CLEAN DEVELOPMENT MECHANISM

CDM-SSCWG53-A05

Draft small-scale Methodology

AMS-III.AH: Shift from high carbon intensive fuel mix ratio to low carbon intensive fuel mix ratio

Version 03.0

Sectoral scope(s): 01

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The recommended revision of “AMS-III.AH: Shift from high carbon intensive fuel mix ratio to low carbon intensive fuel mix ratio” (version 2.0) is informed by the request for clarification “SSC_728: Clarification on baseline emissions calculations in AMS-III.AH”.

2. Purpose

2. The purpose of the recommended revision of the AMS-III.AH is to amend baseline equations to correctly account the share of baseline fuel in the total input energy of the element process for calculating baseline emissions and further clarify on the existing provision as regards ex ante calculations of baseline emissions.

3. Key issues and proposed solutions

3. The example provided in the clarification request SSC_728 substantiated the error in the current baseline equations, if applied would lead to negative emission reductions.

4. The proposed revision addresses the errors identified.

4. Impacts

5. The proposed revision, if approved, will rectify the error in the equations and further clarify the provisions related to baseline emission calculations.

5. Subsequent work and timelines

6. The methodology is recommended by the SSC WG for consideration by the Board at its ninety-fourth meeting.

6. Recommendations to the Board

7. The Board may wish to approve the proposed revision to the small scale methodology AMS-III.AH.

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1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	Replacement or retrofit in order to increase the share of less-carbon-intensive fossil fuels in an element process of industrial, residential or commercial applications
Type of GHG emissions mitigation action	Fuel switch: Switch to less-carbon-intensive fuel in energy conversion processes

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology comprises activities that result in increased share of low GHG intensive fossil fuel in an element process of an industrial, residential, commercial, and institutional or electricity generation application[1] that uses a mix of fossil fuel. For example, shift from high carbon intensive fuel mix ratio to low carbon intensive fuel mix ratio on an annual basis in power generation.[2]

2.2. Applicability

3. This methodology is applicable to retrofit or replacement of existing installations. Cases involving Greenfield projects and capacity additions[3] are not eligible under this methodology.

4. Switching of fuel mix ratio may also result in energy efficiency improvements of the facility, thus both the project activities with or without energy efficiency improvements are eligible under this category. Project activities for implementation of energy efficiency measures not-related to the switch of energy sources may apply Type II SSC methodologies.

5. The requirements for demonstration of the remaining lifetime of the equipment replaced shall be met as described in the "Tool to determine the remaining lifetime of equipment". If the remaining lifetime of the plant increases due to the project activity, the project activity may claim emission reductions only up to the estimated remaining lifetime, i.e. the time when the existing equipment of the element process would have been replaced in the absence of the project activity.

6. This methodology is not applicable to project activities that propose switch from fossil fuel use in the baseline to renewable biomass, biofuel or renewable energy in the project scenario.

[1] Fuel switch in transportation technologies is not eligible under this methodology.

[2] Substitution of heavy fuel oil (HFO) engine with a Natural Gas (NG) engine to shift to a low GHG intensive fuel mix ratio of 25:74:1 (HFO: NG: Diesel) from a baseline fuel mix ratio of 69:30:1 (HFO: NG: Diesel) on an annual basis.

[3] I.e. the project capacity is within +10 % and -10% of the baseline installed capacity.

7. This methodology is not applicable to project activities utilising waste gas or energy; these project activities may consider applying AMS-III.Q.

8. This methodology is applicable to project activities where it is possible to directly measure and record the energy use (e.g. electricity or heat) and consumption (e.g. fossil fuel) within the project boundary, except for cases described under paragraph 25 and 29 where the quantity of project fuel consumed, that is used as a proxy, shall be monitored.

9. Heat or electricity produced under the project activity shall be for on-site captive use and/or export to other facilities included in the project boundary. In case energy produced by the project activity is delivered to another facility or facilities, to displace more carbon intensive energy source than the project fuel mix, within the project boundary, a contract between the supplier and consumer(s) of the energy will have to specify that only the facility generating the energy can claim emission reductions from the fuel switch.

