Approved baseline and monitoring methodology / methodological tool clarification response form (Version 03.0)

INFORMATION TO BE COMPLETED BY THE SECRETARIAT OR PANEL / WG	
Date and number of Panel / WG meeting:	20-23 March 2017 / SSC WG 53
Title/Subject of the request for clarification:	Clarification on baseline emissions calculations in AMS-III.AH
Reference number of the request for clarification:	SSC_728
Exact reference (number, title and version) of the methodology or methodological tool to which the request for clarification applies:	AMS-III.AH. Shift from high carbon intensive fuel mix ratio to low carbon intensive fuel mix ratio --- Version 2.0
Fast track or Regular track:	☐ Fast track ☒ Regular track

Summary of the request for clarification

Original text from Stakeholder:

Project activity: The project activity involves boilers/heaters operate with heavy oil (HFO) & micro-sulfur fuel oil (OC)& fuel gas(FG) in the baseline scenario. In the project scenario, the boilers/heaters generate thermal energy with low carbon fuel-mix i.e.,, natural gas (LNG) & fuel gas (FG). In the baseline scenario, heavy fuel oil is the primary fuel used. In the project scenario, LNG is the main fuel that generating thermal energy with the lower CO2 emission factor than HFO&OC. Reduction in greenhouse gas emissions would achieve through replacement of Fuel Oil with Natural Gas.

It is our understanding that AMS-III.AH covers the underlying project activities that result in increased share of low GHG intensive fossil fuel in an element process that uses a mix of fossil fuel . The project in question may be similar with CDM registered project ref:9714 applying AMS-III.AH.

Also, since the project in question involves multiple fuels, AMS-III.B and AMS-III.AN would not be applicable.

Issue for which clarification is sought:

The application of AMS-III.AH returns negative emission reductions in the example case shown below where fuel mix in the baseline is in the ratio of 67% HFO: 25% Fuel gas:8% micro-sulphur fuel oil and in the project 75% LNG and 25% fuel gas.

About the application of AMS-III.AH ver.02, in the case that the baseline fuel hasn't be replaced completely by a fuel, when following equation (1) to calculate baseline emission, the result of emission reductions will be negative.

Historical information

fuel type	Amount of fuel consumed	Net calorific value	input energy (Mcal/y)	Share of fuel j in the total input energy of the element process i for the identified baseline scenario (%)	CO_2 emission factor (tCO_2/Mcal)
heavy fuel oil (HFO)	4,500 kL/y	9,600 kcal/L	43,200,000	67	3.24×10^{-4}
micro-sulfur fuel oil (OC)	500 kL/y	9,900 kcal/L	4,950,000	8	3.25×10^{-4}

fuel gas (FG)	5,000 km^3/y	3,200 $kcal/m^3$	16,000,000	25	0.9×10^{-4}

In PDD, FC_{BL} use historical fuel combustion. Baseline emission can be estimates as follow.

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

..... equation(1)

BE_y=(5,016 kL/y ×9,600 kcal/L× 3.24×10^{-4}tCO₂/Mcal× 67%)+ (4,864 kL/y ×9,900 kcal/L× 3.25×10^{-4}tCO₂/Mcal× 8%) +(5,000 km^3/y×3,200 kcal/m^3×0.9×10^{-4}tCO₂/Mcal× 25%)
≒ 10,506 tCO₂ + 1,208 tCO₂+ 359 tCO₂≒12,072 tCO₂

In this case, the energy output cannot be measured, in accordance with 24 paragraph, follow equation(3) and equation(5) to estimates project emission.

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

..... equation(3)

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

..... equation(5)

Assuming $Eff_{PJ,i,j,y}$ = $Eff_{BL,j}$, when the project have been implemented, input energy will be generated from LNG and FG. IF there doesn't any change of operational conditions, except LNG to replace HFO, input energy from FG in project scenario would the same with in baseline scenario.
Thus the historical data is used below to estimate equivalent fuel consumption in project scenario (FCPJ,y) for the purpose of ex ante calculation in the PDD. In the crediting period, FCPJ,y shall be based on actually measured data of project activity.

Project information

fuel type	Amount of fuel consumed	Net calorific value	input energy (Mcal/y)	CO_2 emission factor ($tCO_2/Mcal$)
natural gas (LNG)	5,472 km^3/y	8,800 $kcal/m^3$	48,150,000	2.35×10^{-4}
fuel gas (FG)	5,000 km^3/y	3,200 $kcal/m^3$	16,000,000	0.9×10^{-4}

$FC_{PJ,LNG}$=(4,500 kL/y ×9,600 kcal/L+500 kL/y ×9,900 kcal/L)÷ 8,800 $kcal/m^3$
=5,472 km^3/y
$FC_{BL,HFO}$=(5,472 km^3/y×8,800 $kcal/m^3$) ÷9,600 kcal/L= 5,016 kL/y
$FC_{BL,OC}$=(5,472 km^3/y×8,800 $kcal/m^3$) ÷9,900 kcal/L= 4,864 kL/y
$FC_{BL,FG}$=(5,000 km^3/y×3,200 $kcal/m^3$) ÷3,200 $kcal/m^3$= 5,000 km^3/y

PE_y=(5,472 km^3/y×8,800 $kcal/m^3$× 2.35×10^{-4} tCO₂/Mcal)+ (5,000 km^3/y×3,200 $kcal/m^3$×0.9×10^{-4}tCO₂/Mcal)
= 11,315 tCO₂+1,440 tCO₂
= 12,755 tCO₂

Emission reductions as follow will be a negative value.
ER_y=BE_y-PE_y= 12,072 tCO₂-12,755 tCO₂=-683 tCO₂

In this case, the emission factor of LNG(2.35×10^{-4} tCO₂/Mcal) is lower than the emission factor of HFO(3.24×10^{-4} tCO₂/Mcal). When FC_{BL} have been used historical fuel combustion and input energy from FG in project scenario is the same with in baseline scenario, emission reductions shouldn't be a negative value.

