CLEAN DEVELOPMENT MECHANISM

AM0048

Large-scale methodology

New cogeneration project activities supplying electricity and heat to multiple customers

Version 05.0

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	Fossil-fuel-fired cogeneration project supplying heat and electricity to multiple project customers
Type of GHG emissions mitigation action	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 fossil-fuel-fired cogeneration facilities.

3. In order to facilitate the choice of the methodology for the co-generation activities, a flow chart (Appendix) 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 a new fossil-fuel-fired cogeneration facility(ies) that supply heat and electricity to: (a) existing and new recipient facilities; and/or (b) electricity to grid; and/or (c) heat to heat networks.

5. The following applicability conditions apply:

   (a) Where the project activity is connected to grid and/or heat network, the geographical/physical boundaries of the grid and/or heat network to which the project activity is connected shall be identified and documented; and

   (b) The heat-to-power ratio of the project cogeneration facility shall be higher than 1.

6. The methodology is only applicable for the following situations:

   (a) Where the baseline scenario of electricity generation is a construction of a new fossil fuel based electricity generation facility (P2); and

   (b) Where the baseline scenario for heat generation is a construction of a new fossil-fuel based heat generation facility (H2).

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 of the revision 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 "NM0141-rev: Displacing grid/off-grid steam and electricity generation with less carbon-intensive fuels", whose baseline study and project design document were prepared by Quality Tonnes.

11. This methodology also refers to the latest version of the following tool(s):

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

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

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

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

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

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

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

4. Definitions

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

14. The following definitions apply for this methodology:

    (a) **Project facility** – a new fossil-fuel-based cogeneration facility established through investment as CDM project activity that is either a new construction with no operational history or has less than one year of operational history immediately prior to the start date of the project activity 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 by use of fossil fuels;

    (c) **Heat** - thermal energy that is generated in a heat generation facility (e.g. a boiler, a cogeneration plant, thermal solar panels, etc.) and transferred to a heat carrier (e.g. liquids, gases, steam, etc.) for utilization in thermal applications and processes. Note that the specific heat, as defined in this document, refers to the net quantity of thermal energy per unit of mass of heat carrier that is generated in the project facility. For example, in case of a boiler it refers to the difference of the

specific enthalpy of the steam generated in the boiler and the specific enthalpy of the feed water;

(d) **Heat network** – 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;

(f) **Reference energy generation facility** - the most plausible facility generating the power or heat in absence the proposed CDM project. The reference energy generation facility should be identified through economic analysis (including benchmark (e.g. IRR/NPV) analysis, cost-benefit analysis, or analysis of levelised cost of energy), subject to assessment of availability of such source. The reference energy generation facility should also be demonstrated to be commonly used in the relevant industry sector of the host country;

(g) **Recipient facility(ies)** – the facility(ies) that consumes electricity and heat supplied by the CDM project activity.

5. Baseline methodology

5.1. Project boundary

15. The spatial extent of the project boundary encompasses the project facility;

16. 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 the reference energy generation facilities	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 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. Procedure for the selection of the most plausible baseline scenario and demonstrate additionality

17. Project proponents shall apply the latest approved version of the "Combined tool to identify the baseline scenario and demonstrate additionality" (hereafter referred as the "combined tool") to identify the baseline scenario among all reasonable potential alternative scenarios that could provide similar services as the proposed project activity with the following additional guidance.

5.2.1. Identification of alternative scenarios

18. Examine the baseline scenario for the project proponents as per Sub-step 1a where the alternative scenarios should include all realistic and credible alternatives available to the project participants for the project activity that are consistent with current laws and regulations of the host country. All the alternatives shall include different technologies but the same fuel that project activity intends to implement. The PP shall explain why the use of a less carbon intensive fuel than the project fuel is not a realistic baseline alternative.

19. For the proposed project activity, the potential alternative scenarios shall be determined separately for:

    (a) Electricity generation;

    (b) Heat generation.

20. However, alternatives to the project activity should also include the scenario for the construction and operation of new cogeneration plant for electricity generation but using different technology.

21. The project proponent shall conduct the below analysis to establish the relevant electricity and heat alternatives for the project activity including the technology and related efficiency.

22. For electricity generation, the realistic and credible alternative(s) may include, inter alia:

    (a) P1: The project activity not implemented as a CDM project;

    (b) P2: Construction and operation of a new electricity generation facility using the same fuel as that used by project activity;

23. For generation of heat, the realistic and credible alternative(s) may include, inter alia:

    (a) H1: The project activity not implemented as a CDM project;

    (b) H2: Construction and operation of new fossil fuel based heat generation facility using the same fuel as that used by project activity.

