Approved baseline and monitoring methodology AM0069

"Biogenic methane use as feedstock and fuel for town gas production"

I. SOURCE, DEFINITIONS AND APPLICABILITY

Sources

This baseline and monitoring methodology is based on the elements of the proposed new methodology NM0262 "Biogenic methane use as Town Gas Factory feedstock and methane emission reduction of flare efficiency" prepared by CantorCO2e.

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

- Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion;
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption;
- Tool for the demonstration and assessment of additionality;
- Combined tool to identify the baseline scenario and demonstrate additionality.

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

Selected approach from paragraph 48 of the CDM modalities and procedures

"Existing actual or historical emissions, as applicable"

Definitions

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

Town gas is a mixture of hydrogen, methane, carbon monoxide, carbon dioxide and other gases[1].

Applicability

This methodology is applicable to project activities where biogas captured at a wastewater treatment facility or a landfill is used to fully or partially substitute natural gas or other fossil fuels of higher carbon content as feedstock and fuel for the production of town gas.

[1] See Annex 1 for details of town gas production process.

The methodology is applicable under the following conditions:

- The town gas produced using biogas as feedstock and fuel is distributed through town gas grids and is combusted for energy purpose;
- Use of biogas as feedstock does not lead to a change in the quality of the produced town gas, i.e. Wobbe index should not vary more than 10%;
- The geographic extent of the town gas distribution grid is within the host country boundaries;
- The biogas used in the project activity is captured at an existing landfill site or an existing wastewater treatment facility, which has at least three-year record of venting or flaring of biogas. Biogas would continue to be vented or flared in the absence of the project activity. The project participants shall demonstrate this through documented evidence of venting or flaring prior to the implementation of the project activity;
- The project activity is implemented in an existing Town Gas Factory, which used only fossil fuels, no biogas, prior to the start of implementation of the project activity. The town gas factory shall have at least three-year record of using fossil fuel(s) as feedstock for the production of town gas. The Town Gas Factory has to have data on the quantity and quality of town gas produced as well as the quantity and quality of fossil fuels used for the most recent three years prior to the start of the project activity.

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 venting or flaring of biogas at the site where it is captured and the use of fossil fuels as feedstock for town gas production.

Note: If the source of biogas is another registered CDM project activity, the details of this registered CDM project activity shall be provided in the CDM-PDD.

II. BASELINE METHODOLOGY PROCEDURE

Identification of the baseline scenario

Project participants shall apply the following steps to identify the baseline scenario:

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

The most plausible baseline scenarios should be determined regarding:

(a) What would happen to biogas in the absence of the project activity;
(b) How town gas would be produced in the absence of the project activity.

The plausible alternative scenarios for the use of biogas shall include, but not limited to:

B 1: Biogas is vented into the atmosphere;
B 2: Biogas is captured and flared;
B 3: Biogas is captured and used to produce electricity and/or thermal energy;

B 4: Biogas is captured and used as feedstock for useful products other than town gas;
B 5: Biogas is captured and used as transportation fuel; and
B 6: The proposed project activity undertaken without being registered as a CDM project activity.

The plausible alternative scenarios for the production of town gas shall include, but not limited to:

T 1: Town gas is produced using fossil fuel(s) as feedstock and fuel for the production process;
T 2: Town gas is produced using biomass and fossil fuels as feedstock and fuel for the production process;
T 3: Town gas is produced using biogas, delivered from sites not included in the project activity, as feedstock and fuel for the production process;
T 4: The proposed project activity undertaken without being registered as a CDM project activity.

Project participants should identify all realistic and credible combinations of baseline scenarios for the use of biogas (B1 to B6) and the production of town gas (T1 to T4).

Project participants shall provide an overview of other practices for use of biogas and the production of town gas that have been implemented previously or are currently underway in the relevant geographical area. The relevant geographical area should in principle be the host country of the proposed CDM project activity. A region within the country could be the relevant geographical area if the framework conditions vary significantly within the country. However, the relevant geographical area should include preferably ten facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the Town Gas Factory and the biogas source involved in the proposed CDM project activity. If less than ten facilities (or projects) that provide outputs or services with comparable quality, properties and application areas as the Town Gas Factory and the biogas source involved in the proposed CDM project activity are found in the region/host country, the geographical area may be expanded to an area that covers if possible, ten such facilities (or projects).

