Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE III - OTHER PROJECT ACTIVITIES

Project participants shall apply the general guidelines to SSC CDM methodologies and information on additionality (attachment A to Appendix B) provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

III.AL. Conversion from single cycle to combined cycle power generation

Technology/measure

1. This methodology is applicable for projects that convert existing single cycle gas turbine(s) or internal combustion engine (s) with or without cogeneration system to a combined cycle system with or without cogeneration.

2. For the purpose of this methodology:

   (a) 'Single cycle gas turbine/engine with cogeneration system' is defined as the simultaneous generation of (i) electricity and (ii) useful thermal energy (steam or hot water) via heat recovery from exhaust heat of the gas turbine/engine;

   (b) 'Combined cycle gas turbine/engine with cogeneration system' is defined as the simultaneous production of (i) electricity and (ii) useful thermal energy (steam or hot water); exhaust heat of the gas turbine(s)/engine(s) is utilised to produce steam which in turn is used to generate both (a) additional electricity via one or more condensing or non-condensing steam turbines and (b) useful thermal energy.[1]

3. The methodology is applicable under the following conditions:

   (a) The additional electricity produced by the project activity is for:

      (i) Captive use; and/or

      (ii) Supply to a grid.[2]

   (b) The useful thermal energy produced in the baseline and the project situation is for captive use only. The following conditions apply for conservative estimation of emission reductions:

      (i) If the amount of useful thermal energy supplied for captive use in the project scenario is less than the useful thermal energy supplied in the baseline scenario (on an annual basis, use the immediate past three years

[1] For example, in the baseline, a number of gas turbines are used for generating electricity while heat is recovered from only one of the gas turbines for process heat application. The remaining gas turbines operate in single cycle mode. The project activity utilizes flue gas generated by all the gas turbines and generates additional electricity using a steam turbine. Low pressure steam would also be extracted from the steam turbine to continue to provide at least the same quantity and quality of the process heat that was supplied in the baseline.

[2] Where it can be demonstrated that the equivalent amount of electricity would have otherwise been supplied by a grid and not by any other captive fossil fuel fired power plants.

data), the emissions associated with shortfall met by using other systems shall be taken into account as project emissions;

(ii) If the amount of useful thermal energy supplied for captive use in the project scenario is greater than the useful thermal energy supplied in the baseline scenario (on an annual basis, use the immediate past three years data), no emission reductions can be claimed for the incremental production of useful thermal energy.[3]

(c) The project activity utilizes excess heat (e.g. gas turbine/engine exhaust heat) that was previously unused (for at least three years before the start of the project activity) by the baseline system and this can be demonstrated by providing documents such as original process diagrams and schemes from the construction of the baseline single cycle system and/or on-site checks that the excess heat is unused in the baseline;

(d) The project activity does not involve any major overhauls to a baseline single cycle gas turbine/engine system. Specifically:

(i) The project activity does not increase the lifetime of the existing gas turbine/engine during the crediting period (i.e. this methodology is applicable up to the end of the lifetime of existing gas turbine or engine, if shorter than crediting period);

(ii) The project activity does not increase the capacity of the existing gas turbine/engine by more than 10%.

(e) It can be demonstrated that the baseline scenario is the continuation of the current practice i.e., in the absence of the proposed project activity,

(i) The electricity demand will be met by:

1. the operation of the existing single cycle gas turbine(s)/engine(s)system, and

2. Grid supply

(ii) Useful thermal energy demand will be met by the existing practice (e.g. through partial heat recovery from exhaust heat of the gas turbine/engine).

4. For the purpose of this methodology, natural gas is defined as a gas which consists primarily of methane, and which is derived from (i) natural gas fields (non-associated gas), (ii) associated gas found in oil fields. It may be blended up to 1% on a volume basis with gas from

[3] DOE shall check the historical data of useful thermal energy consumption and compare it with the energy consumed during the crediting period.

other sources, such as *inter alia*, biogas generated by biodigesters, gas from coal mines, or gas that is gasified from solid fossil fuels.[4]

5. Measures are limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.

Boundary

6. The physical site of the facility where (i) the baseline and project systems are in operation and (ii) the useful thermal energy is consumed.

