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Determination of the CO_2 Emissions Factor

the electrical system of the Dominican Republic

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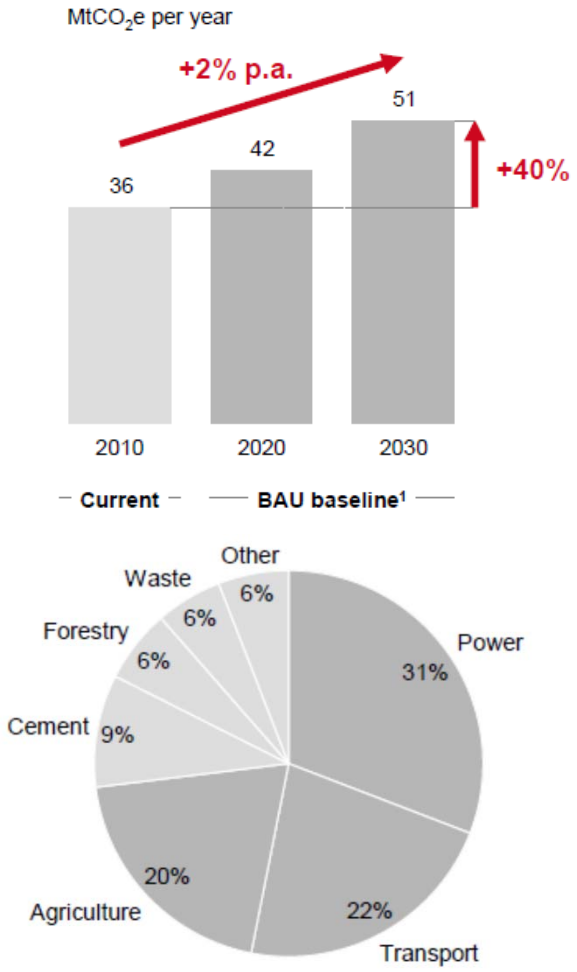
Background

Total area: 48,442 km2

Population: 9,445,281

GDP (PPP): $102.6 billion

Generation: 13,356 GWh

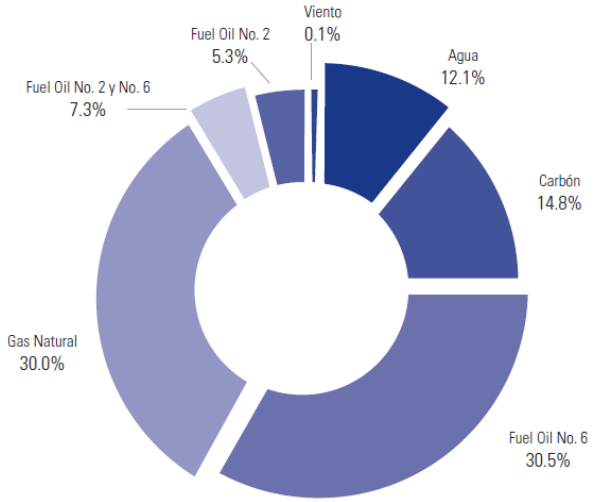


National Commitment

-25% in 2030

Doha, COP-18 (2012)

Figura 4-8. Generación Mensual del SENI por Fuente Primaria de Energía en el 2011 (%)



[1] Climate-Compatible Development Plan of the Dominican Republic (2011)

Questions?

What is a grid emissions factor?

Its define how much CO_2 is emitted per kWh of produced electricity in a electricity system. This factor is used to calculate the amount of GHG emissions of projects or activities connected to such grid or displacing electricity from it.

Why it is necessary?

a) to provide information on which to build an effective strategy to manage GHG emissions; b) to assess compliance with regulations, if any is already in place; c) used as well to participate in GHG markets (as CDMs and/or VERs).