In cases where the above-described definition of geographical area is not suitable, the project proponents should provide an alternative definition of geographical area. Other registered CDM project activities are not to be included in this analysis. Provide relevant documentation to support the results of the analysis. The alternatives to the project activity shall be in compliance with all applicable legal and regulatory requirements even if these laws and regulations have objectives other than GHG reductions, e.g., to mitigate local air pollution.

If an alternative does not comply with all applicable legislation and regulations, eliminate such 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: Eliminate alternatives that face prohibitive barriers

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

− If there is only one alternative scenario that is not prevented by any barrier, and if this alternative is not the proposed project activity undertaken without being registered as a CDM project activity, then this alternative scenario is identified as the baseline scenario.

− If there are still several alternative scenarios remaining project participants may choose to either:

- Option 1: Go to step 3 (investment analysis), or
- Option 2: Identify the alternative with the lowest emissions (i.e. the most conservative) as the baseline scenario.

Step 3: Conduct an investment analysis

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

- If the sensitivity analysis is not conclusive, identify the alternative with the lowest emissions (i.e. the most conservative).

- If the sensitivity analysis confirms the result of the investment comparison analysis, then the most economically or financially attractive alternative scenario is considered as baseline scenario.

Note: The methodology is only applicable if the identified baseline scenario is a combination of scenario B1 and/or B2 with scenario T1.

Additionality

The additionality of the project activity shall be demonstrated and assessed using the latest version of the "Tool for the demonstration and assessment of additionality" approved by the CDM Executive Board available on the UNFCCC CDM website.

Project boundary

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

- The source facility, where the biogas is generated;
- The pipeline supplying biogas from the source to the TGF;
- All auxiliary equipment installed to transport and clean the biogas;
- The Town Gas Factory (TGF);
- The town gas distribution grid;
- The flare where the biogas was destroyed prior to the implementation of the project activity.

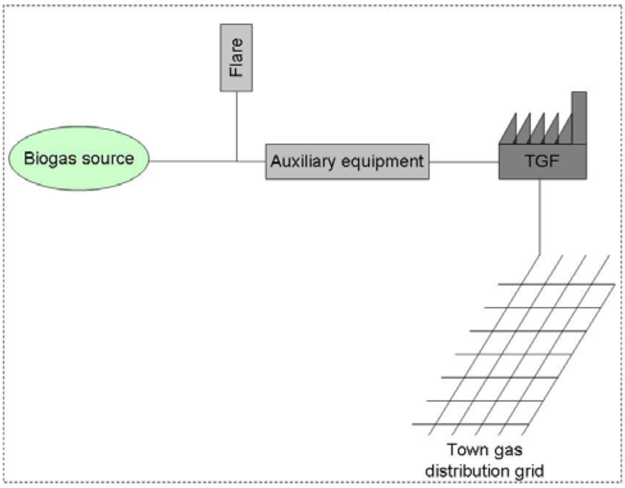

Figure 1: Project boundary

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	Town Gas Factory	**CO_2**	**Yes**	Emissions due to the use of fossil fuels as feedstock and fuel for production of town gas
		CH_4	No	Emissions due to methane venting will not be accounted since those will not change with the implementation of the project
		N_2O	No	Emissions are considered negligible from this source and will not change with the implementation of the project activity
	Town gas distribution grid	**CO_2**	**Yes**	The town gas is combusted in the distribution grid
		CH_4	No	Emissions due to methane venting will not be accounted since those will not change with the implementation of the project
		N_2O	No	Emissions are considered negligible from this source and will not change with the implementation of the project activity

	Source	Gas	Included?	Justification / Explanation
Project Activity	Town Gas Factory and Auxiliary equipment	**CO_2**	**Yes**	Emissions due to electricity or fossil fuel consumption
		CH_4	No	Emissions are considered negligible from this source
		N_2O	No	Emissions are considered negligible from this source

Project emissions

The project emissions accounted in this methodology are those related to the energy consumption (electricity and fuels) of auxiliary equipment used for transportation of the biogas from its source to the Town Gas Factory and to clean the biogas before entering the facility, and those from fossil fuel(s) used as feedstock and fuel for process at the Town Gas Factory in the case when biogas only partially substitutes fossil fuel(s).

