Baseline parameter standardization

Explain how the methodological approach contained in the valid version of the approved methodological tool or in the proposed new or revised methodological tool was applied to standardize the baseline parameter (e.g. baseline emission factor). Document all underlying data, data sources, assumptions, calculation steps and outcomes in a clear and transparent manner.

The grid emission factor will be calculated following the steps from the "Tool to determine the emission factor of an electricity system" (Tool), version 7.0.

Step 1. Identify the relevant electricity systems

Grenada is composed by 3 islands (Grenada, Carriacou, and Petit Martinique), each with its electric grid which are not interconnected among themselves. Therefore, the electricity systems are:

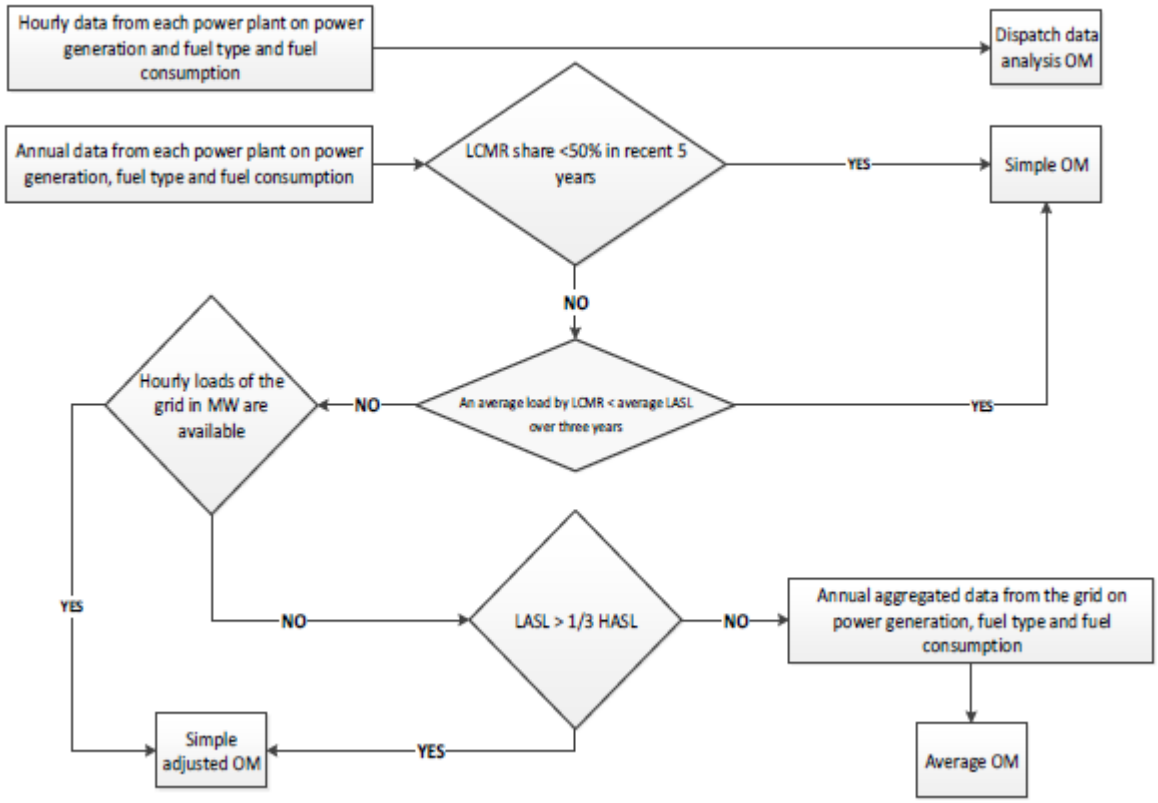
- Electric grid from the island of Grenada
- Electric grid from the island of Carriacou
- Electric grid from the island of Petit Martinique

Step 2. Choose whether to include off-grid power plants in the project electricity system (optional);

The electric system of each island is composed by one power plant each. Therefore, there are no off-grid plants.

