Verified Carbon Standard

VCS Module

VMD0014

ESTIMATION OF EMISSIONS FROM FOSSIL FUEL COMBUSTION (E-FFC)

Version 1.1

27 November 2023

Sectoral Scope 14

Avoided Deforestation Partners and Climate Focus convened the development of version 1.0 of this module. It was authored by Silvestrum Climate Associates (Igino Emmer and Eveline Trines), Winrock International (Dr. Sandra Brown and Dr. Tim Pearson), Carbon Decisions International (Lucio Pedroni), and TerraCarbon (David Shoch).

Version 1.1 of this module was prepared by Verra with support from Tim Pearson.

CONTENTS

1 SUMMARY DESCRIPTION OF THE MODULE

This module provides a step-wise approach for estimating GHG emissions from fossil fuel combustion.

2 DEFINITIONS

All terms in the following module are used inline with VCS program definitions.

3 APPLICABILITY CONDITIONS

All fossil fuel combustion associated with a project may be accounted, including fossil fuel combustion of subcontractors that are conducting (parts of the) work to implement the project. Fossil fuel combustion in all situations is an optional emission source. Project proponents may, however, elect to include fossil fuel combustion if emissions are higher in the baseline than in the project case thus generating emission reductions through project activities. Where emissions from fossil fuel combustion are estimated in the baseline, monitoring and estimation must also occur in the with-project scenario[1].

4 PROCEDURES

Emissions can be estimated from either the fuel consumed or the distance travelled by the vehicles. Even though in general the first approach is appropriate for CO_2 and the second (distance travelled by vehicle type and road type) is appropriate for CH_4 and N_2O, the IPCC (2006) allows CH_4 and N_2O emissions from fossil fuel combustion to be estimated as:

$$E_{FC,i,t} = \sum_{a=1}^{A} \left(Fuel_{a,i,t} \times EF_a \right) \quad (1)$$

Where:

$E_{FC,i,t}$ = CO_2-e emissions of fossil fuel combustion in stratum *i* in year *t*; t CO_2-e

$Fuel_{a,i,t}$ = Amount of Fuel of type a consumed in stratum *i* in year *t*; terrajoule (TJ)

EF_a = Emission Factor of Fuel type a; tCO_2-e/TJ

[1] Emissions due to fossil fuel combustion both inside and outside the project boundary will be considered project emissions

a = 1,2,3,...A fuel types (e.g. diesel, gasoline, etc.)

The amount of fuel of a particular kind combusted in year t ($\text{Fuel}_{a,t}$) can be estimated as:

$$Fuel_{a,i,t} = Liters_{Fuel,a,i,t} \times Density_{Fuel,a} \times NCV_{Fuel} \div 10^6 \quad (2)$$

Where:

$\text{Fuel}_{a,t}$ = Amount of Fuel type a consumed in stratum *i* in year *t*; TJ

$\text{Liters}_{\text{Fuel},a,t}$ = Quantity of Fuel of type a consumed in stratum *i* in year *t*; ltr

$\text{Density}_{\text{Fuel},a}$ = Density of Fuel type a; kg/ltr

NCV_{Fuel} = Net Calorific Value of Fuel type a; TJ/Gg

In section III, default values are provided for all parameters not monitored. However, it is recommended and encouraged to use country-specific NCVs and EFs where available.

5 DATA AND PARAMETERS

5.1 Data and Parameters Available at Validation

Data / Parameter	EF_a
Data unit	tCO_2-e/TJ
Description	Emission factor
Equations	1
Source of data	Table 1.4 Chapter 1 Volume 2 of IPCC, 2006.
Value applied	Default emission factors are presented in the table below.

Table: Road transport default CO2 emission factors[a]

Fuel Type	Default effective CO_2 emission factor (t CO2/TJ)
Motor gasoline	69,3
Gas/Diesel Oil	74,1
Liquefied Petroleum Gases	63,1
Kerosene	71,9
Lubricants	73,3
Compressed Natural Gas	56,1
Liquefied Natural Gas	56,1

[a]Values represent 100% oxidation of fuel carbon content.