Project emissions are calculated as follows:

$$PE_y = PE_{FC,y} + PE_{EC,y} \quad (1)$$

Where:

PE_y	=	Project emissions in year *y* (t CO_2/yr)
$PE_{FC,y}$	=	Project emissions from fossil fuel combustion in year *y* (t CO_2/yr)
$PE_{EC,y}$	=	Project emissions from electricity consumption in year y (t CO_2yr)

CO_2 emissions from electricity consumption should be calculated using the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption". CO_2 emissions from fossil fuel consumption should be calculated using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".

Ex ante estimations

A conservative estimation of energy consumption can be made using the equipment manufacturer's specifications. Emissions due to energy consumption can be estimated using the appropriate methodological tool (either the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" or the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion").

Baseline emissions

Baseline emissions are calculated as follows:

$$BE_y = \frac{Q_{PR,TG,y} * NCV_{TG,y} * CEF_{NG}}{\eta_{BL,y}} \quad (2)$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2/yr)
$Q_{PR,TG,y}$	=	Quantity of project activity town gas produced in year *y* (kg or m^3)
$NCV_{TG,y}$	=	Average net calorific value of town gas in year *y* (TJ/kg or TJ/m^3)
CEF_{NG}	=	Carbon emission factor of natural gas (tCO2eq/TJ). In the case when natural gas, which was used in the Town Gas Factory prior to the start of the project activity and would have been used in the absence of project activity, contains a fraction of methane of biogenic origin, the carbon emission factor has to be adjusted to account for this.
$\eta_{BL,y}$	=	Baseline process efficiency in year *y*

$$Q_{PR,TG,y} = \min\{Q_{TG,y}; Q_{TG,hist}\} \quad (3)$$

Where:

$Q_{TG,y}$	=	Measured quantity of town gas produced in year *y* (kg or m^3)
$Q_{TG,hist}$	=	Maximum annual quantity of town gas produced in the historic period of three most recent years prior to the start of the project activity (kg or m^3)

Baseline process efficiency in year *y* is determined as the highest value among efficiencies experienced with different fossil fuels used as feedstock and fuel at the Town Gas Factory during the most recent three years prior to the start of the project activity and the actual efficiency in year *y*:

$$\eta_{BL,y} = \max\{\eta_{hist}; \eta_y\} \quad (4)$$

Where:

$\eta_{BL,y}$	=	Baseline process efficiency
η_{hist}	=	Historical process efficiency
η_y	=	Process efficiency in year *y*

$$\eta_{hist} = \max\{\frac{Q_{TG,x} * NCV_{TG,x}}{\sum_i Q_{i,x} * NCV_{i,x}}; \frac{Q_{TG,x-1} * NCV_{TG,x-1}}{\sum_i Q_{i,x-1} * NCV_{i,x-1}}; \frac{Q_{TG,x-2} * NCV_{TG,x-2}}{\sum_i Q_{i,x-2} * NCV_{i,x-2}}\} \quad (5)$$

$$\eta_y = \frac{Q_{TG,y} * NCV_{TG,y}}{\sum_i Q_{i,y} * NCV_{i,y} + Q_{BG,y} * NCV_{GB,y}} \quad (6)$$

Where:

η_{hist}	=	Historical process efficiency
$Q_{TG,x}$; $Q_{TG,x-1}$; $Q_{TG,x-2}$	=	Annual quantity of town gas produced in the three most recent years prior to the start of the project activity *x*, *x-1* and *x-2* (kg or m^3)
$NCV_{TG,x}$; $NCV_{TG,x-1}$; $NCV_{TG,x-2}$	=	Average net calorific value of town gas in the most recent three years prior to the start of the project activity *x*, *x-1* and *x-2* (TJ/kg or TJ/m^3)
$Q_{i,x}$; $Q_{i,x-1}$; $Q_{i,x-2}$	=	Annual quantity of fossil fuel type *i* used as feedstock and fuel for the production of town gas in the three most recent years prior to the start of the project activity *x*, *x-1* and *x-2* (kg or m^3)
$NCV_{i,x}$; $NCV_{i,x-1}$; $NCV_{i,x-2}$	=	Average net calorific value of fossil fuel type *i* used as feedstock and fuel for the production of town gas in the most recent three years prior to the start of the project activity *x*, *x-1* and *x-2* (TJ/kg or TJ/m^3)
x, x-1, x-2	=	Three most recent years prior to the start of the project activity
η_y	=	Process efficiency in year *y*
$Q_{TG,y}$	=	Annual quantity of town gas produced in year *y* (kg or m^3)
$NCV_{TG,y}$	=	Average net calorific value of town gas in year *y* (TJ/kg or TJ/m^3)
$Q_{i,y}$	=	Annual quantity of fossil fuel type *i* used as feedstock and fuel for the production of town gas in year *y* (kg or m^3)
$NCV_{i,y}$	=	Average net calorific value of fossil fuel type *i* used as feedstock and fuel for the production of town gas in year *y* (TJ/kg or TJ/m^3)
$Q_{BG,y}$	=	Annual quantity of biogas used as feedstock and fuel in the Town Gas Factory in year *y* (kg or m^3)
$NCV_{BG,y}$	=	Average net calorific value of biogas in year *y* (TJ/kg or TJ/m^3)
i	=	All fossil fuel types used in the Town Gas Factory

$Q_{i,x}$ / $Q_{i,x-1}$ / $Q_{i,x-2}$ and $Q_{i,y}$ are measured as the total input of fossil fuel type i to the Town Gas Factory used for the generation of thermal energy of the process and as feedstock for the methane reforming and hydrocarbon mix process.

<u>*Ex ante* estimations</u>

Ex ante estimations will be performed using an estimated amount of town gas that will be produced in the TGF in the project scenario, a historical average value of NCV of town gas and the IPCC default natural gas carbon emission factor.

Leakage

No leakage is considered in this methodology.

Emission reductions

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y \quad \textbf{(7)}$$

Where:

ER_y	=	Emission reductions in year *y* (t CO_2e/yr)
BE_y	=	Baseline emissions in year *y* (t CO_2e/yr)
PE_y	=	Project emissions in year *y* (t CO_2/yr)

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

For 2nd and 3rd crediting periods project participants will have to demonstrate that changes in the local laws and regulations occurred during the past crediting period do not affect the validity of the baseline, or that no significant changes have occurred.

Project participants should update emission factors for the combustion of fossil fuels or for the use of electricity in the project activity.

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:	CEF_{NG}
Data unit:	(tCO2eq/TJ)
Description:	Carbon emission factor of the natural gas.
Source of data:	The latest version of the IPCC Guidelines for National Greenhouse Gases Inventories
Measurement procedures (if any):	No measurements will be performed
Any comment:	In the case when natural gas, which was used in the Town Gas Factory prior to the start of the project activity and would have been used in the absence of project activity, contains a fraction of methane of biogenic origin, the carbon emission factor has to be adjusted to account for this.

Data / parameter:	$Q_{TG,x}$; $Q_{TG,x-1}$; $Q_{TG,x-2}$
Data unit:	kg or m^3
Description:	Annual quantity of town gas produced in the three most recent years prior to the start of the project activity *x*, *x-1* and *x-2*
Source of data:	Project participants
Measurement procedures (if any):	Continuous measurements performed using certified flow meters
Monitoring frequency:	Continuous
Any comment:	

Data / parameter:	$NCV_{TG,x}$; $NCV_{TG,x-1}$; $NCV_{TG,x-2}$
Data unit:	TJ/kg or TJ/m^3
Description:	Average net calorific value of town gas in the most recent three years prior to the start of the project activity *x*, *x-1* and *x-2*
Source of data:	Projects participants
Measurement procedures (if any):	Continuous measurements made by certified equipments
Monitoring frequency:	Monthly
Any comment:	

Data / parameter:	$Q_{i,x}$; $Q_{i,x-1}$; $Q_{i,x-2}$
Data unit:	kg or m^3
Description:	Annual quantity of fossil fuel type *i* used as feedstock and fuel for the production of town gas in the three most recent years prior to the start of the project activity *x*, *x-1* and *x-2*
Source of data:	Project participants
Measurement procedures (if any):	Continuous measurements performed using certified flow meters
Monitoring frequency:	Continuous
Any comment:	