Baseline

7. The baseline emissions for year *y* are calculated as follows:

$$BE_{X,y} = \left(EF_{BLsys} \cdot EG_{X,y}\right) + \left(EF_{grid,y} \cdot (EG_{PJ,y} - EG_{X,y})\right) \quad \textbf{(1)}$$

Where:

$EG_{X,y}$	Net electricity generated by the baseline system (MWh)
$BE_{X,y}$	Baseline emissions for year *y*
$EG_{PJ,y}$	Net electricity generated in year *y* (MWh)
EF_{BLsys}	Emission factor for the baseline system (tCO_2/MWh)
$EF_{grid,y}$	Emission factor of grid electricity displaced by the project activity during year *y* (tCO_2/MWh) determined in accordance with the procedure provided in AMS-I.D

8. If more than one fuel is used in the baseline system, the baseline calculation must use the emission factor of the least carbon intensive fuel that has been used in either (i) the three years immediately before project implementation or (ii) any year during the crediting period.

Step 1: Determining $EG_{X,y}$

Net electricity generated by the baseline system ($EG_{X,y}$) shall be determined by using two different methods as described below:

(a) Based on historic generation data ($EG_{HY,y}$) i.e. average net annual electricity generation of the baseline system during the three years immediately prior to the project start date (in MWh); and

(b) Based on the amount of base line electricity generation calculated assuming load situation of the project system ($EG_{LF,y}$):

[4] This limitation is included because the methodology does not provide procedures to estimate the GHG emissions associated with the production of gas from these other sources. Project activities that use gas that does not comply with this definition must apply for a revision of the methodology.

$$EG_{LF,y} = \frac{C_{BL}}{C_{PJ}} \cdot EG_{PJ.y} \quad \textbf{(2)}$$

Where:

C_{BL}	Net power generation capacity of the baseline system[5] (MW)
C_{PJ}	Net installed electricity generation capacity (MW) of the project system including the capacity of the baseline system (gas turbines/engines) and capacity of the steam turbine generator

Step 2: Estimating the emission factor for electricity generated in the baseline system

The emission factor for the baseline system (EF_{BLsys}) is determined from the historical performance of the system, using the data from the three most recent years and is calculated as follows:

$$EF_{BLsys} = \frac{FC_{HY}}{EG_{HY}} \cdot NCV_{FF} \cdot EF_{FF,CO2} \quad \textbf{(3)}$$

Where:

FC_{HY}	Average annual fuel consumption of the baseline system based on data from the three years prior to the start of the project (mass or volume units)
EG_{HY}	Average annual net electricity generation of the baseline system based on data from the three years prior to the start of the project (MWh)
NCV_{FF}	Net calorific value based on energy content per mass or volume unit
$EF_{FF,CO2}$	The CO_2 emission factor per unit of energy of the fossil fuel used in the baseline system in (tCO_2/TJ)

Step 3: Conservative estimation of baseline emissions

Applying equation 1 calculate ($BE_{,X,y}$) (as there are two values of ($EG_{X,y}$) there will be two results for ($BE_{X,y}$). The baseline emissions (BE_y) for year *y* is the lowest of the two values of ($BE_{,X,y}$) obtained i.e. based historical power generation ($BE_{HY,y}$) and based on the load factor of the project situation ($BE_{LF,y}$).

$$BE_y = MIN\left(BE_{HY,y}, BE_{LF,y}\right) \quad \textbf{(4)}$$

[5] Net capacity is defined as gross capacity minus auxiliary consumption of the plant.

Project Emissions

Project emissions include:

(a) Emissions from on-site consumption of fossil fuels by the gas turbines/engines and supplementary fossil fuel used in the project steam turbine plant calculated as per the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

(b) Emissions from electricity consumption of the project activity calculated using the latest version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption";

(c) If the amount of useful thermal energy (e.g. process heat) for captive use during the crediting period is less than the thermal energy supplied to the captive use in the baseline scenario, associated project emissions shall be estimated using the emission factor of the fuel used in the pre-project scenario:

$$PE_y = \frac{(EG_{thermal,HY} - EG_{PJ,thermal,y})}{\eta_{BL}} \cdot NCV_{FF} \cdot EF_{FF,CO2} \quad \textbf{(5)}$$

Where:

PE_y	Project emissions to be accounted for when thermal energy supplied to the captive use in the project scenario is less than that supplied in the baseline scenario (tCO_2)
$EF_{FF,CO2}$	The CO_2 emission factor per unit of energy of the fossil fuel used in the baseline system (tCO_2/TJ)
η_{BL}	Efficiency of the baseline thermal energy generation equipment. The efficiency shall be determined as per the procedures for determining baseline efficiency in AMS-I.C or the "Tool to determine the baseline efficiency of thermal or electric energy generation systems"
$EG_{thermal,HY}$	Thermal energy supplied to the captive use in the pre project scenario (in TJ); calculated by taking an average of the thermal energy supplied to the captive use in the most recent three years, prior to the start of the project
$EG_{PJ,thermal,y}$	Thermal energy supplied to the captive use by the project activity in year *y* (TJ)

Leakage

9. Leakage is to be considered if energy generating equipment is transferred from outside the boundary to the project activity.

