Annex 14

A/R Methodological Tool

"Estimation of GHG emissions related to fossil fuel combustion in A/R CDM project activities"

(Version 01)

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope and applicability

This tool allows for estimating increase in GHG emissions[1] (both project and leakage emissions) related to fossil fuel combustion in A/R CDM project activities. The sources of emissions are: vehicles (mobile sources, such as trucks, tractors, etc.) and mechanical equipments (e.g., portable equipment such as chain saws and stationary equipment such as, water pumps) required by the A/R CDM project activity.

Parameters

This tool provides procedures to determine the following parameter:

Parameter	SI Unit	Description
$ET_{FC,y}$	t-CO_2	CO_2 emissions from fossil fuel combustion during the year *y*

II. PROCEDURE[2]

$$ET_{FC,y} = \sum_{j=1}^{J} ET_{FC,j,y} \qquad \textbf{(1)}$$

Where:
$ET_{FC,y}$: CO_2 emissions from fossil fuel combustion during the year *y* (tCO_2)
$ET_{FC,j,y}$: CO_2 emission from fossil fuel combustion in vehicle/equipment type *j* during year *y* (tCO_2/yr)
j: Type of vehicle/equipment
J: Total number of types of vehicle/equipment used in the project activity

For estimation of $ET_{FC,j,y}$ the following two methods can be used:

1) Direct method
2) Indirect method

[1] For fossil fuel combustion in A/R project activities only CO2 emissions should be taken into account.
[2] Project proponents are reminded that the "Tool for testing significance of GHG emissions in A/R CDM project activities" could be applied to identify whether combustion emissions related to fossil fuel consumption are not significant for a particular CDM A/R project activity.

These can be used interchangeably, or simultaneously.

1) Direct method

Direct method assumes availability of data on the amount of fuel combusted. The method may be used in estimating vehicle/equipment emission in the project activity, when the vehicle/equipment is captive (i.e. controlled by the project participant) and the entire fuel consumptions can be monitored. The equation is as follows.

$$ET_{FC,j,y} = \sum_{i=1}^{I} FC_{i,j,y} * EF_{CO2\,i} * NCV_i \quad \textbf{(2)}$$

Where:

$ET_{FC,j,y}$: CO_2 emission from fossil fuel combustion in vehicle/equipment type *j* during year *y* (tCO_2/yr)
$FC_{i,j,y}$: Quantity of fuel type *i* consumed in vehicle/equipment type *j* during year *y* (mass or volume unit / yr)
$EF_{CO2.i}$: CO_2 emission factor of the fuel type *i* combusted (tCO_2 / GJ)
NCV_i: Net calorific value of fuel *i* (GJ/mass or volume unit)[3]
i: Fuel types combusted
I: Total number of fuel types

2) Indirect method

This can be used when vehicle/equipment is not captive (i.e. when vehicle use is commissioned to third parties) and fuel consumption cannot be monitored by project, or in the case of ex ante estimation when key parameters are hypothetical.

For vehicles (mobile sources)[4]:

$$ET_{FC,j,y} = \sum_{i=1}^{I} n * MT_{j,y} / TL_{j,y} * AD_{j,y} * SECk_{j,i,y} * EF_{CO2.i} * NCV_i \quad \textbf{(3a)}$$

or

$$ET_{FC,j,y} = \sum_{i=1}^{I} NV_{j,y} * TD_{j,y} * SECk_{j,i,y} * EF_{CO2.i,} * NCV_i \quad \textbf{(3b)}$$

or

$$ET_{FC,j,y} = \sum_{i=1}^{I} MT_{j,y} * TD_{j,y} * SECkt_{j,i,y} * EF_{CO2.i} * NCV_i \quad \textbf{(3c)}$$

[3] The conversion from volume units to mass units, whenever needed, shall be made by multiplying the volume (m^3) by its density (kg/m^3). Fuel density shall be obtained from verifiable local or national data.
[4] For the estimation of GHG emissions related to transportation outside the project boundary only the distance up to the first point of commuting should be taken into consideration.