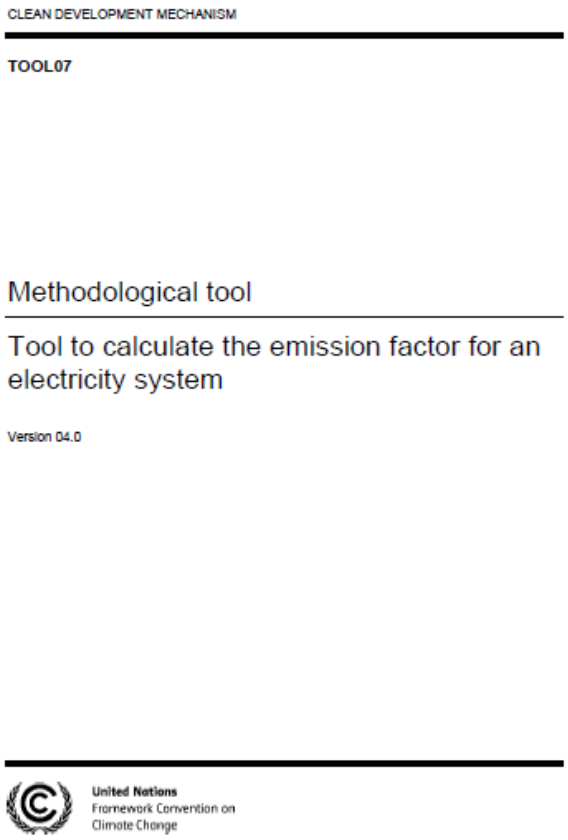
How to calculate this parameter?

- Ensuring calculations traceable, consistent, transparent, conservative, and verifiable;
- *OECD Report on Estimation of GHG Emissions and Sinks* (1991);
- *Revised IPCC Guidelines for National GHG Inventories* (2006);
- *ISO 14064:2006 -for quantification and reporting of greenhouse gas emissions;*
- *GHG Protocol: Corporate Accounting and Reporting Standards* (2008)
- ***Tool to calculate the emission factor for an electricity system*** (version 04.0)

Methodological tool

Tool to calculate the emission factor for an electricity system[2]

Tool07 (version 04.0); EB75 – Annex 15 | Valid From 4 Oct 2013 onwards


CLEAN DEVELOPMENT MECHANISM

TOOL07

Methodological tool

Tool to calculate the emission factor for an electricity system

Version 04.0

United Nations
Framework Convention on
Climate Change

> It does determines the CO2 emission factor for the use / displacement of electricity generated by power plants in an electricity system, by calculating the *combined margin* (CM) of the system. The CM is the weighted average of two independent factors: the *operating margin* (OM) emission factor and the *build margin* (BM) emission factor.

OM: The operating margin is the emission factor that refers to the group of existing power plants whose *current generation* would be affected by a proposed project activity connected to such system.

BM: The build margin is the emission factor that refers to the group of prospective power plants whose *entry-in-force* would be affected by a proposed project activity connected to such system.

[2] http://cdm.unfccc.int/DNA/Reference/tools/index.html

Procedure

(a) Step 1: Identify clearly the relevant electricity systems;

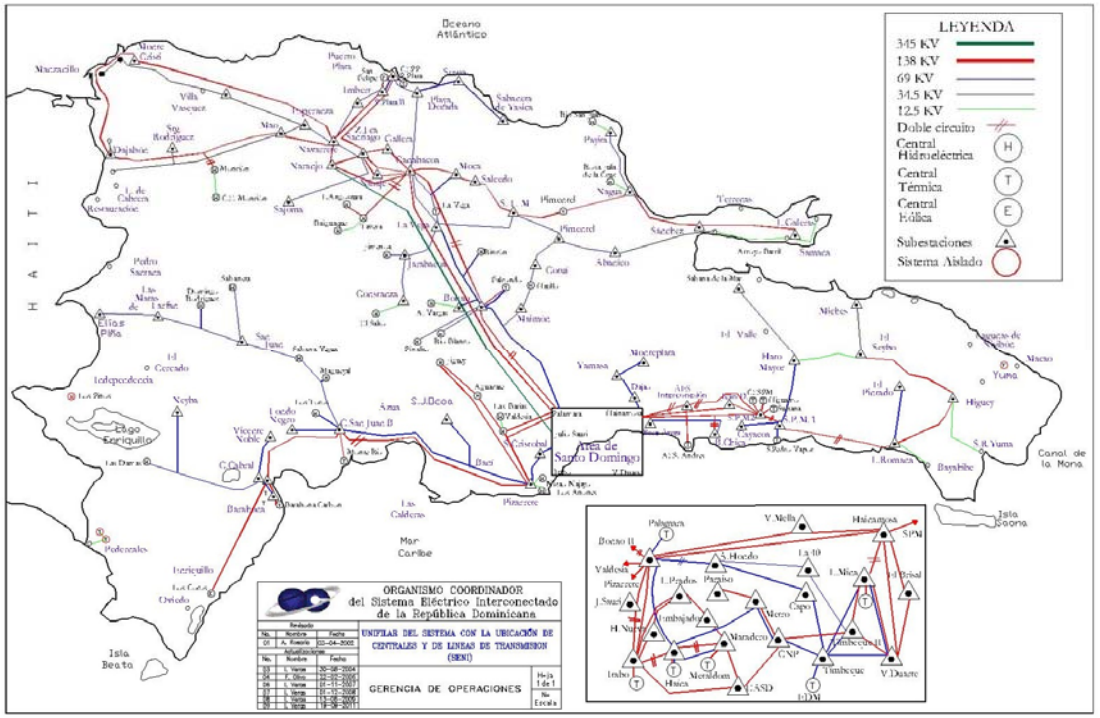
(b) Step 2: Choose whether *to include off-grid power plants* in the electricity system;