That may be as a result of parameter α in equation (1).

Consideration of that the baseline fuel hasn't been replaced completely by single fuel, parameter α may be calculated of $FC_{BL,y}$, such as AMS-III.AH. **ver.01** equation (2). In the case that the energy output cannot be measured, may be use other parameter βto calculate $FC_{BL,y}$ in equation(3).As follows.
$FC_{BL,i,j,y}$=[$FC_{PJ,i,j,y}$ ×($NCV_{PJ,j}$×$Eff_{PJ,i,j,y}$)/ ($NCV_{BL,j}$×$Eff_{BL,i,j,y}$)] ×β

β= Share of fuel j in **the total input energy of x fuel type** of the element process i for the identified baseline scenario (ratio)

For example in above,

fuel type	input energy (Mcal/y)	Share of fuel j in the total input energy of x fuel type of the element process i for the identified baseline scenario (%)
heavy fuel oil (HFO)	43,200,000	89.72
micro-sulfur fuel oil (OC)	4,950,000	10.28
fuel gas (FG)	16,000,000	100

$FC_{BL,HFO}$=[(5,472 km^3/y×8,800 kcal/m^3) ÷9,600 kcal/L] ×89.72%= 4,500 kL/y
$FC_{BL,OC}$=[(5,472 km^3/y×8,800 kcal/m^3) ÷9,900 kcal/L] ×10.28%= 500 kL/y
$FC_{BL,FG}$=[(5,000 km^3/y×3,200 kcal/m^3) ÷3,200 kcal/m^3] ×100%= 5,000 km^3/y

BE_y=(4,500 kL/y ×9,600 kcal/L× 3.24×10^{-4}tCO$_2$/Mcal)+ (500 kL/y ×9,900 kcal/L× 3.25×10^{-4}tCO$_2$/Mcal)
+(5,000 km^3/y×3,200 kcal/m^3×0.9×10^{-4}tCO$_2$/Mcal)
≒13,997 tCO$_2$ + 1,609 tCO$_2$+ 1,440 tCO$_2$≒17,046 tCO$_2$

ER_y=BE_y-PE_y= 17,046 tCO$_2$-12,755 tCO$_2$≒4,290 tCO$_2$

Baseline emissions calculated directly from historical data: 13997+ 1609+ 1440 = 17046 tCO2
Project emissions = 12755 tCO2
ER= 17046-12755 = 4290 tCO2

The clarification thus is requested:

In according to AMS-III.AH ver2.0 paragraph 13 “The project activity does not result in integrated process change.” Nor there are any changes in operational conditions are expected before and after project activity. Hence energy consumption in heat generating of boilers during the project would equal to the energy consumption in the baseline. However, the above example shows that case calculating baseline emission with AMS-III.AH ver2.0 equation (1), even if there are not any change between project activity implementation, energy consumption would not be equal and would lead toa negative emission reduction.

In order to estimate baseline emissions correctly, perhaps α shouldn’t be calculated in equation(1). Or, maybe α would be redefined as “baseline energy ratio of fuel replaced in project scenario” such as β shown in the example above or if the fuel not to be replaced in project scenario, α = 1.

Clarification by the secretariat or Panel / WG

The SSC WG would like to thanks the author for submitting the clarification request. The SSC WG acknowledged the error in the equations to calculate the baseline emissions and agreed to clarify as follows:

1. The baseline emissions can be determined using the equation below:

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

Where:

BE_y	=	Baseline emissions during year *y* (tCO$_2$e)
$FC_{BL,i,j,y}$	=	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)

2. 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:

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

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
$NCV_{BL,j}$	=	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)

3. For cases where the energy output cannot be measured, 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[1] and the net calorific values between the project scenario and the baseline scenario using the equation below.

$$EG_{PJ,i,y} = \sum_{j} \left(FC_{PJ,i,j,y} \times NCV_{PJ,j} \times Eff_{PJ,i,j,y} \right) \qquad \text{Equation (3)}$$

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* (%)

With regards the ex ante estimation, paragraph 28 of the methodology states "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". The estimated production, for example can be determined using historical information following paragraph 21 of the methodology in case efficiency of the project 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).

The SSC WG, taking into account the above clarification, agreed to recommend the revision of AMS-III.AH, as contained in Annex 5 of the meeting report of the SSC WG 53.

Version(s) of the approved methodology / methodological tool to which the clarification is applicable:

AMS-III.AH: Shift from high carbon intensive fuel mix ratio to low carbon intensive fuel mix ratio --- Version 2.0

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

Document information

Version	*Date*	*Description*
03.0	13 May 2016	Revised to include the row "Version(s) of the approved methodology / methodological tool to which the clarification is applicable"
02.0	18 July 2013	Revised to remove the row "Date and signature of the chair and vice chair of Panel/WG (in case of clarification by Panel/WG)"
01.0	4 July 2013	Initial publication. This document supersedes and replaces the following documents: • Recommendation Form for Small Scale Methodologies (F-CDM-SSCwg) (Version 01.1) • Recommendation Form for Small Scale A/R Methodologies and Procedures (F-CDM-SSC-AR) (Version 01.1)

Decision Class: Regulatory
Document Type: Form, Clarification
Business Function: Methodology
Keywords: applying methodologies and tools