5.3. Investment analysis

24. Apply an investment comparison analysis, as per Step 3 of the combined tool if more than one alternative is remaining after Step 1.

25. An integrated investment analysis combining the baseline scenarios for heat and electricity shall be performed to determine the baseline scenario. Although through the above steps alternatives may be identified separately for power generation and heat generation, the economic comparison of the baseline scenario alternatives should be

performed on the basis of the total cost to generate the total amount of electricity and heat to be provided by the project facility.

26. For investment analysis a levelized cost comparison shall be performed between the various alternatives available to the project participant. Since the price incurred by individual recipient facility(ies) for electricity and heat is not to be considered ex ante, the project participants shall assume that same price for electricity and heat generation is applicable to various alternatives and each alternative considered have a similar heat to power ratio amongst the compared alternatives.

5.4. Outcome

27. The methodology is applicable if the above procedure results in the following alternatives as the most plausible baseline scenarios:

    (a) Where the baseline scenario of electricity generation is P2;

    (b) Where the baseline scenario for heat generation is H2.

5.4.1. Determination of specification of the reference energy generation facility

28. The identified most plausible baseline scenario is the reference energy generation facility. The project proponent in the determination of the specification of reference energy generation facility shall:

    (a) Submit an alternative design for the electricity and heat generation separately for the capacity that will be displaced under the project activity;

    (b) Demonstrate through investment analysis that such alternative design would have been the baseline scenario for the electricity and heat generated in the Greenfield facility;

    (c) This alternative design provides the technology, whereas the fuel used shall be that used in the project facility.

29. A clear description of the reference electricity and heat generation facility, including information on the technology, such as the efficiency and technical lifetime shall be provided in the CDM-PDD.

5.5. Baseline emissions

30. The baseline emissions are sum of emissions from generation of electricity and emissions from generation of heat:

$$BE_y = BE_{EL,y} + BE_{HT,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in year *y* (t CO_2)
$BE_{EL,y}$	=	Baseline emissions from electricity generation in year *y* (t CO_2)
$BE_{HT,y}$	=	Baseline emissions from heat generation in year *y* (t CO_2)

5.5.1. Emissions for the production of electricity in year *y*

$$BE_{EL,y} = EL_{PJ,y} \times EEF_{BL}$$ Equation (2)

Where:

$EL_{PJ,y}$ = Amount of electricity generated by the project facility and supplied to recipient facility(ies) and/or the power grid in year *y* (MWh)

EEF_{BL} = Baseline CO_2 emission factor for electricity of the reference energy generation facility (t CO_2/MWh)

31. The baseline CO_2 emission factor for electricity is calculated as below.

5.5.2. Determination of the emission factor for baseline scenario P2

$$EEF_{BL} = \frac{EF_{P,co2} \times 3.6}{\eta_{P,ref}}$$ Equation (3)

Where:

$EF_{P,co2}$ = CO_2 emission factor of fuel type of the project facility that represents power generation facility (t CO_2/TJ)

$\eta_{P,ref}$ = Average net energy conversion efficiency of the technology of the reference energy generation facility for power generation (ratio)

Note: For calculation of baseline emissions it is assumed in this methodology that the baseline fossil fuel is the same as that used by project facility.

32. The efficiency $\eta_{P,ref}$ shall be determined by identification of a reference energy generation facility for electricity generation. The efficiency of the reference energy generation facility for electricity generation is determined as:

(a) Highest of the efficiency values provided by two or more reputed suppliers/manufacturers for the technology of the reference power plant; or

(b) Assume a power generation efficiency of 60 per cent as a conservative approach.

5.5.3. Emissions for the production of heat in year *y* (use of steam or hot water)

5.5.3.1. Steam or hot water

33. It is assumed that steam or hot water is produced at constant temperature and pressure.

$$BE_{HT,y} = SC_{PJ,y} \times SEF_{BL}$$ Equation (4)

Where:

$SC_{PJ,y}$ = Amount of steam or hot water generated in the project facility and supplied to recipient facility(ies) and/or heat networks in year *y* (TJ)

SEF_{BL} = Baseline CO_2 emission factor for steam or hot water of their reference energy generation facility (t CO_2/TJ)

34. The baseline CO_2 emission factor for steam or hot water is calculated as below.

5.5.4. Determination of the emission factor for scenarios H2

$$SEF_{BL} = \frac{EF_{H,co2,i}}{\eta_{H,ref}}$$ Equation (5)

Where:

$EF_{H,co2,i}$ = CO_2 emission factor of fuel type of the project facility that represents heat generation facility (t CO_2/TJ)

$\eta_{H,ref}$ = Average net energy conversion efficiency of the of the technology of the reference energy generation facility for heat generation (ratio)

Note: For calculation of baseline emissions it is assumed in this methodology that the baseline fossil fuel is the same as that used by project facility.

