CLEAN DEVELOPMENT MECHANISM

CDM-EB92-A09

Large-scale methodology

AM0107: New natural gas based cogeneration plant

Version 04.0

Sectoral scope(s):01

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology.

Table 1. Methodology key elements

Typical projects	**Natural gas based cogeneration project supplying heat and electricity to multiple project customers**
Type of GHG emissions mitigation action	Fuel switch/technology switch/energy efficiency: Switch to cogeneration of steam and electricity

2. Scope, applicability, and entry into force

2.1. Scope

2. The scope of methodology covers the projects that implement new natural gas based cogeneration facilities.

3. In order to facilitate the choice of the methodology for the co-generation activities, a flow chart (Annex 1) has been prepared with major checkpoints, such as baseline scenario, fuel type, and heat-to-power ratio.

2.2. Applicability

4. This methodology applies to project activities that install a project facility(ies) that supplies: (a) heat to heat networks and/or to existing or new recipient facilities; and (b) electricity to power grid and/or to existing or new recipient facilities.

5. Where the project activity is connected to power grid and/or heat network, the geographical/physical boundaries of the power grid and/or heat network to which the project activity is connected shall be identified and documented.

6. The heat-to-power ratio of the project cogeneration facility shall higher than 0.3 during the crediting period.

7. In addition, the applicability conditions included in the tool referred to below apply.

2.3. Entry into force

8. The date of entry into force is the date of the publication of the EB 92 meeting report on 4 November 2016.

2.4. Applicability of sectoral scopes

9. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology application of sectoral scope 01 is mandatory.

3. Normative references

10. This methodology is based on elements from the following proposed new methodology:

11. "NM0356: New natural gas based combined heat and power plant" prepared by Sino Carbon Innovation and Investment Co., Ltd, and Beijing Energy Investment Holding Co., Ltd., Beijing Jingneng Clean Energy Corporation Limited, Beijing Jingqiao thermal power Co., Ltd., Beijing Energy Gaoantun gas-fired cogeneration Co., Ltd.

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

    (a) "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

    (b) "Tool to determine the baseline efficiency of thermal or electric energy generation systems";

    (c) "Combined tool to identify the baseline scenario and demonstrate additionality";

    (d) "Upstream leakage emissions associated with fossil fuel use";

    (e) "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

    (f) "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation".

13. For more information regarding the proposed new methodology and the tools as well as their consideration by the Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board) please refer to <http://cdm.unfccc.int/methodologies/PAmethodologies/index.html>.

3.1. Selected approach from paragraph 48 of the CDM modalities and procedures

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

4. Definitions

15. The definitions contained in the Glossary of CDM terms shall apply.

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

    (a) **Project facility** - a new natural gas based cogeneration facility established through investment as CDM project activity that is a new construction with no operational history developed to generate and supply electricity and/or heat directly to recipient facility(ies) and/or to the grid or heat network;

    (b) **Cogeneration facility** - facility that generates electricity and heat simultaneously;

    (c) **Heat** - useful thermal energy that is supplied by a heat carrier (e.g. liquids, gases, steam, etc.) for utilization in thermal applications and processes. Note that the specific useful heat, as defined in this document, refers to the net quantity of thermal energy per unit of mass of heat carrier that is transferred from the working fluid at the consumer's facility. For example, it refers to the difference of the specific

enthalpy of the steam supplied to the consumer and the specific enthalpy of the condensate return. For simplicity, when there is no information about the consumer and the rate of condensate return, the useful heat will be defined as the difference of the enthalpy of the steam generated in the boiler and the enthalpy of the feed water;

(d) **Heat network** - is defined by the spatial extent of the heat generation facilities that are physically connected through heating pipeline (e.g. pipeline network that supplies heat to several recipient facility(ies)) where project heat can be dispatched in this network without transmission constraints;

(e) **Power grid** - is defined by the spatial extent of the power plants that are physically connected through transmission and distribution lines to the project activity (e.g. the cogeneration plant location or the recipient facility(ies) where electricity is consumed) and that can be dispatched without significant transmission constraints.

5. Baseline methodology

5.1. Project boundary

17. The spatial extent of the project boundary encompasses the project facility(ies) and consumers of heat and electricity.