10. Export of electricity to a grid is not eligible under this methodology. That is, the project activity may physically connect to a grid but emission reduction cannot be claimed by exporting electricity to the grid.

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

12. Regulations do not constrain the facility from using the energy sources before the fuel switch. Regulations do not require the use of low carbon energy sources (e.g. natural gas or any other fuel) in the element processes.

13. The project activity does not result in integrated process change. The purpose is to exclude measures that affect other characteristics of the process besides switch of energy sources, e.g. operational conditions, type of raw material processed, use of non-energy additives, change in type or quality of products manufactured etc.

2.3. Entry into force

14. The date of entry into force is the date of the publication of the EB 94 meeting report on 5 May 2017.

2.4. Applicability of sectoral scopes

15. 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

16. Project participants shall apply the “General guidelines for SSC CDM methodologies” and the tool “Demonstration of additionality of small-scale project activities” provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> mutatis mutandis.

17. This methodology also refers to the latest approved versions of the following tools and methodologies:

    (a) “ACM0009: Fuel switching from coal or petroleum fuel to natural gas”;

(b) "AMS-III.Q: Waste energy recovery (gas/heat/pressure) projects";

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

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

4. Definitions

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

19. For the specific purpose of this methodology, an **element process** is defined as fuel combustion, energy conversion or energy use in single equipment. Each element process generates a single output (such as electricity, steam, hot air) by using a single or combinations of fossil fuels. This methodology covers fuel switch in several element processes, i.e. project participants may submit one CDM-PDD for fuel switch in several element processes within a facility.

5. Baseline methodology

5.1. Boundary

20. The project boundary is the physical, geographical site where the switching of energy source takes place. It includes all installations, processes or equipment affected by the switching. The boundary also extends to the industrial, commercial or residential facilities consuming energy generated by the system.

5.2. Baseline

21. Historical information (detailed records) on the use of fossil fuels and the element process output (e.g. heat or electricity) from at least three years prior to project implementation shall be used in the baseline calculations, e.g. information on coal use and heat output by a district heating plant, liquid fuel oil use and electricity generated by a generating unit (records of fuel used and output can be used in lieu of actual collecting baseline validation data). For facilities that are less than three years old, all historical data shall be available (a minimum of one-year data would be required). In case of project activity exporting to other facilities included in the project boundary, the above historical information from the recipient plants is required.

22. During the crediting period, if there is a restricted availability of a particular baseline fuel on account of local regulations, this has to be considered by adjusting the baseline emissions ex post for the period where the baseline fuel is not available. The adjustment is done in a conservative manner i.e. if the restriction results in downward adjustment of baseline emissions it shall be taken into account[4]. On the other hand, upward adjustment of baseline emissions is not eligible.

[4] With reference to footnote 3, if the regulations result in for example HFO:NG ratio of 60:39 it shall be used for baseline calculations.

23. The baseline emissions can be determined as follows:

$$BE_y = \sum_{i,j} \left(FC_{BL,i,j,y} \times NCV_{BL,j} \times EF_{BL,j} \times a_{BL,i,j} \right)$$ Equation (1)

Where:

BE_y	=	Baseline emissions during year *y* (tCO_2e)
$FC_{BL,i,j,y}$	=	Amount of baseline fuel *j* consumed by the element process *i* during the year *y* operating at the baseline energy scenario (liters, tons, etc.)
$NCV_{BL,j}$	=	Net calorific value of the baseline fuel type *j* (kJ/unit)
$EF_{BL,j}$	=	CO_2 emission factor of the baseline fuel type *j* (tCO_2/kJ)
$a_{BL,i,j}$	=	Share of fuel j in the total input energy of the element process *i* for the identified baseline scenario (ratio)

24. The amount of each fuel type *j* consumed is calculated ex post using the total monitored energy output of the element process *i* during year *y* and the share of each energy source in the identified baseline scenario:

$$FC_{BL,i,j,y} = \frac{EG_{PJ,i,y}}{NCV_{BL,j} \times Eff_{BL,i,j}} \times a_{BL,i,j}$$ Equation (2)