35. The efficiency $\eta_{H,ref}$ shall be determined by identification of a reference energy generation facility for heat. The efficiency of the reference energy generation facility for heat is determined as:

(a) Highest of the efficiency values provided by two or more reputed suppliers/manufacturers for the technology of the reference heat generation plant; or

(b) Assume a heat generation efficiency of 100 per cent as a conservative approach.

5.6. Project emissions

36. To calculate the project emissions from the combustion of fossil fuels to produce heat and electricity at the project facility(s) (PE_y), apply 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* are the processes that fire fossil-fuels attributable to the project activity.

5.7. Leakage

37. 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 grid 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.

38. Leakage shall be determined as per the provisions of the latest version of the tool "Upstream leakage emissions associated with fossil fuel use".

5.8. Emissions reductions

39. The emissions reductions are calculated as:

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

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

40. 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".

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

41. 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".

5.11. Data and parameters not monitored

Data / Parameter table 1.

<table>
<tr><td>Data / Parameter:</td><td>$\mathbf{EF_{P,co2}}$, $\mathbf{EF_{H,co2}}$</td></tr>
<tr><td>Data unit:</td><td>t CO_2/TJ</td></tr>
<tr><td>Description:</td><td>CO_2 emission factor of the fuel used in the reference energy generation facility that represents the power generation facility.
CO_2 emission factor of fuel used in the reference energy generation facility that represents the heat generation facility</td></tr>
<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) Values provided by the fuel supplier in invoices</td><td>This is the preferred source</td></tr>
<tr><td>(b) Measurements by the project participants</td><td>If (a) is not available</td></tr>
<tr><td>(c) Regional or national default values</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>
</table>

	(d) 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	If (c) is not available
Measurement procedures (if any):	For (a) and (b): measurements should be undertaken in line with national or international fuel standards	
Any comment:	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), (c) or (d) should be used	

Data / Parameter table 2.

Data / Parameter:	$\eta_{P,ref}$, $\eta_{H,ref}$
Data unit:	-
Description:	Efficiency of the reference energy generation facility
Source of data:	Electricity generation: efficiency of the reference energy generation facility for electricity generation is determined as: (a) Highest of the efficiency values provided by two or more reputed suppliers/manufacturers for the technology of the reference power plant; or (b) Assume a power generation efficiency of 60 per cent as a conservative approach. Heat generation: The efficiency of the reference energy generation facility for heat is determined as: (a) Highest of the efficiency values provided by two or more reputed suppliers/manufacturers for the technology of the reference power heat generation plant; or (b) Assume a heat generation efficiency of 100 per cent as a conservative approach
Measurement procedures (if any):	-
Any comment:	-

6. Monitoring methodology

42. 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.

43. 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.