Where:

$ET_{FC,j,y}$: CO_2 emission from fossil fuel combustion in vehicle/equipment type *j* during year *y* (tCO_2/yr)
n: Indicator of return load (dimensionless)[5]
$MT_{j,y}$: Total mass transported by vehicle type *j* during year *y* (tonne)
$TL_{j,y}$: Load capacity of vehicle type *j* during year *y* (tonne)
$AD_{j,y}$ Average single-trip distance for vehicle type *j* during year *y* (km)
$SECk_{j,i,y}$: Specific energy consumption of vehicle type *j* for fuel *i* during year *y* (quantity of fuel / km)
$EF_{CO2\,i}$: CO_2 emission factor of the fuel type *i* combusted (t-CO_2 / GJ)
NCV_i : Net calorific value of fuel *i* (GJ/mass or volume unit)
$NV_{j,y}$: Number of vehicle type *j* during year *y* (dimensionless)
$TD_{j,y}$: Total travel distance (including the return trip) for vehicle type *j* during year *y* (km)
$SECkt_{j,i,y}$: Specific energy consumption of vehicle type *j* for fuel *i* during year *y* (quantity of fuel / tonne-km)
i: Fuel types combusted
I: Total number of fuel types

Where $MT_{j,y}$ cannot be obtained according to vehicle types, then $(MT_{j,y}/TL_{j,y})$ can be substituted by $(MT_y/TL_{av,y})$ where MT_y is the total mass transported, and $TL_{av,y}$ is the indicative load capacity of the fleet (i.e. the type of vehicle which has carried the most load).

For parameters $SECk_{j,i,y}$ in eq. 3b and $SECkt_{j,i,y}$ in eq. 3c, a reference figure can be used. Upon verification, DOE will check the parameters to ensure that the conditions which the parameters apply correspond to the situation of the project activity, or that a more conservative assumption is used.

Approach 3a is preferred to 3b, and 3b to 3c.

For equipment (stationary equipment):

$$ET_{FC,j,y} = \sum_{i=1}^{I} NE_{j,y} * TU_{j,y} * SECu_{j,i,y} * EF_{CO2.} * NCV_{i\,i} \quad \textbf{(4)}$$

Where:

$ET_{FC,j,y}$: CO_2 emission from fossil fuel combustion in vehicle/equipment type *j* during year *y* (tCO_2/yr)
$NE_{j,y}$: Number of equipment type *j* during year *y* (dimensionless)
$TU_{j,y}$: Total use for equipment type *j* during year *y* (hours)
$SECu_{j,i,y}$: Specific energy consumption of equipment type *j* for fuel *i* during year *y* (quantity of fuel / hour)
$EF_{CO2\,i}$: CO_2 emission factor of the fuel type *i* combusted (t-CO_2 / GJ)
NCV_i : Net calorific value of fuel *i* (GJ/mass or volume unit)
i: Fuel types combusted
I: Total number of fuel types

For portable equipment (such as chainsaws), the equation above can only be used if verifiable data is available on the specific energy consumption. In this case, the product $TU_{j,y} * SECu_{j,i,y}$ can be replaced by, e.g. product of volume of harvested wood and fuel consumption per unit of volume of harvested wood.

[5] n = 1 when return load is full (with other commodity), n = 2 when return load is empty. If PPs cannot demonstrate that the return load is full then n=2.

III. REFERENCE AND ANY OTHER INFORMATION

Default values can be founded in:

- 2006 IPCC Guidelines for National Greenhouse Gas Inventories - Volume 2 Energy: Chapter 3 Mobile Combustion (available at http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_3_Ch3_Mobile_Combustion.pdf)

- IPCC Emission Factor Database (EFDB) – available at http://www.ipcc-nggip.iges.or.jp/EFDB/main.php

Data and parameters not monitored

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
$EF_{CO2\,i}$	t-CO_2 / GJ	CO_2 emission factor of the fuel type *i* combusted	Country-specific data, IPCC		Not monitored		
NCV_i	GJ/mass or volume unit	Net calorific value of the fuel type *I* combusted	Country-specific data, IPCC		Not monitored		
$n_:$	Dimen-sion less	Indicator of return load	Specification of project	Use of default value to be determined upon validation and renewal of crediting period, .	Not monitored		n = 1 when return load is full (with other commodity), n = 2 when return load is empty. Intermediate values are possible if only a fraction of the return loads is empty.