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III.AL. Conversion from single cycle to combined cycle power generation (cont)

Emission Reductions

10. The emission reduction achieved by the project activity will be calculated as the difference between the baseline emissions, project emissions and the leakage.[6]

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

Where:

ER_y Emission reductions in the year y (tCO_2e)

LE_y Leakage emissions in year y

Monitoring

11. Monitoring shall include :

(a) Document all technical specifications of the equipment and systems;

(b) Relevant parameters shall be monitored as indicated in the Table III.AL.1. below. The applicable requirements specified in the General Guidelines to SSC methodologies (e.g. calibration requirements, sampling requirements) are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants.

[6] If a project activity temporarily results in "negative emission reductions", any further CERs will only be issued when the emissions increase has been compensated by subsequent emission reductions by the project activity (EB 21, paragraph 18)

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III.AL. Conversion from single cycle to combined cycle power generation (cont)

Table III.AL. 1

No	Parameter	Description	Unit	Monitoring/ recording frequency	Measuring Methods and Procedures
1	$EG_{PJ,thermal,y}$	Thermal energy consumed in the captive use in year *y*	TJ/year	Continuous, integrated hourly, at least monthly recording	Measured using calibrated meters. Thermal energy production is determined as the difference between the enthalpy of the steam or hot water generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and any condensate returns. The respective enthalpies shall be determined based on mass (or volume) flows, temperature, and pressure (in the case of superheated steam. Steam tables or appropriate thermodynamic equations may be used to calculate enthalpy as a function of temperature and pressure. In the case of a process that produces hot water or oil, this parameter is determined as the difference between the enthalpy of the hot water/oil supplied to and that returned from the plant
2		Temperature	°C	Continuous monitoring, hourly measurement and at least monthly recording	Measured using calibrated meters
3		Pressure	kg/cm^2	Continuous monitoring, hourly measurement and at least monthly recording	Measured using calibrated meters
4		Fuel consumption of the gas turbine(s)/engine(s)	Mass or volume unit/year	Hourly, prepare annually an energy balance	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". The quantity of fossil fuel combusted should be collected separately for all types of fossil fuel
5		Fuel consumption of the steam turbine(s) in year *y*	Mass or volume unit/year	Hourly, prepare annually an energy balance	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion." The quantity of fossil fuel combusted should be collected separately for all types of fossil fuel

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III.AL. Conversion from single cycle to combined cycle power generation (cont)

No	Parameter	Description	Unit	Monitoring/ recording frequency	Measuring Methods and Procedures
6	NCV_{FF}	The net calorific value of the fuel used	MJ/mass or volume	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion
7	$EF_{FF,CO2}$	Emission factor of the fossil fuels used	tCO_2/TJ	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion
8	$EG_{thermal,HY}$	Historical thermal energy consumption in process application (Average of the most recent three years)	TJ/year		Calculated based on steam consumption data and steam temperature & pressure data from the log books for the most recent three years. The calibration certificates for the recording meters shall be checked

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III.AL. Conversion from single cycle to combined cycle power generation (cont)

No	Parameter	Description	Unit	Monitoring/ recording frequency	Measuring Methods and Procedures
9	$EG_{PJ,y}$	Net quantity of electricity generated by the project activity	MWh/year	Continuous monitoring, hourly measurement and at least monthly recording	Measurements are undertaken using calibrated energy meters. If applicable, measurement results shall be cross checked with records for sold/purchased electricity (e.g. invoices/receipts)
10	C_{BL}	Net electricity generation capacity of the baseline system	MW	Once in crediting period	Net power generation capacity of single the cycle gas turbine or engine (before the project activity). Net capacity is defined as gross capacity less auxiliary consumption of the plant
11	C_{PJ}	Net electricity generation capacity of the project system	MW	Annually	Capacity of the project power plant in combined cycle operation be given as declared net capacity. Net capacity is defined as gross capacity less auxiliary consumption of the plant

Project activity under a programme of activities

12. The proposed methodology is not intended for application to a project activity under a program of activities.

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History of the document

Version	Date	Nature of revision
01	EB 55, Annex # 30 July 2010	To be considered at EB 55.
Decision Class: Regulatory **Document Type**: Standard **Business Function**: Methodology		