Step 3: Select a method to determine the operating margin (OM);

Figure 2. Flow chart: Overview of the application of OM methods



The Dispatch Data Analysis OM is not applicable since the three electric systems are composed solely by one power plant each and there is no merit dispatch order. The power plants installed are mostly fossil-fuel based and connected PV plants' share is minor (LCMR share < 10% in recent 3 years) so far in operation in the country as indicated by the yearly reports from GRENLEC (Grenada Electricity Services Ltd). The share of low-cost/must-run is deemed less than 50%, hence, **Simple OM** method is selected.

Step 4: Calculate the operating margin emission factor according to the selected method

GRENLEC, the electric company from Grenada and responsible for managing the power plants, performs measurements of the quantity and type of fossil fuel consumed, the NCV of each fossil fuel and the electricity generated by each power plant. Therefore, Option A (Calculation based on average efficiency and electricity generation of each plant) was used to calculate the operating margin CO_2 emission factor ($EF_{grid,OM\text{-}ave,y}$) i.e., Option A1 was used to determine the CO_2 emission factor of power unit m ($EF_{EL,m,y}$).

GRENLEC provided the following information about the power plants:

Power Plant	Electric System (Island)	Electricity Generated (MWh)[1]			Fuel consumed (US Gallons)[2]			Fuel density (kg/L)			NCV (MJ/Kg)[3]		
		2018	2019	2020	2018	2019	2020	2018	2019	2020	2018	2019	2020
Queen's Park Power Plant	Grenada	217,537.14	225,524.56	207,279.17	13,584,653.38	14,274,498.18	12,929,119.43	0.8561	0.8561	0.8561	42,69	42,69	42,69
Beasajour Power Plant	Carriacou	8,949.11	9,456.47	9,784.82	573,157.13	649,093.00	543,920.58	0.8561	0.8561	0.8561	42,69	42,69	42,69
Petite Martinique Power Plant	Petit Martinique	795.45	798.65	792.43	62,318.40	64,044.58	62,094.44	0.8561	0.8561	0.8561	42,69	42,69	42,69

The OM Emission Factor is calculated for each island through equation (3) from the Tool, as follows:

$$EFgrid,OMsimple,y = \frac{\sum_m \mathrm{EGm,y} \times \mathrm{EF_{EL,m,y}}}{\sum_m \mathrm{EGm,y}}$$

$EF_{EL,\,m,\,y}$ was calculated for power plant through Option A1, as follows:

[1] Source: GRENLEC – Grenada Electricity Services Ltd.
[2] Source: GRENLEC – Grenada Electricity Services Ltd
[3] Source: GRENLEC – Grenada Electricity Services Ltd

$$EF_{EL,m,y} = \frac{\sum_{m,i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}$$

The combination of the above equations result in the one indicated below:

$$EF_{grid,OM\,simple,y} = \frac{\sum_{m} EG_{m,y} \times \frac{\sum_{m,i} FC_{i,m,y} \times NCV_{i,y} \times EF_{CO2,i,y}}{EG_{m,y}}}{\sum_{m} EG_{m,y}}$$, where:

EFgrid,OMsimple,y	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
EGm,y	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)
EFEL,m,y	=	CO_2 emission factor of power unit *m* in year *y* (t CO_2/MWh)
m	=	All power units serving the grid in year *y* except low-cost/must-run power units
y	=	The relevant year as per the data vintage chosen in Step 3
EFgrid,OMsimple,y	=	Simple operating margin CO_2 emission factor in year *y* (t CO_2/MWh)
EGm,y	=	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y* (MWh)

The table below provides a step-wise calculation of the $EF_{grid, OM\text{-}ave,y}$ for each electric system and for each year (2018, 2019 and 2020). The OM grid emission factor will be fixed ex-ant

Power Plant *m*	Electric System (Island)	Year	Fuel type	Electricity Generated (MWh) A	Fuel Emission Factor (tCO2/TJ) B	Fuel consumption (tons) C	NCV fuel (GJ/t) D	Fuel consumption (TJ) E = C x D / 1,000	CO2 Emissions (tCO2) F = B x E	OM (tCO_2e/MWh) G = F/A
Queen's Park Power Plant	Grenada	2018	LFO	217,537.14	75.50	44,224.20	42.69	1,887.93	142,539	0.66
		2019	LFO	225,524.56	75.50	46,469.95	42.69	1,983.80	149,777	0.66
		2020	LFO	207,279.17	75.50	42,090.14	42.69	1,796.83	135,661	0.65