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

(d) Step 4: Calculate the operating OM according to the selected method;

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

(f) Step 6: Calculate the combined margin (CM) emission factor.



Important Issues

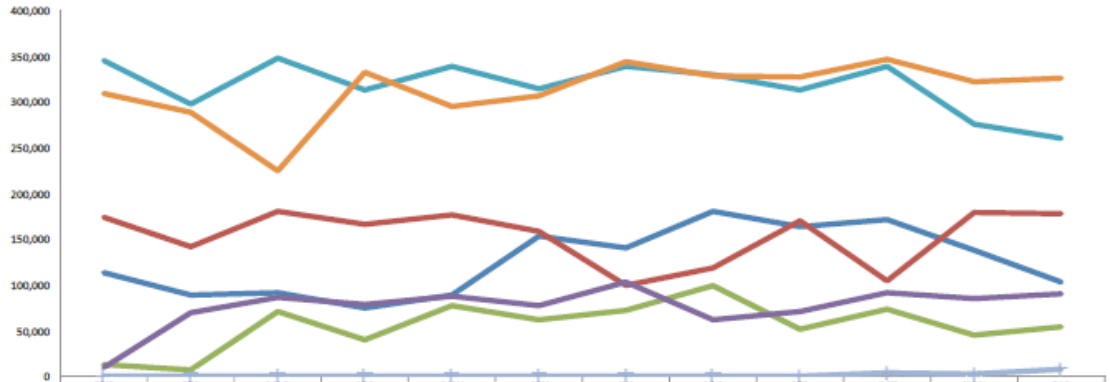
- Imports and Exports
- Transmission Constraints
- Data Oficial (available?)

[3] http://www.oc.org.do/SENI/Seni/RedNacional.aspx

OM Methods

(a) Simple OM (b) Simple adjusted OM; (c) Dispatch data analysis OM (d) Average OM

Figura 4-6. Generación Mensual del SENI por Fuente Primaria de Energía en el 2011 (MWh)



	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SEP	OCT	NOV	DIC
Agua	113,584	88,865	90,784	74,025	88,830	153,413	139,968	180,434	163,602	170,678	137,126	103,077
Carbón	173,692	141,275	179,456	166,369	175,638	158,471	99,084	118,153	169,117	104,107	179,252	177,906
Fuel Oil No. 2	13,147	6,808	70,560	39,824	76,664	60,959	71,842	98,713	51,525	73,627	44,816	53,398
Fuel Oil No. 2 y No. 6	9,306	68,804	86,246	78,171	87,068	77,598	102,568	61,454	70,907	90,683	85,067	90,030
Fuel Oil No. 6	345,177	296,573	347,226	312,017	337,906	314,164	338,204	328,789	311,856	338,388	275,227	259,639
Gas Natural	308,400	288,063	224,204	331,610	294,124	305,488	343,142	327,727	326,378	346,299	321,604	325,669
Viento	0	0	0	0	0	0	0	0	295	3,412	2,923	7,114

Low cost/must-run sources are less of 50%

Utilized Equation for OM

$$EF_{grid,OMsimple,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

EFgrid,OMsimple,y = Simple operating margin CO2 emission factor in year *y* (t CO2/MWh)

EGm,y = Net quantity of electricity generated and delivered to the grid by unit *m* in year *y* (MWh)

EFEL,m,y = CO2 emission factor of power unit *m* in year *y* (t CO2/MWh)

m = All power units serving the grid in year *y* except *low-cost/must-run* power units

y = the relevant year

[4] Memoria Anual del OC-SENI (2011).

