T-VER-P-TOOL-02-01

Tool to Calculate Project or Leakage CO_2 Emissions from Fossil Fuel Combustion

Version 01

Entry into force on 1 March 2023

1. Introduction

This document is a reference tool to calculate project emission or leakage of CO_2 emissions from fossil fuel combustion for power plants or power generation units. Renewable energy is produced for own use or connected to the national grid, including the generation of electricity and heat from biomass. It shows that the process of calculating the project's greenhouse gas emissions from fossil fuel combustion, in relation to greenhouse gas emissions from project activity (Project emission) or greenhouse gas emissions outside the project scope (Leakage emission). It is calculated according to the amount of fossil fuels combusted and the properties of fossil fuels. This calculation is required to determine the type of combustion process. This includes specifying the method/data source of the parameters to be monitored.

2. Definitions

- Renewable energy is an infinite source of energy that can be renewed, such as solar, wind, hydro and biomass, etc.
- Fossil Fuel is a finite energy source such as oil, coal, natural gas, etc.
- Greenfield is a new renewable energy power plant that is constructed and operated at a site where no renewable energy power plant was operated prior to the implementation of the project activity.
- Rehabilitation is an investment to restore the existing power plants/units that was severely damaged or destroyed due to foundation failure, excessive seepage, earthquake, liquefaction, or flood. The primary objective of rehabilitation or refurbishment is to restore the performances of the facilities. Rehabilitation may also lead to increase in efficiency, performance, or power generation capacity of the power plants/units with/without adding new power plants/units.
- Replacement is an investment in new power plants/units that replaces one or several existing units at the existing power plant. The new power plants/units have the same or a higher power generation capacity than the plants/units that were replaced.

3. Applicability and Conditions

This calculation tool is used to calculate greenhouse gas emissions from fossil fuel combustion from project operations or outside the scope of projects with renewable power generation activities such as solar, water, wind, and biomass, etc., to replace the production of electricity from fossil fuels. The project activities may be a new power generation unit or greenfield, rehabilitation and replacement.

4. Calculating Greenhouse Gas Emissions

The Calculation of greenhouse gas emissions from the combustion of fossil fuels from project implementation as well as outside the project boundary. This determines the following parameters

Parameters	Unit	Description
$PE_{FF,j,y}$	tCO_2/y	CO_2 emissions from fossil fuel combustion in process j during the year y
$LE_{FF,y}$	tCO_2/y	Leakage emissions from fossil fuel combustion in year y

4.1 Activities that consider greenhouse gas emissions from project.

Types	Activities
Electricity generation from solar/hydro/wind energy	Using a backup generator
Biomass power generation	Using biomass loaders or biomass trucks within the project Using a backup generator
Cogeneration, electricity, and heat from biomass	Using biomass loaders or biomass trucks within the project Using a backup generator

4.2 Greenhouse gas emissions from the use of fossil fuels

Greenhouse gas emissions from the combustion of fossil fuels in process j are calculated from the amount of fuel used and the emission factor of greenhouse gas of fuel. The details are as follows.

$$PE_{FF,j,y} = \sum_{i} FC_{i,j,y} \times COEF_{i,y} \qquad \text{Equation (1)}$$

or

$$LE_{FF,y} = \sum_{i} FC_{TR,i,y} \times COEF_{i,y} \qquad \text{Equation (2)}$$

Where:

$PE_{FF,j,y}$ = Project emissions from fossil fuel consumption in process j in the year y (tCO_2/y)

$LE_{FF,y}$ = Leakage emissions in year y (tCO_2/y)

$FC_{i,j,y}$ = Quantity of fuel type i combusted in process j in the year y (mass or volume unit/y)

$FC_{TR,i,y}$ = Amount of fossil fuel type i used to transport biomass in the year y (mass or volume unit/y)

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i in the year y (tCO_2/mass or volume unit)

i = Fuel types combusted in process j in the year y

$COEF_{i,y}$

The CO_2 emission coefficient $COEF_{i,y}$ can be calculated using one of the following two Options, depending on the availability of data on the fossil fuel type i, as follows:

Option 1: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on the chemical composition of the fossil fuel type i, using the following approach

Case 1: If $FC_{i,j,y}$ and $FC_{TR,i,y}$ are measured in a mass unit:

$$COEF_{i,y} = w_{C,i,y} \times 44/12 \quad \text{Equation (3)}$$

Case 2: If $FC_{i,j,y}$ and $FC_{TR,i,y}$ are measured in a volume unit:

$$COEF_{i,y} = w_{C,i,y} \times \rho_{I,y} \times 44/12 \quad \text{Equation (4)}$$

Where:

$COEF_{i,y}$ = CO_2 emission coefficient of fuel type i in the year y (tCO_2/mass or volume unit)

$w_{C,i,y}$ = Weighted average mass fraction of carbon in fuel type i in year y (tC/mass unit of the fuel)

$\rho_{i,y}$ = Weighted average density of fuel type i in year y (mass unit/volume unit of the fuel)

i = Fuel types combusted in process j during the year y

Option 2: The CO_2 emission coefficient $COEF_{i,y}$ is calculated based on net calorific value and CO_2 emission factor of the fuel type i, as follows:

$$COEF_{i,y} = NCV_{i,y} \times EF_{CO2,i,y}$$ Equation (5)

Where:

$COEF_{i,y}$	=	CO_2 emission coefficient of fuel type i in the year y (tCO_2/mass or volume unit)
$NCV_{i,y}$	=	Weighted average net calorific value of the fuel type i in year y (GJ/mass or volume unit)
$EF_{CO2,i,y}$	=	Weighted average CO_2 emission factor of fuel type i in year y (tCO_2/GJ)
i	=	Fuel types combusted in process j during the year y

5. Monitoring methodology procedure

5.1 Monitoring procedures

1) The project developer describes and identifies the procedure for monitoring the project activity data or checking all measurement results in PDD, including the type of measurement instrumentation used. The responsibilities for monitoring and QA/QC procedures will be applied, where the methodology provides different options (e.g. use of default values or on-site measurements), and specify which option will be used. Meters should be installed, maintained and calibrated according to equipment manufacturer instructions and be in line with national standards, or, if these are not available, international standards (e.g. IEC, ISO).