Data / parameter:	$NCV_{i,x}$; $NCV_{i,x-1}$; $NCV_{i,x-2}$
Data unit:	TJ/kg or TJ/m^3
Description:	Average net calorific value of fossil fuel type *i* used as feedstock and fuel for the production of town gas in the most recent three years prior to the start of the project activity *x*, *x-1* and *x-2*
Source of data:	Projects participants
Measurement procedures (if any):	Continuous measurements made by certified equipments
Monitoring frequency:	Monthly
Any comment:	

III. MONITORING METHODOLOGY

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

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

Flaring of biogas by an "emergency flare" at the site of biogas capture

During the periods when the upgrading facility is closed due to the scheduled maintenance, reparation of equipment, or other emergency, project participants should ensure that the captured biogas is flared at the site of its capture using the flare that was in operation prior to the start of the project activity. Appropriate monitoring procedures should be established to monitor this "emergency flare".

Monitoring of the source of natural gas

Project participants have to monitor the origin of natural gas, which was used prior to the start of the project activity and would continue to be used in the absence of project activity, as to a possible content of biogenic methane. In the case when natural gas contains a fraction of methane of biogenic origin, the carbon emission factor has to be adjusted to account for this.

Monitoring of the quality of town gas

Periodic monitoring of the quality of the produced town gas has to be undertaken to ensure that the Wobbe index does not vary more than 10% in comparison with that of town gas produced prior to the start of the project activity.

Data and parameters monitored

Data / Parameter:	$Q_{TG,y}$
Data unit:	kg or m^3
Description:	Measured quantity of town gas produced in year *y*
Source of data:	Project participants
Measurement procedures (if any):	Continuous measurements performed using certified flow meters
Monitoring frequency:	Continuous
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Data / Parameter:	$NCV_{TG,y}$
Data unit:	TG/kg or TJ/m^3
Description:	Average net calorific value of town gas in year *y*
Source of data:	Projects participants
Measurement procedures (if any):	Continuous measurements made by certified equipments
Monitoring frequency:	Monthly
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Data / parameter:	$\mathbf{Q_{i,y}}$
Data unit:	kg or m^3
Description:	Annual quantity of fossil fuel type *i* used as feedstock and fuel for the production of town gas in year *y*
Source of data:	Project participants
Measurement procedures (if any):	Continuous measurements performed using certified flow meters
Monitoring frequency:	Continuous
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Data / parameter:	$NCV_{i,y}$
Data unit:	TJ/kg or TJ/m^3
Description:	Average net calorific value of fossil fuel type *i* used as feedstock and fuel for the production of town gas in year *y*
Source of data:	Projects participants
Measurement procedures (if any):	Continuous measurements made by certified equipments
Monitoring frequency:	Monthly
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Data / parameter:	$Q_{BG,y}$
Data unit:	kg or m^3
Description:	Annual quantity of biogas used as feedstock and fuel for the production of town gas in year *y*
Source of data:	Project participants
Measurement procedures (if any):	Continuous measurements performed using certified flow meters
Monitoring frequency:	Continuous
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Data / parameter:	$NCV_{BG,y}$
Data unit:	TJ/kg or TJ/m^3
Description:	Average net calorific value of biogas used as feedstock and fuel for the production of town gas in year *y*
Source of data:	Projects participants
Measurement procedures (if any):	Continuous measurements made by certified equipments
Monitoring frequency:	Monthly
QA/QC procedures:	Zero checks and calibration procedures as recommended by equipment manufacturers
Any comment:	

Annex 1

Town gas production

The first part of the manufacturing process of town gas is the production of synthesis gas through the process of steam reforming of natural gas or biogas, where methane is transformed into hydrogen and carbon dioxide due to the reaction of steam with methane in presence of a metal catalyst (nickel), according to the following chemical equations:

CH4 + H_2O------------CO + 3H2 (endothermic reaction)

CO + H_2O--------------CO_2 + H2

Methane reforming occurs at high temperatures (700°C-800°C); in order to achieve those temperatures, and to reheat the catalyst, large amounts of fuel are used.

Synthesis gas (*syngas)* is often mixed with other gaseous hydrocarbons (commonly methane) to improve its calorific value before it is delivered to final users.

- - - - -

History of the document

Version	Date	Nature of revision(s)
01	EB 41, Annex 1 02 August 2008	Initial adoption.