriate frequency to ensure performance is maintained within design accuracy. |
| Monitoring frequency: | Continuously |
| QA/QC procedures: | Calibration and maintenance of metering instrumentation will be carried out to manufacturer and reference standard requirements.<br>Internal audit of metering system calibrations prior to each monitoring report<br>Data trend and production cross checks prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $w_{carbon,A,y}$ |
|---|---|
| Data unit: | $kgC/m^3$ |
| Description: | Average content of carbon in the recovered associated gas at point A in Figure 1 during the year *y* |
| Source of data | Analysis by either on-line analyser or by manual sample extraction and laboratory analysis using laboratory analyser. |
| Measurement procedures (if any): | Sampling equipment, sampling procedure, gas analyser and analysis procedures shall comply with appropriate reference standards and where laboratory analysis is used the laboratory shall comply with national accreditation standards.<br>Calibration |
| Monitoring frequency: | Monthly |
| QA/QC procedures: | Calibration and maintenance of analyser shall be carried out to manufacturer and reference standard requirements.<br>Internal audit of analyser calibrations shall be carried out prior to each monitoring report<br>Data trend and production cross checks shall be carried out prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $w_{carbon,NA,y}$ |
|---|---|
| Data unit: | kgC/m³ |
| Description: | Average content of carbon in the non-associated gas at point B in Figure 1 during the year *y* |
| Source of data | Analysis by either on-line analyser or by manual sample extraction and laboratory analysis using laboratory analyser. |
| Measurement procedures (if any): | Sampling equipment, sampling procedure, gas analyser and analysis procedures shall comply with appropriate reference standards and where laboratory analysis is used the laboratory shall comply with national accreditation standards.<br>Calibration |
| Monitoring frequency: | Monthly |
| QA/QC procedures: | Calibration and maintenance of analyser shall be carried out to manufacturer and reference standard requirements.<br>Internal audit of analyser calibrations shall be carried out prior to each monitoring report<br>Data trend and production cross checks shall be carried out prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $w_{carbon,Ei,y}$ |
|---|---|
| Data unit: | kgC/m³ |
| Description: | Average content of carbon in the associated or combined gas at point $E_i$ in Figure 1 during the year *y* |
| Source of data | Analysis by either on-line analyser or by manual sample extraction and laboratory analysis using laboratory analyser. |
| Measurement procedures (if any): | Sampling equipment, sampling procedure, gas analyser and analysis procedures shall comply with appropriate reference standards and where laboratory analysis is used the laboratory shall comply with national accreditation standards.<br>Calibration |
| Monitoring frequency: | Monthly |
| QA/QC procedures: | Calibration and maintenance of analyser shall be carried out to manufacturer and reference standard requirements.<br>Internal audit of analyser calibrations shall be carried out prior to each monitoring report<br>Data trend and production cross checks shall be carried out prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $w_{carbon,F,y}$ |
|---|---|
| Data unit: | kgC/m³ |
| Description: | Average content of carbon in the associated or combined gas at point F in Figure 1 during the period *y* |
| Source of data | Analysis by either on-line analyser or by manual sample extraction and laboratory analysis using laboratory analyser. |
| Measurement procedures (if any): | Sampling equipment, sampling procedure, gas analyser and analysis procedures shall comply with appropriate reference standards and where laboratory analysis is used the laboratory shall comply with national accreditation standards.<br>Calibration |
| Monitoring frequency: | Monthly |
| QA/QC procedures: | Calibration and maintenance of analyser shall be carried out to manufacturer and reference standard requirements.<br>Internal audit of analyser calibrations shall be carried out prior to each monitoring report<br>Data trend and production cross checks shall be carried out prior to each monitoring report |
| Any comment: | --- |

| **Data** / **Parameter**: | $N_{transport,y}$ |
|---|---|
| Data unit: | --- |
| Description: | Number of transport vehicle trips during the year y |
| Source of data: | On-site measurements |
| Measurement procedures (if any): | --- |
| Monitoring frequency: | Daily |
| QA/QC procedures: | Check consistency of number of transport vehicle trips with the quantity of the associated or combined gas delivered. |
| Any comment: | --- |

| **Data / Parameter:** | $AVD_{transport,y}$ |
|---|---|
| Data unit: | Km |
| Description: | Average round trip distance (from and to) between the associated or combined gas mother station and the daughter station of the project plant during the year y |
| Source of data: | Records by project participants |
| Measurement procedures (if any): | --- |
| Monitoring frequency: | Regularly |
| QA/QC procedures: | --- |
| Any comment: | --- |

| **Data / parameter:** | $EF_{transport,km,CO2,y}$ |
|---|---|
| Data unit: | $tCO_2/km$ |
| Description: | Average $CO_2$ emission factor per km for the transport vehicles during the year *y* |
| Source of data: | Conduct sample measurements of the fuel type, fuel consumption and distance travelled for all transport vehicle types. Calculate $CO_2$ emissions from fuel consumption by multiplying with appropriate net calorific values and $CO_2$ emission factors. For net calorific values and $CO_2$ emission factors, use reliable national default values or, if not available, (country-specific) IPCC default values. Alternatively, choose emission factors applicable for the vehicle types used from the literature in a conservative manner (i.e. the higher end within a plausible range). |
| Measurement procedures (if any): | --- |
| Monitoring frequency: | At least annually |
| QA/QC procedures: | Cross-check measurement results with emission factors referred to in the literature. |
| Any comment: | --- |

| **Data / Parameter:** | $FC_{transport,TR,i,y}$ |
|---|---|
| Data unit: | Mass or volume unit |
| Description: | Fuel consumption of fuel type i in vehicles for transportation of associated or combined gas during the year y |
| Source of data: | Fuel purchase receipts or fuel consumption meters in the transport vehicles |
| Measurement procedures (if any): | |
| Monitoring frequency: | Continuously, aggregated annually |
| QA/QC procedures: | Cross-checked the resulting $CO_2$ emissions for plausibility with a simple calculation based on the distance approach (option 1) |
| Any comment: | This parameter only needs to be monitored if option 2 is chosen to estimate $CO_2$ emissions from transportation. |

| **Data / parameter:** | $NCV_{transport,i}$ |
|---|---|
| Data unit: | GJ / mass or volume unit |
| Description: | Net calorific value of fossil fuel type *i* |
| 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 international standards. |
| Monitoring frequency: | In case of measurements: At least every six months, taking at least three samples for each measurement.<br>In case of other data sources: Review the appropriateness of the data annually. |
| QA/QC procedures: | Check consistency of measurements and local / national data with default values by the IPCC. If the values differ significantly from IPCC default values, collect additional information or conduct additional measurements. |
| Any comment: | |

## IV. REFERENCES AND ANY OTHER INFORMATION

Not applicable.

**History of the document**

| Version | Date | Nature of revision(s) |
|---|---|---|
| 01 | EB 45, Annex #<br>13 February 2009 | Initial adoption. |