2) All data collected as part of the greenhouse gas emission reduction monitoring. The data should be stored in on electronic format and the retention period is in accordance with the guidelines prescribed by the TGO or the organization's quality system. But the period will not be less than the period specified by the TGO that requires at least 2 years after the end of the last carbon credit period. The data should be monitored if not indicated differently in the comments in the Table 5.2

5.2. Parameters monitored

Parameter	$FC_{i,j,y}$
Unit	Mass or volume unit per year (e.g. ton/y or m^3/y)
Description	Quantity of fuel type i combusted in process j during the year y
Source of data	Onsite measurements
Measurement procedures	• Use either mass or volume meters. In cases where fuel is supplied from small daily tanks, rulers can be used to determine mass or volume of the fuel consumed, with the following conditions: ▪ The ruler gauge must be part of the daily tank and calibrated at least once a year ▪ Have a book of control for recording the measurements (on a daily basis or per shift); • Accessories such as transducers, sonar and piezo electronic devices are accepted if they are properly calibrated with the ruler gauge and receiving a reasonable maintenance; • In case of daily tanks with pre-heaters for heavy oil, the calibration will be done under normal operation.
Monitoring frequency	Continuously
QA/QC procedures:	• The consistency of fuel consumption meters should be cross-checked by an annual energy balance that is based on purchased quantities and stock changes. • Where the purchased fuel invoices can be identified specifically for the project, the metered fuel consumption quantities should also be cross-checked with available purchase invoices from the financial records.

Parameter	$FC_{TR,i,y}$
Unit	Mass or volume unit per year (ton/y or m^3/y)
Description	Quantity of fossil fuel type i in the transport of biomass during the year y
Source of data	1. Verifiable fossil fuel consumption report 2. Documents recorded from the receipt
Measurement procedures	Record values from evidence showing fuel consumption.
Monitoring frequency	Monthly detailed data reports
QA/QC procedures:	-

Parameter	$w_{C,i,y}$
Unit	tC/mass unit of the fuel
Description	Weighted average mass fraction of carbon in fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
(1) Values provided by the fuel supplier in invoices	This is the preferred source
(2) Measurements by the project	If (1) is not available

	participants
Measurement procedures	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	The mass fraction of carbon should be obtained for each fuel delivery, from which weighted average annual values should be calculated
QA/QC procedures:	Verify if the values under (1) and (2) are within the uncertainty range of the product of the IPCC default values as provided in Table 1.2 and Table 1.3, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in (b) should have ISO17025 accreditation or justify that they can comply with similar quality standards
Any comment	Applicable where Option 1 is used

Parameter	$\rho_{i,y}$
Unit	Mass unit/volume unit
Description	Weighted average density of fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
(1) Values provided by the fuel supplier in invoices	This is the preferred source
(2) Measurements by the project participants	If (1) is not available
(3) Regional or national default values	If (1) 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)

Measurement procedures	Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	The density of the fuel should be obtained for each fuel delivery, from which weighted average annual values should be calculated
QA/QC procedures:	-
Any comment	- Applicable where Option 1 is used and where $FC_{i,j,y}$ is measured in a volume unit. - Preferably the same data source should be used for $w_{C,i,y}$ and $\rho_{i,y}$

Parameter	$NCV_{i,y}$
Unit	MJ/Unit

Description	Weighted average net calorific value of fuel type i in year y
Source of data	Option 1: Values provided by the fuel supplier's invoices. Option 2: Measurements by the project participants Option 3: Thailand energy statistics report published by Department of Alternative Energy Development and Efficiency, Ministry of Energy Option 4: IPCC Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Measurement procedures	For option 1 and 2: Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For option 1 and 2: The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For option 3: Review appropriateness of the values annually. For option 4: Any future revision of the IPCC Guidelines should be taken into account.
QA/QC procedures:	-

Parameter	$EF_{CO2,i,y}$
Unit	tCO_2/GJ
Description	Weighted average CO_2 emission factor of fuel type i in year y
Source of data	The following data sources may be used if the relevant conditions apply:

Data source	Conditions for using the data source
(1) Values provided by the fuel supplier in invoices	This is the preferred source
(2) Measurements by the project participants	If (1) is not available
(3) Regional or national default values	If (1) 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)
(4) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	If (1) is not available

Measurement procedures	For (1) and (2): Measurements should be undertaken in line with national or international fuel standards
Monitoring frequency	For (1) and (2): The CO_2 emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For (3): Review appropriateness of the values annually.

	For (4): Any future revision of the IPCC Guidelines should be taken into account.
QA/QC procedures:	Applicable where option 2 is used. For (1): 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 (2), (3) or (4) should be used

6. References

CDM Methodological tool:

1) TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion. Version 03
2) TOOL16: Project and leakage emissions from biomass. Version 05

Document information T-VER-P-TOOL-02-01

Version	Amendment	Entry into force	Description
01	-	1 March 2023	Change document code from TVER-TOOL-02-01 Version 01.
01	-	24 August 2022	Initial adoption.