18. The greenhouse gases included in or excluded from the project boundary are shown in Table 2 below.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Combustion of fossil fuels to produce heat and electricity in a baseline cogeneration facility	CO_2	Yes	Main emission source in the combustion of fossil fuels
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification
Project activity	Combustion of fossil fuels to produce heat and electricity at the project cogeneration facility(s)	CO_2	Yes	Main emission source in the combustion of fossil fuels
		CH_4	No	Excluded for simplification
		N_2O	No	Excluded for simplification

5.2. Selection of the baseline scenario and demonstration of additionality

19. The selection of the baseline scenario and the demonstration of additionality shall be conducted using the latest version of the “Combined tool to identify the baseline scenario and demonstrate additionality”. The following additional guidance should be used when applying the tool.

20. When applying “Sub-step 1a” of the tool, alternatives to be analysed by the project proponent should include, inter alia:

(a) P1: The construction of one or several other cogeneration facility(ies) using the same fuel as a project facility, but other technologies;

(b) P2: The construction of one or several other cogeneration facility(ies) using fossil fuels other than project fuel;

(c) P3: The construction of one or several other cogeneration facility(ies) using biomass;

(d) P4: The proposed project activity undertaken without being registered as a CDM project activity;

(e) P5: The separate generation of electricity and heat, e.g. the construction electric generation/supply by a power grid and heat generation facilities.

21. All alternatives do not need to consist solely of facility(ies) of the same capacity and operational characteristics (i.e. several smaller facilities, or the share of a larger facility may be a reasonable alternative to the project activity), however they should deliver same level of services. Ensure that all relevant technologies that have recently been constructed or are under construction or are being planned by the project participants are included as plausible alternatives.

22. A clear description of each baseline scenario alternative, including information on the technology, such as the efficiency and technical lifetime, shall be provided in the project design document (CDM-PDD).

23. While applying Step 3 of the tool, the following guidance should be used:

(a) The level of profitability for different alternative scenarios (such as IRR or NPV) should be used as criteria of investment comparison analysis. The baseline scenario with the best financial indicators shall be selected as the most feasible baseline scenario;

(b) The sensitivity analysis should also consider variations between heat to electricity ratios, as the level of profitability of two sources are different. For example, if the project is additional for the variation of heat-to-electricity ratio by +/- 10%, then the heat-to-electricity ratio should be within this range in the project period. This shall be done by including a parameter ($\theta_{PJ,y}$).

24. The heat-to-electricity ratio of the cogeneration plant in year y ($\theta_{PJ,y}$) can be determined as follows:

$$\emptyset_{PJ,y} = \frac{HG_{PJ,y}}{3.6 \times EG_{PJ,y}} \qquad \text{Equation (1)}$$

Where:

$\emptyset_{PJ,y}$	=	Heat-to-electricity ratio of the cogeneration plant in year
$HG_{PJ,y}$	=	Quantity of heat supplied by the project activity in year *y* (GJ)
$EG_{PJ,y}$	=	Quantity of electricity generated in the project cogeneration plant that is fed into the electric power grid in year *y* (MWh)
3.6	=	Conversion factor, expressed as GJ/MWh

25. Where the application of the "Combined tool to identify the baseline scenario and demonstrate additionality" concludes that the most plausible baseline scenario is "The construction of one or several other cogeneration facility(ies) using fossil fuels other than project fuel" separate additionality demonstration of the fuel switching is required.

26. Additionality of the fuel switching shall be demonstrated comparing the historical average retail price of the fuel to be used in the project over the recent three years, with the fuel that was identified in the baseline scenario for the same period. Retail prices per unit of energy (local currency unit/GJ) shall be used for the comparison. If the average retail price of the project fuel is higher than the one of the baseline fuel, the fuel switching measures are considered additional.

27. If the fuel switching measures are not demonstrated to be additional, emission reductions from the fuel switching cannot be claimed for certified emission reductions (CERs). In such a case, the CO_2 emission factor of the fuel that would have been used in the baseline cogeneration plant ($EF_{BL,y}$) shall be the same as the one in the project. With this adjustment, however, emission reductions from energy efficiency measures can still be deemed additional.

28. The methodology is not applicable if the outcome of the selection of the baseline scenario and additionality demonstration results in the separate generation of electricity and heat as a most plausible baseline scenario.[1]

5.3. Baseline emissions

29. Baseline emissions are calculated as follows:

$$BE_y = \left[\frac{HG_{PJ,y}}{\eta_{BL,HG}} + \frac{EG_{PJ,y} \times 3.6}{\eta_{BL,EG}}\right] \times EF_{BL,y} \qquad \text{Equation (2)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2e)
$HG_{PJ,y}$	=	Quantity of heat supplied by the project activity in year *y* (GJ)
$EG_{PJ,y}$	=	Quantity of electricity supplied by the project activity in year *y* (MWh)
$\eta_{BL,HG}$	=	Assumed efficiency of heat generation in the baseline cogeneration plant (fraction)
$\eta_{BL,EG}$	=	Assumed efficiency of electricity generation in the baseline cogeneration plant (fraction)
$EF_{BL,y}$	=	CO_2 emission factor of the fuel that would have been used in the baseline cogeneration plant (t CO_2/GJ)

[1] The project participants are recommended to check whether the methodology "AM0048: New cogeneration project activities supplying electricity and heat to multiple customers" is applicable in case the most plausible baseline scenario is separate generation.