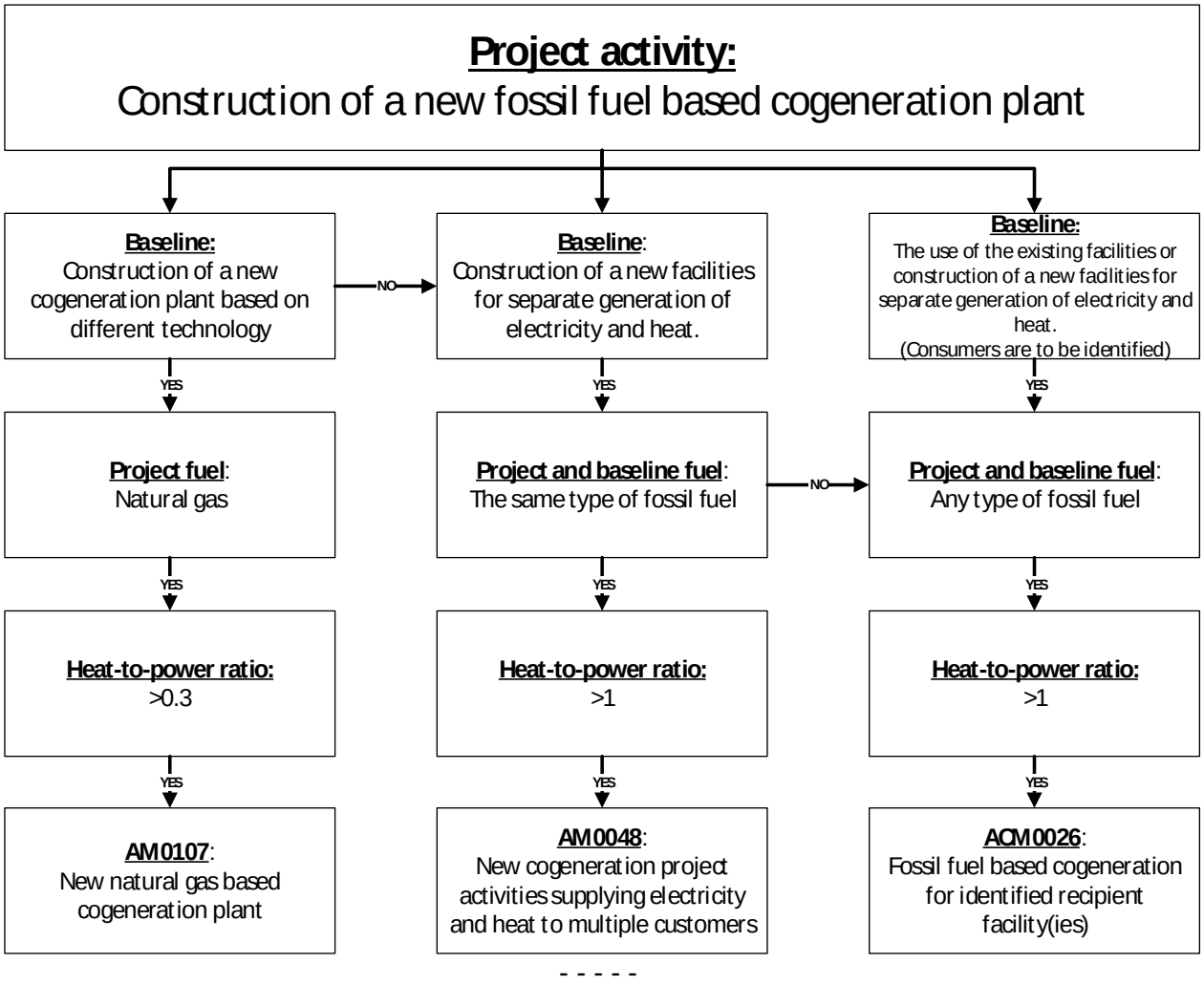
44. In addition, the monitoring provisions in the tools referred to in this methodology apply. Accordingly, $EL_{PJ,y}$ should be determined as per the "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation". When applying the tool, requirement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

6.1. Data and parameters monitored

Data / Parameter table 3.

Data / Parameter:	$\mathbf{SC_{PJ,y}}$
Data unit:	TJ
Description:	Amount of steam or hot water generated in the project facility and supplied to recipient facility(ies) and/or heat networks
Source of data:	On-site measurements
Measurement procedures (if any):	This parameter should be determined as the difference of the enthalpy of the process heat (steam or hot water) supplied to process heat loads in the project activity minus the enthalpy of the feed-water, the boiler blow-down and any condensate return to the heat generators. The respective enthalpies should be determined based on the mass (or volume) flows, the temperatures and, in case of superheated steam, the pressure. Steam tables or appropriate thermodynamic equations may be used to calculate the enthalpy as a function of temperature and pressure
Monitoring frequency:	Calculated based on continuously monitored data and aggregated as appropriate, to calculate emissions reductions
QA/QC procedures:	-
Any comment:	-

Appendix. The flowchart to navigate through fossil fuel cogeneration methodologies



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Document information

Version	*Date*	*Description*
05.0	4 November 2016	EB92, Annex 8 Revision to include the requirements in TOOL05 and to incorporate a flowchart to help project participants navigate through fossil fuel cogeneration methodologies.
04.0	28 November 2014	EB 81, Annex 8 The revision (i) simplifies and streamlines the methodology; and (ii) changes the title from "New cogeneration project activities supplying electricity and heat to multiple costumers" to "New

Version	*Date*	*Description*
		cogeneration project activities supplying electricity and heat to multiple customers".
03.1	20 July 2012	EB 68, Annex 9 Amendment to: (i) broaden the applicability of the methodology, by including calculations for the baseline emissions for projects that generate hot water; (ii) implement several editorial corrections; and (iii) change the title from "New cogeneration facilities supplying electricity and/or heat steam to multiple customers and displacing grid/off-grid steam heat and electricity generation with more carbon-intensive fuels" to "New cogeneration project activities supplying electricity and heat to multiple costumers".
03.0	12 February 2010	EB 52, Annex 6 Revision to (i) incorporate the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion", and (ii) correct an error in the units of equations (22) and (23).
02.0	19 October 2007	EB 35, Para 24 Revision to incorporate the use of the "Tool to calculate the emission factor for an electricity system".
01.0	4 May 2007	EB 31, Annex 2 Initial adoption.

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