	The emission factors assume that 100% of the carbon content of the fuel is oxidized during or immediately following the combustion process (for all fuel types in all vehicles) irrespective of whether the CO_2 has been emitted as CO_2, CH_4, CO or NMVOC or as particulate matter.
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	Must be updated each time the baseline is revisited (at least every 10 years)

Data / Parameter	$Density_{Fuel,a}$
Data unit	Kg/ltr
Description	Density of Fuel type
Equations	2
Source of data	Table A3.8 Page 181 of the Energy Statistics Manual of OECD/IEA, 2004.
Value applied	Densities for relevant petroleum products as presented in table A3.8 **Typical Density Values for Selected Petroleum Products**
Justification of choice of data or description of measurement methods and procedures applied	-
Purpose of Data	Calculation of baseline and project emissions
Comments	Must be updated each time the baseline is revisited (at least every 10 years)

Fuel Type	Density (kg/ltr)	Liters per ton
Motor gasoline	0.7407	1350
Gas/Diesel Oil	0.8439	1185
Naphtha	0.6906	1448
Aviation gasoline	0.7168	1350
Aviation Turbine fuel	0.8026	1246
Other kerosene	0.8026	1246

Data / Parameter	NCV_a

<table>
<tr><td>Data unit</td><td>GJ/tonne</td></tr>
<tr><td>Description</td><td>Net Caloric Value per Fuel Type</td></tr>
<tr><td>Equations</td><td>2</td></tr>
<tr><td>Source of data</td><td>Table A3.8, page 181, IEA Statistics Manual, OECD/IEA, 2004;
and,
Table 1.2, Chapter 1, Volume 2, IPCC 2006 Inventory Guidelines</td></tr>
<tr><td>Value applied</td><td>Default NCVs are presented in tables below.

<table>
<tr><th>Fuel Type</th><th>Density (kg/ltr)</th><th>NCV (GJ/t)[a]</th></tr>
<tr><td>Motor gasoline</td><td>0.7407</td><td>44.75</td></tr>
<tr><td>Gas/Diesel Oil</td><td>0.8439</td><td>43.38</td></tr>
<tr><td>Naphtha</td><td>0.6906</td><td>45.34</td></tr>
<tr><td>Aviation gasoline</td><td>0.7168</td><td>45.03</td></tr>
<tr><td>Aviation Turbine fuel</td><td>0.8026</td><td>43.92</td></tr>
<tr><td>Other kerosene</td><td>0.8026</td><td>43.92</td></tr>
</table>
[a]1000 GJ = 1 TJ

Table: Default NCVs (excerpt from table 1.2, Chapter 1, Volume 2, IPCC, 2006 Inventory Guidelines)
<table>
<tr><th>Fuel Type</th><th>Default Net Caloric Value (NCV) (TJ/Gg)[b]</th></tr>
<tr><td>Crude Oil</td><td>42.3</td></tr>
<tr><td>Orimulsion</td><td>27.5</td></tr>
<tr><td>Natural Gas Liquids</td><td>44.2</td></tr>
<tr><td>Motor Gasoline</td><td>44.3</td></tr>
<tr><td>Aviation Gasoline</td><td>44.3</td></tr>
<tr><td>Jet Gasoline</td><td>44.3</td></tr>
<tr><td>Jet Kerosene</td><td>44.1</td></tr>
<tr><td>Other Kerosene</td><td>43.8</td></tr>
<tr><td>Gas/Diesel Oil</td><td>43.0</td></tr>
<tr><td>bio-gasoline/bio-diesel</td><td>27.0</td></tr>
<tr><td>other liquid biofuels</td><td>27.4</td></tr>
</table>
[b]TJ/Gg = GJ/t</td></tr>
<tr><td>Justification of choice of data or description of measurement methods and procedures applied</td><td>-</td></tr>
<tr><td>Purpose of Data</td><td>Calculation of baseline and project emissions</td></tr>
</table>

Comments	For more NCVs for other fuels, see the original data sources. Must be updated each time the baseline is revisited (at least every 10 years)

5.2 Data and Parameters Monitored

Data / Parameter:	$Liters_{Fuel,a,i,t}$
Data unit:	Liters
Description:	Quantity of Fuel of type a consumed in stratum i in year t
Equations	1
Source of data:	Records of fuel consumed or distance travelled by vehicles.
Description of measurement methods and procedures to be applied:	In the absence of direct fuel consumption data, each major fuel type used by each road vehicle type can be estimated from data on vehicle kilometers travelled (which requires a km registration system) or from the expenditure on fuel (on the basis of receipts/fuel acquired). Records / monitoring shall be continuous and consumption/mileage shall be divided by equipment type / road vehicle type. Where estimation of fossil fuel combustion is elected as an emission source, fossil fuel use by the project both inside and outside the project boundary shall be recorded and considered as project emissions.
Frequency of monitoring/recording:	-
QA/QC procedures to be applied:	-
Purpose of data:	Calculation of baseline and project emissions
Calculation method:	-
Comments:	*Ex-ante* an estimate shall be made of annual fuel consumption based on projected usage (e.g. distance traveled). If fuel use does not differ significantly by stratum or if records are kept at the project level then stratification is not necessary.

DOCUMENT HISTORY

Version	Date	Comment
v1.0	3 Dec 2010	Initial version
v1.1	27 Nov 2023	• Update to latest VCS methodology template • Removal of references to VM0007