Where:

$EG_{PJ,i,y}$	=	Total monitored output (heat, electricity, etc.) of the element process *i* during year *y* (kJ)
$Eff_{BL,i,j}$	=	Conversion efficiency of the element process *i* when operating with fuel type *j* in the baseline scenario
		Net calorific value of the baseline fuel type *j* (kJ/unit)
$a_{BL,i,j}$	=	Share of fuel j in the total input energy of the element process *i* for the identified baseline scenario (ratio)

25. Alternatively for cases where the energy output cannot be measured, the amount of each baseline fossil fuel type *j* $FC_{BL,i,j,y}$, it can be estimated based on the actual monitored quantity of project fossil fuel in the element process ($FC_{PJ,i,j,y}$) and the energy efficiency[5] and the net calorific values between the project scenario and the baseline scenario using the equation below.

$$EG_{PJ,i,y} = \sum_{j} \left(FC_{PJ,i,j,y} \times NCV_{PJ,j} \times Eff_{PJ,i,j,y} \right)$$

$$FC_{BL,i,j,y} = FC_{PJ,i,j,y} \times \left(NCV_{PJ,j} \times Eff_{PJ,i,j,y} \right) / \left(NCV_{BL,j} \times Eff_{BL,i,j} \right)$$ Equation (3)

[5] In case of multiple fuels used weighted average efficiency should be used both for baseline and project.

Where:

$FC_{PJ.i.j.y}$	=	Amount of project fossil fuel type *j* consumed by the element process *i* during the year y (liters, tons, etc.)
$NCV_{PJ,j}$	=	Net calorific value of the project fuel type *j* (kJ/unit)
$Eff_{PJ,i,j,y}$	=	Conversion efficiency of the element process *i* when operating with fuel type *j* in the project scenario in year *y* (%)

26. Efficiency of the baseline units shall be determined by adopting one of the following criteria (in a preferential order):

(a) Highest measured operational efficiency over the full range of operating conditions of a unit with similar specifications, using baseline fuel. The efficiency tests shall be conducted following the guidance provided in relevant national / international standards;

(b) Highest of the efficiency values provided by two or more manufacturers for units with similar specifications, using the baseline fuel;

(c) If the amount of the baseline fuel consumption is determined as per the paragraph 24 above and where project participants can reasonably demonstrate that the efficiency of the element process does not change due to the fuel switch or that any changes are negligible (e.g. less than 1%) (or that project efficiency can be expected to be higher than the baseline efficiency, project participants can assume that the $Eff_{PJ,i,j,y} = Eff_{BL,j}$ as a simplification, provided that baseline and project efficiency can be established ex ante. The same can be applied in cases where the project efficiency is to be established ex post using one year of monitored data and fixed for the rest of crediting period;

(d) Use default baseline efficiency as per Option F of the "Tool to determine the baseline efficiency of thermal or electric energy generation systems";

(e) Default efficiency of 100%.

27. The values for baseline efficiency should be documented in the PDD and shall remain fixed throughout the crediting period.

28. The ex *ante* calculation of the baseline emissions shall be presented in the PDD based on the estimated production of the element process *i* during the crediting period[6].The ex post calculations are done based on measured output of the element process.

29. In case of project activities where the energy output cannot be directly measured and the estimated annual emission reductions of each of the element processes are equal to or less than 600 t CO_2e per year per project element process ~~and where the energy output cannot be directly measured~~ the baseline emissions can be estimated using as a proxy

[6] For example, the estimated production may be determined using historical information following paragraph 21 of the methodology.

the amount of fossil fuel consumed in the project activity in year *y* ($FC_{PJ,i,j,y}$) following the equation below:

$$BE_y = \sum_{i,j} FC_{PJ,i,j,y} \times NCV_{PJ,j} \times EF_{BL,j} \times a_{BL,i,j}$$ Equation (4)

5.3. Project Activity Emissions

30. Project activity emissions consist of those related to use of fossil fuel in element processes *i* during the crediting period.