Data and parameters estimated for the *ex-ante* and monitored for *ex-post* calculations

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
$FC_{i,j,y}$	Mass (e.g. tonnes) or volume (e.g. kilolitres)	Quantity of fuel type *i* consumed in vehicle/equipment type *j* during year *y*	*Ex-ante*: Estimated *Ex-post*: Onsite measurements	Procedures to keep record of fossil fuel consumption related to the	Annually	Cross check with fuel purchase data. Check the	

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
				project activity		appropriateness of receipt with other known parameters such as amount transported, etc.	
j	Dimen-sion less	Number of each type of vehicle/equipment used in the project activity	*Ex-ante*: Estimated *Ex-post*: Onsite measurements		Annually		
J	Dimen-sion less	Number of types of vehicle/equipment used in the project activity	*Ex-ante*: Estimated *Ex-post*: Onsite measurements		Annually		
$MT_{j,y}$	Tonnes	Total mass transported by vehicle type *j* during year *y*	*Ex-ante*: Estimated *Ex-post*: Actual measurement	Weigh bridge, etc. Harvest volume or mass measurements	According to the project activity	According to the project activity	Where $MT_{j,y}$ cannot be obtained according to vehicle types, then $(MT_{j,y} / TL_{j,y})$ can be substituted by $(MT_y / TL_{av,y})$ where MT_y is the total mass transported, and $TL_{av,y}$ is the indicative load capacity of the fleet (i.e. the average load capacity of relevant vehicles in the fleet)

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
$TL_{j,y}$	Tonnes	Load capacity of vehicle type *j* during year y	*Ex-ante*: Estimated *Ex-post*: Annual inventory	Fleet data	Annually		Where $(MT_{j,y}/TL_{j,y})$ is substituted by $(MT_y/TL_{av,y})$, $TL_{av,y}$ is the indicative load capacity of the fleet (i.e. the average load capacity of relevant vehicles in the fleet)
$AD_{j,y}$	Km	Average single-trip distance for vehicle type *j* during year *y* (such as the distance between the plantation site and the biomass plant)	*Ex-ante*: Estimated distances based on specification of the project activity. *Ex-post*: Verifiable information on traveled distances.	Maps or other methods to calculate distance. Invoices or other records to show start location and destination.	Annually		
$SECk_{j,i,y}$	Quantity of fuel / km	Specific energy consumption of vehicle type *j* for fuel *i* during year *y*	*Ex-ante*: Based on manufacturer specification or verifiable default values *Ex-post*: Fuel consumption record of fleet, and total travel	Based on available records	Annually		May be not monitored if a constant conservative value is applied. DOE to check that the choice of default data reflects the situation of the project during the monitoring period (e.g. with respect to vehicle size or road condition).

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
			distance				
$NE_{j,y}$	Dimen-sion less	Number of equipment type *j* during year *y*	*Ex-ante:* Estimates based on specification of project *Ex-post*: Annual inventory	Based on available records	Annually		
$NV_{j,y}$	Dimen-sion less	Number of vehicle type *j* during year *y*	*Ex-ante*: Estimates based on specification of project *Ex-post*: Annual inventory	Based on available records	Annually		

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
$TD_{j,y}$	Km	Total travel distance for vehicle type *j* during year *y*	*Ex-ante*: Estimated distances based on specification of the project activity. *Ex-post*: Odometer or verifiable information on traveled distances.		According to the project activity	It is desirable that the data on total harvest is cross checked with travel distance	Odometer is not applicable when vehicle has other purpose of use
$TU_{j,y}$	Hours	Total use for equipment type *j* during year *y*	*Ex-ante*: Estimated *Ex-post*: Onsite measurements		According to the project activity		
$SECu_{j,i,y}$	Quantity of fuel / hour	Specific energy consumption of equipment type *j* for fuel *i* during year *y*	*Ex-ante*: Based on manufacturer specification or verifiable default values *Ex-post:* Fuel consumption record of	Based on available records	Annually		May be not monitored if a constant conservative value is applied. DOE to check that the choice of the default data reflects the situation of the project during the monitoring period (e.g. with respect to vehicle size or road condition).

Data / para-meter:	Data unit:	Description:	Source of data:	Measurement procedures (if any):	Monitoring frequency:	QA/QC procedures:	Any comment:
			equipment, and hours used				

History of the document

Version	Date	Nature of revision(s)
01	EB 33, Annex 14 27 July 2007	Initial adoption