30. The assumed efficiencies of heat generation and electricity generation in the baseline cogeneration plant shall correspond to the maximum efficiency of heat production and maximum efficiency of electricity production by the baseline cogeneration plant. These efficiencies shall be provided in the CDM-PDD as a part of the baseline scenario and supported by manufacturer.

31. Where assumed efficiencies are not provided by the manufacturer, the default values provided in the "Tool to determine the baseline efficiency of thermal or electric energy generation systems" shall be used.

5.4. Project emissions

32. Project emissions (PE_y) shall be calculated as the CO_2 emissions from fossil fuel(s) combustion associated with the production of heat and electricity in the project cogeneration plant, using the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". The parameter PE_y corresponds to $PE_{FC,j,y}$ in the tool, where *j* is the combustion of project fossil fuel and small amounts of other start-up or auxiliary fuels in the cogeneration plant.

5.5. Leakage

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

    (a) Fugitive CH_4 emissions associated with the extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels used in the project plant and fossil fuels used in the reference plant in the absence of the project activity;

    (b) In the case liquefied natural gas (LNG) is used in the project plant: CO_2 emissions from fuel combustion/electricity consumption associated with the liquefaction, transportation, re-gasification and compression into a natural gas transmission or distribution system.

34. Leakage shall be determined as per the provisions of the latest version of the tool "Upstream leakage emissions associated with fossil fuel use". When applying the tool the parameters $FC_{PJ,x,y}$ and $FC_{BL,x,y}$ shall be determined as follows:

$$FC_{PJ,x,y} = FC_{PJ,NG,y} = FC_{NG,y} \times NCV_{NG,y} \quad \text{Equation (3)}$$

$$FC_{BL,x,y} = \left[\frac{HG_{PJ,y}}{\eta_{BL,HG}} + \frac{EG_{PJ,y} \times 3.6}{\eta_{BL,EG}}\right] \div 1000 \quad \text{Equation (4)}$$

Where:

$FC_{PJ,x,y}$ = Quantity of fossil fuel type x used in the project situation in year *y* (TJ)

$FC_{PJ,NG,y}$ = Quantity of natural gas used in the project situation in year *y* (TJ)

$FC_{NG,y}$	=	Quantity of natural gas consumption in the project facility in year *y* (mass or volume unit)
$FC_{BL,x,y}$	=	Quantity of fossil fuel type x used in the baseline situation in year *y* (TJ)
$NCV_{NG,y}$	=	Quantity of fossil fuel type x used in the baseline situation in year *y* (TJ)
$HG_{PJ,y}$	=	Quantity of heat supplied by the project activity in year *y* (GJ)
$EG_{PJ,y}$	=	Quantity of electricity supplied by the project activity in year *y* (MWh)
$\eta_{BL,HG}$	=	Assumed efficiency of heat generation in the baseline cogeneration plant (fraction)
$\eta_{BL,EG}$	=	Assumed efficiency of electricity generation in the baseline cogeneration plant (fraction)

5.6. Emissions reductions

35. The emissions reductions are calculated as:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (5)}$$

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

36. Refer to the latest approved version of the methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".

5.8. Project activity under a programme of activities (PoA)

37. Refer to the latest approved version of the standard for "Demonstration of additionality, development of eligibility criteria and application of multiple methodologies for programme of activities".

5.9. Data and parameters not monitored

Data / Parameter table 1.

Data / Parameter:	$EF_{BL,y}$
Data unit:	t CO_2/TJ
Description:	CO_2 emission factor of the fuel that would have been used in the baseline cogeneration plant

<table>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:

<table>
<tr><th>Data source</th><th>Conditions for using the data source</th></tr>
<tr><td>(a) Measurements by the project participants</td><td>This is the preferred source</td></tr>
<tr><td>(b) Regional or national default values</td><td>If (a) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
<tr><td>(c) IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If (b) is not available

These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)</td></tr>
</table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>For (a) measurements should be undertaken in line with national or international fuel standards</td></tr>
<tr><td>Any comment:</td><td>For (a): if the fuel supplier does provide the NCV value and the CO_2 emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO_2 factor should be used. If another source for the CO_2 emission factor is used or no CO_2 emission factor is provided, options (b), or (c) should be used</td></tr>
</table>

Data / Parameter table 2.

