Approved VCS Module VMD0014
Version 1.0
REDD Methodological Module:
Estimation of emissions from fossil fuel combustion (E-FFC)
Sectoral Scope 14

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope

This module provides a step-wise approach for estimating emissions from fossil fuel combustion in Reduced Emissions from Deforestation and Degradation (REDD) projects.

Applicability

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].

Parameters

Parameter	SI Unit	Description
$E_{FC,i,t}$	t CO_2-e	Emission from fossil fuel combustion in stratum *i* in year *t*

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

II. PROCEDURE

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:

$E_{FC,i,t}$	Net CO_2-e emissions of Fuel Consumption 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
a	1,2,3,…A fuel types (e.g. diesel, gasoline, etc.)

The amount of fuel of a particular kind combusted in year *t* ($Fuel_{a,t}$) 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:

$Fuel_{a,t}$	Amount of Fuel type *a* consumed in stratum *i* in year *t*; TJ
$Liters_{Fuel\ a,t}$	Quantity of Fuel of type *a* consumed in stratum *i* in year *t*; ltr
$Density_{Fuel\ a}$	Density of Fuel type *a*; kg/ltr
$NCV_{Fuel\ a}$	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.

III. DATA AND PARAMETERS NOT MONITORED (DEFAULT OR MEASURED ONE TIME)

Data / parameter:	EF_a
Data unit:	tCO2-e/TJ
Used in equations:	1
Description:	Emission factor

<table>
<tr><td>Source of data:</td><td>Table 1.4 Chapter 1 Volume 2 of IPCC, 2006.</td></tr>
<tr><td>Measurement procedures (if any):</td><td>Default emission factors are presented in the table below.
Table: Road transport default CO_2 emission factors.[a]
<table>
<tr><th>Fuel Type</th><th>Default effective CO_2 emission factor (t CO_2/TJ)</th></tr>
<tr><td>Motor gasoline</td><td>69,3</td></tr>
<tr><td>Gas/Diesel Oil</td><td>74,1</td></tr>
<tr><td>Liquefied Petroleum Gases</td><td>63,1</td></tr>
<tr><td>Kerosene</td><td>71,9</td></tr>
<tr><td>Lubricants</td><td>73,3</td></tr>
<tr><td>Compressed Natural Gas</td><td>56,1</td></tr>
<tr><td>Liquefied Natural Gas</td><td>56,1</td></tr>
</table>
[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.</td></tr>
<tr><td>Any comment:</td><td>Must be updated each time the baseline is revisited (at least every 10 years)</td></tr>
</table>

<table>
<tr><td>Data / parameter:</td><td>Density $_{Fuel\ a}$</td></tr>
<tr><td>Data unit:</td><td>Kg/ltr</td></tr>
<tr><td>Used in equations:</td><td>2</td></tr>
<tr><td>Description:</td><td>Density of Fuel type</td></tr>
<tr><td>Source of data:</td><td>Table A3.8 Page 181 of the Energy Statistics Manual of OECD/IEA, 2004.</td></tr>
<tr><td>Measurement procedures (if any):</td><td>Densities for relevant petroleum products as presented in table A3.8
Typical Density Values for Selected Petroleum Products
<table>
<tr><th>Fuel Type</th><th>Density (kg/ltr)</th><th>Liters per ton</th></tr>
<tr><td>Motor gasoline</td><td>0.7407</td><td>1350</td></tr>
</table></td></tr>
</table>

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

Any comment:	Must be updated each time the baseline is revisited (at least every 10 years)

Data / parameter:	NCV_a
Data unit:	GJ/tonne
Used in equations:	2
Description:	Net Caloric Value per Fuel Type
Source of data:	Table A3.8, page 181, IEA Statistics Manual, OECD/IEA, 2004; and, Table 1.2, Chapter 1, Volume 2, IPCC 2006 Inventory Guidelines
Measurement procedures (if any):	Default NCVs are presented in tables below.

Fuel Type	Density (kg / ltr)	NCV (GJ/t)[a]
Motor gasoline	0.7407	44.75
Gas/Diesel Oil	0.8439	43.38
Naphtha	0.6906	45.34
Aviation gasoline	0.7168	45.03
Aviation Turbine fuel	0.8026	43.92
Other kerosene	0.8026	43.92

[a] 1000 GJ = 1 TJ

Table: Default NCVs (excerpt from table 1.2, Chapter 1, Volume 2, IPCC, 2006 Inventory Guidelines)

Fuel type (English description)	Default Net Caloric Value (NCV)

	<table><tr><th></th><th>(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
Any comment:	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)

IV. DATA AND PARAMETERS MONITORED

Data / parameter:	$Liters_{Fuel,a,i,t}$
Data unit:	liters
Used in equations:	1
Description:	Quantity of Fuel of type *a* consumed in stratum *i* in year *t*
Source of data:	Records of fuel consumed or distance travelled by vehicles.
Measurement procedures (if any):	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.
Any comment:	*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.