$$PE_y = \sum_{i,j} FC_{PJ,i,j,y} \times NCV_{PJ,j} \times EF_{PJ,j}$$ Equation (5)

Where:

PE_y	=	Project emissions during the year *y* (t CO_2e)
$FC_{PJ,i,j,y}$	=	Quantity of fuel type *j* combusted in element process *i* during the year *y* (mass or volume unit)
$NCV_{PJ,j}$	=	Net calorific value of the fuel type *j* (kJ/unit)
$EF_{PJ,j}$	=	CO_2 emission factor of the fuel type *j* (tCO_2/kJ)

5.4. Leakage

31. No leakage calculation is required.

5.5. Emission Reductions

32. The emission reduction achieved by the project activity will be calculated as the difference between the baseline emissions and the project emissions.

$$ER_y = BE_y - PE_y$$ Equation (6)

Where:

ER_y	=	Emission reductions in the year *y* (tCO_2e)

33. For the determination of the emission factor and the net calorific value for the fossil fuels used guidance by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories shall be followed where appropriate. Project participants may either conduct measurements or they may use accurate and reliable local or national data where available. In the case of coal, the data shall be based on test results for periodic samples of the coal purchased if such tests are part of the normal practice for coal purchases. Where such data is not available, IPCC default emission factors (country-specific, if available) may be used if they are deemed to reasonably represent local circumstances. All values shall be chosen in a conservative manner (i.e. lower values for the baseline and

higher values for the project should be chosen within a plausible range) and the choice shall be justified and documented in the SSC-CDM-PDD. Where measurements are undertaken, project participants shall document the measurement results and the calculated average values of the emission factor or net calorific value for the ex post determination of the baseline and project emissions.

6. Monitoring methodology

6.1. Parameters not monitored:

Data / Parameter table 1.

Data / Parameter:	$NCV_{BL,j}$
Data unit:	(TJ/mass or volume unit)
Description:	Net calorific value of baseline fuel type *j*
Source of data:	National values or the latest version IPCC
Measurement procedures (if any):	
Monitoring frequency:	
QA/QC procedures:	
Any comment:	Reliable local or national data for the NCV shall be used; IPCC default values should be used only when country or project specific data are not available or difficult to obtain. Note that IPCC default values are provided in the unit of TJ/Gg. To convert from mass to volume unit, the density of the fuel should be determined in accordance with the options and relevant conditions provided in the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

Data / Parameter table 2.

Data / Parameter:	$EF_{BL,j}$
Data unit:	gCO2/MJ
Description:	CO_2 emission factor of fuel in the year y
Source of data:	National values or the latest version IPCC
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	--
Any comment:	

Data / Parameter table 3.

Data / Parameter:	$Eff_{BL,i,j}$
Data unit:	(-)
Description:	Conversion efficiency of the element process *i* when operating with fuel type *j* in the baseline scenario.

Source of data:	Determined in accordance with paragraph 26
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$a_{BL,i,j}$
Data unit:	(-)
Description:	Share of fuel j in the total input energy of the element process *i* for the identified baseline scenario (ratio)
Source of data:	Historic data based on records, as per paragraph 21
Measurement procedures (if any):	-
Monitoring frequency:	-
QA/QC procedures:	-
Any comment:	-

6.2. Monitored parameters

34. Relevant parameters shall be monitored and recorded during the crediting period as indicated in the section below. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" are also an integral part of the monitoring guidelines specified below and therefore shall be followed by the project participants.

Data / Parameter table 5.

Data / Parameter:	$FC_{PJ,l,j,y}$
Data unit:	m^3 or kg
Description:	Quantity of fossil fuel j combusted in the element process *i* during the year y
Source of data	"Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Measurement procedures (if any):	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	As per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedures:	
Any comment:	

Data / Parameter table 6.

Data / Parameter:	***$EG_{PJ,y,I}$ (electricity)***
Data unit:	MWh
Description:	Total monitored output (electricity) of the element process *i* during year y
Source of data:	On-site measurements
Measurement procedures (if any):	Use energy meters
Monitoring frequency:	Continuously, aggregated at least annually
QA/QC procedures:	Cross check measurement results with invoices for purchased electricity if relevant
Any comment:	

Data / Parameter table 7.