Data / Parameter:	$\eta_{BL,HG}\eta_{BL,EG}$
Data unit:	Fraction
Description:	Assumed efficiency of heat/electricity generation in the baseline cogeneration plant (fraction)
Source of data:	Quotation provided by manufacturer for the purpose of baseline scenario identification
Measurement procedures (if any):	-
Any comment:	Default values can be used if manufacturer data is not available

6. Monitoring methodology

38. Describe and specify in the CDM-PDD all monitoring procedures, including the type of measurement instrumentation used, the responsibilities for monitoring and quality assurance and quality control procedures that shall be applied. Where the methodology provides difference options (e.g. use of default values or on-site measurements), specify which option shall be used. All meters and instruments should be calibrated regularly as per industry practices.

39. All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred per cent of the data should be monitored if not indicated differently in the comments in the tables below.

40. In addition, the monitoring provisions in the tools referred to in this methodology apply. Accordingly, $EG_{PJ,l,y}$ should be determined as per the Tool for "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool, the requirements for $EG_{PJ,facility,l,y}$ should apply to parameter $EG_{PJ,l,y}$.

6.1. Data and parameters monitored

~~**Data / Parameter table 3.**~~

~~**Data / Parameter:**~~	~~$EG_{PJ,y}$~~
~~Data unit:~~	~~MWh~~
~~Description:~~	~~Quantity of electricity supplied by the project activity in year *y* (MWh)~~
~~Source of data:~~	~~Measured by project participants using electricity meters~~
~~Measurement procedures (if any):~~	~~This parameter should be either monitored using bi-directional energy meter or calculated as difference between (a) the quantity of electricity supplied by the project plant/unit to the grid; and (b) the quantity of electricity the project plant/unit from the grid.~~ ~~In case it is calculated then the following parameters shall be measured:~~ ~~(a) The quantity of electricity supplied by the project plant/unit to the grid; and~~ ~~(b) The quantity of electricity delivered to the project plant/unit from the grid~~
~~Monitoring frequency:~~	~~Continuous measurement and at least monthly recording~~
~~QA/QC procedures:~~	~~Cross-check measurement results with records for sold electricity~~
~~Any comment:~~	~~-~~

Data / Parameter table 4.

Data / Parameter:	$HG_{PJ,y}$
Data unit:	GJ
Description:	Quantity of heat supplied by the project activity in year *y*
Source of data:	Measured by project participants using heat meters or calculated
Measurement procedures (if any):	On-site measurements
Monitoring frequency:	Continuously
QA/QC procedures:	Cross-check measurement results with records for sold heat
Any comment:	In case quantity of heat is calculated, for example using steam/water flow, pressure and enthalpy, calculation procedure shall be validated by the designated operational entity (DOE)