Power Plant *m*	Electric System (Island)	Year	Fuel type	Electricity Generated (MWh) A	Fuel Emission Factor (tCO2/TJ) B	Fuel consumption (tons) C	NCV fuel (GJ/t) D	Fuel consumption (TJ) E = C x D / 1,000	CO2 Emissions (tCO2) F = B x E	OM (tCO_2e/MWh) G = F/A
Carriacou Power Plant	Carriacou	2018	LFO	8,949.11	75.50	1,865.89	42.69	79.65	6,014	0.67
		2019	LFO	9,456.47	75.50	2,113.09	42.69	90.21	6,811	0.72
		2020	LFO	9,784.82	75.50	1,770.71	42.69	75.59	5,707	0.58

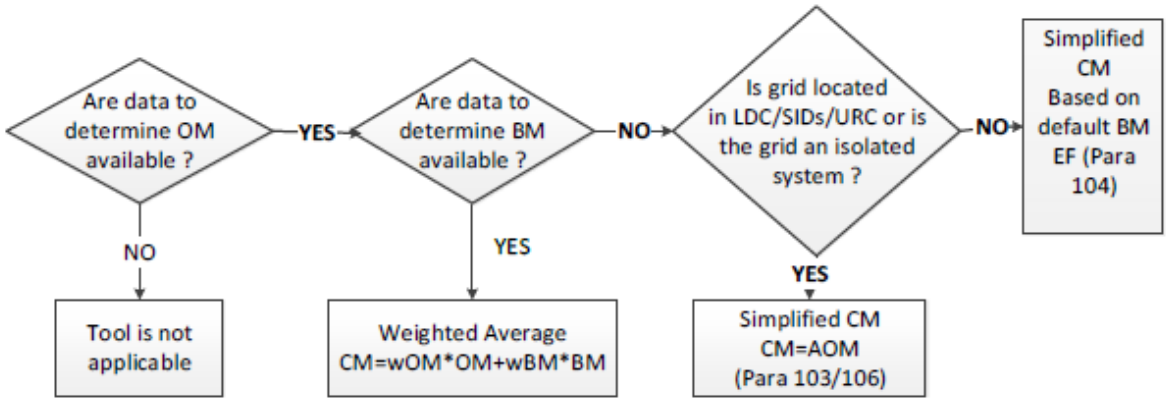
Power Plant *m*	Electric System (Island)	Year	Fuel type	Electricity Generated (MWh) A	Fuel Emission Factor (tCO2/TJ) B	Fuel consumption (tons) C	NCV fuel (GJ/t) D	Fuel consumption (TJ) E = C x D / 1,000	CO2 Emissions (tCO2) F = B x E	OM (tCO_2e/MWh) G = F/A
Petit Martinique Power Plant	Petit Martinique	2018	LFO	795.45	75.50	202.87	42.69	8.66	654	0.82
		2019	LFO	798.65	75.50	208.49	42.69	8.90	672	0.84
		2020	LFO	792.43	75.50	202.15	42.69	8.63	652	0.82

Step 5: Calculate the build margin (BM) emission factor

N/A. Since Grenada is one of Small Island Developing States (SIDS), the weight of BM is equal to zero (paragraph 90 of the TOOL07) and, therefore, doesn't need to be calculated.

Step 6: Calculate the combined margin emissions factor

Figure 5. Flow chart: Determination of CM emission factor



Since the electric grids do not meet the requirements of step 5 of version 7.0 of the Tool and the grid is located in SIDS, the Combined Margin (CM) will be calculated as the **Simplified CM** – where the weight of BM is equal to 0 and the weight of OM is equal to 1. The results for each electric system for each type of power plant are presented in the table below:

Plant's Name	Electric System (Island)	$EF_{grid, Simplified CM}$
Queen's Park Power Plant	Grenada	**0.66**
Carriacou Power Plant	Carriacou	**0.66**
Petite Martinique Power Plant	Petit Martinique	**0.83**