Data / Parameter:	***$EG_{PJ,y,I}$ (heat)***
Data unit:	TJ
Description:	Total monitored output (thermal energy) of the element process *i* during year y
Source of data:	Plant records
Measurement procedures (if any):	Heat generation is determined as the difference of the enthalpy of the steam or hot fluid and/or gases generated by the heat generation equipment and the sum of the enthalpies of the feed-fluid and/or gases blow-down and if applicable any condensate returns. 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. In case of equipment that produces hot water/oil this is expressed as the difference in the enthalpy between the hot water/oil supplied to and returned by the plant. In case of equipment that produces hot gases or combustion gases, this is expressed as the difference in the enthalpy between the hot gas produced and all streams supplied to the plant. The enthalpy of all relevant streams shall be determined based on the monitored mass flow, temperature, pressure, density and specific heat of the gas. In case the project activity is exporting heat to other facilities, the metering shall be carried out at the recipient's end
Monitoring frequency:	Continuous monitoring, aggregated annually
QA/QC procedures:	Measurement results shall be cross checked with records for sold/purchased thermal energy (e.g. invoices/receipts)
Any comment:	Metering the energy produced by a sample of the systems where the simplified baseline is based on the energy produced multiplied by an emission coefficient

Data / Parameter table 8.

Data / Parameter:	$Eff_{PJ,i,j,y}$
Data unit:	(%)
Description:	Conversion efficiency of the element process *i* when operating with fuel type *j* in the project scenario in year *y*
Source of data:	
Measurement procedures (if any):	The efficiencies should be determined by undertaking measurements at the element process firing the relevant fuels. All measurements should be conducted at a representative load factor (or operation mode), based on national or international standards. Where a representative load factor (or operation mode) cannot be determined, measurements should be conducted for different load factors (or operation modes) and be weighted by the time these load factors (or operation modes) are typically operated. For project activities with estimated annual emission reductions of each of the element processes equal to or less than 3000 t CO_2e per year the efficiencies may be determined using sampling in accordance with the standard "Sampling and surveys for CDM project activities and programme of activities". Estimates at upper limit of the uncertainty at 95 per cent confidence interval should be used
Monitoring frequency:	Monthly or fixed for the crediting period if Option D of the methodology is applied
QA/QC procedures:	
Any comment:	

Data / Parameter table 9.

Data / Parameter:	$EF_{PJ,j,y}$
Data unit:	t CO_2/GJ
Description:	CO_2 emission factor of the fossil fuel j combusted in element process *i* in the year *y*
Source of data:	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Measurement procedures (if any):	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

Data / Parameter table 10.

Data / Parameter:	$NCV_{PJ,j}$
Data unit:	GJ/m^3
Description:	Average net calorific value of the fossil fuel *j* combusted in element process *i* during the year *y*
Source of data:	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Measurement procedures (if any):	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

Monitoring frequency:	As per "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
QA/QC procedures:	
Any comment:	Note that IPCC default values are provided in the unit of TJ/Gg. To convert from mass to volume unit, the density of the fuel should be determined in accordance with the options and relevant conditions provided in the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"

6.3. Project activity under a programme of activities

35. The following conditions apply for use of this methodology in a project activity under a programme of activities:

(a) Leakage emissions resulting from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary shall be considered, as per the guidance provided in the leakage section of ACM0009. In case leakage emissions in the baseline situation are higher than leakage emissions in the project situation, leakage emissions will be set to zero.

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Document information

Version	*Date*	*Description*
03.0	3 April 2017	SSC WG 53, Annex 05 To be considered by the Board at EB 94. Revision to rectify the error in the baseline equations and further clarify the provisions related to baseline emission calculations.
02.0	24 July 2015	EB 85, Annex 17 Revision to • Further improve consistency amongst small and large scale fuel switch methodologies; and • Provide options with distinguishing methods by project size (e.g. microscale) with an aim to further simplify emission reduction calculations.
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