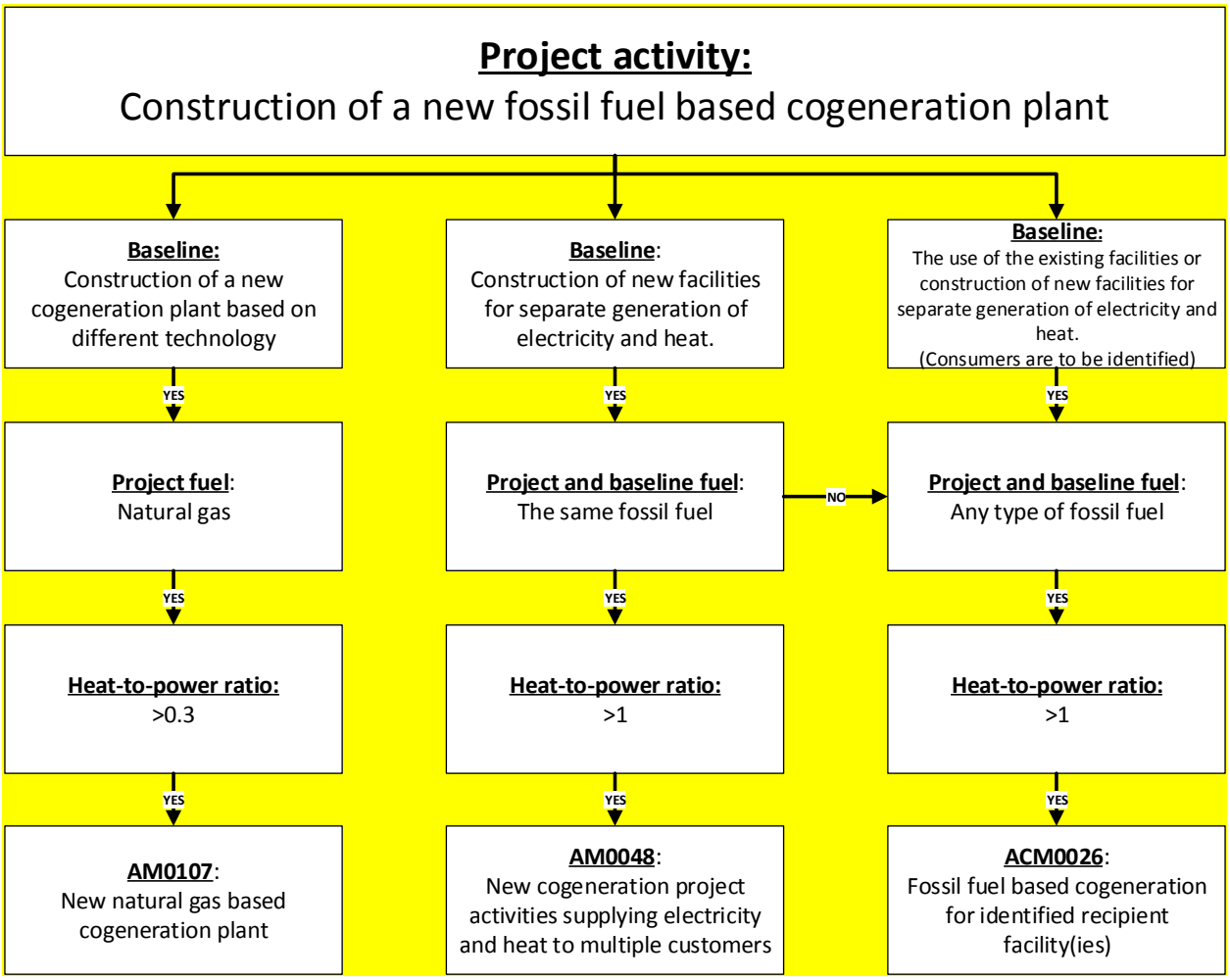
Data / Parameter table 5.

Data / Parameter:	$NCV_{NG,y}$
Data unit:	TJ/mass or volume unit
Description:	Net calorific value (energy content) of natural gas in year *y*
Source of data:	The following data sources may be used if the relevant conditions apply: **Data source** / **Conditions for using the data source** Values provided by the fuel supplier of the power plants in invoices / If data is collected from power plant operators (e.g. utilities) Regional or national average default values / If values are reliable and documented in regional or national energy statistics/energy balances IPCC default values at the lower limit of the uncertainty at a 95 per cent confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	The gross calorific value (GCV) of the fuel can be used, if gross calorific values are provided by the data sources used. Make sure that in such cases also a gross calorific value basis is used for CO_2 emission factor

Data / Parameter table 6.

Data / Parameter:	$FC_{NG,y}$
Data unit:	Mass or volume unit
Description:	Quantity of natural gas consumption in the project facility in year *y*
Source of data:	On-site meter(s)
Measurement procedures (if any):	On-site measurements
Monitoring frequency:	Continuously
QA/QC procedures:	Cross-check measurement results with records for natural gas purchasing
Any comment:	-

Appendix. The flowchart to navigate through fossil fuel cogeneration methodologies



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Document information

Version	*Date*	*Description*
04.0	4 November 2016	EB92, Annex 9. Revision to include the requirements in TOOL05 and to incorporate a flowchart to help project participants navigate through fossil fuel cogeneration methodologies.
03.0	16 April 2015	EB 83, Annex 4 Revision to simplify the methodology and improve its consistency.
02.0.0	13 September 2012	EB 69, Annex 16

Version	*Date*	*Description*
		Revision to remove the restriction for application under a programme of activities (PoA) in line with the decision at EB 68 stating that all approved methodologies are eligible for application in a PoA (EB 68, para. 97).
01.0.0	20 July 2012	EB 68, Annex 6 Initial adoption.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: cogeneration, fuel switching, power plants