OM Calculation

Unit	Technology	Fuel	Location	MW*
AES Andrés	Combined Cycle	Gas Natural	Santo Domingo	319.0
Río San Juan	Diesel Engines	Fuel Oil No. 2	María Trinidad Sánchez	1.9
CEPP 1	Diesel Engines	Fuel Oil No. 6	Puerto Plata	18.7
CEPP 2	Diesel Engines	Fuel Oil No. 6	Puerto Plata	58.1
CESPM 1	Combined Cycle	Fuel Oil No. 2	San Pedro	100.0
CESPM 2	Combined Cycle	Fuel Oil No. 2	San Pedro	100.0
CESPM 3	Combined Cycle	Fuel Oil No. 2	San Pedro	100.0
Los Mina 5	Gas Turbines	Natural Gas	Santo Domingo	118.0
Los Mina 6	Gas Turbines	Natural Gas	Santo Domingo	118.0
La Vega	Diesel Engines	Fuel Oil No. 6	La Vega	87.5
Palamara	Diesel Engines	Fuel Oil No. 6	Santo Domingo	107.0
Barahona Carbón	Steam Turbines	Coal	Barahona	53.6
Haina 1	Steam Turbines	Fuel Oil No. 6	Santo Domingo	54.0
Haina 2	Steam Turbines	Fuel Oil No. 6	Santo Domingo	54.0
Haina 4	Steam Turbines	Fuel Oil No. 6	Santo Domingo	84.9
Haina TG	Gas Turbines	Fuel Oil No. 2	Santo Domingo	100.0
Puerto Plata 1	Steam Turbines	Fuel Oil No. 6	Puerto Plata	27.6
Puerto Plata 2	Steam Turbines	Fuel Oil No. 6	Puerto Plata	39.0
San Pedro Vapor	Steam Turbines	Fuel Oil No. 6	San Pedro	30.0
Sultana del Este	Diesel Engines	Fuel Oil No. 6	San Pedro	102.0
Itabo 1	Steam Turbines	Coal	Santo Domingo	128.0
Itabo 2	Steam Turbines	Coal	Santo Domingo	132.0
Pimentel 1	Diesel Engines	Fuel Oil No. 6	Duarte	31.6
Pimentel 2	Diesel Engines	Fuel Oil No. 6	Duarte	28.0
Pimentel 2	Diesel Engines	Fuel Oil No. 6	Duarte	51.6
Metaldom	Diesel Engines	Fuel Oil No. 6	Santo Domingo	42.0
Monterio	Diesel Engines	Fuel Oil No. 6	Azua	100.1
San Felipe	Combined Cycle	Fuel Oil No. 2 + 6	Puerto Plata	185.0
Estrella del Mar	Diesel Engines	Fuel Oil No. 6	Santo Domingo	73.3
Estrella del Norte	Diesel Engines	Fuel Oil No. 6	Santo Domingo	43.0

Inputs:

(a) Electricity Production

(b) Average Efficiency

(c) Fuel Type

(d) Fuel Consumption

(e) Fuel CO_2 emission factor

(f) Net Caloric Value (NCV)

Data Vintage

ex-ante: 3 most recent years with data available (2009/2011).

Output:

EF*grid*,OM= 0.8223 t CO_2/MWh

BM Considerations

The sample group of power units *m* used to calculate the build margin should be determined as:

(a) Identify the set of 5 units, excluding registered CDM projects, that started to supply electricity to the grid most recently ($SET_{5\text{-units}}$) and determine their annual electricity generation (MWh); or

(b) Identify the set of power units, excluding registered CDM projects, that started to supply electricity to the grid most recently and that comprise 20% of total yearly generation **($SET_{\geq 20\%}$)** and determine their annual electricity generation in (MWh);

(c) From $SET_{5\text{-units}}$ and $SET_{\geq 20\%}$ select the set of power units that comprises the larger electricity generation (SET_{sample}).

Equation Utilized for BM

$$EF_{grid,BM,y} = \frac{\sum_m EG_{m,y} \times EF_{EL,m,y}}{\sum_m EG_{m,y}}$$

EFgrid,BM,y = Building margin CO2 emission factor in year *y* (t CO2/MWh)

EGm,y = Net quantity of electricity generated and delivered to the grid by unit *m* in year *y* (MWh)

EFEL,m,y = CO2 emission factor of power unit *m* in year *y* (t CO2/MWh)

m = All power units serving the grid in year *y* except *low-cost/must-run* power units

y = the relevant year

BM Calculation

Projections

Year	Unit	Type	MW
2007	Vapor Carbon	Carbon	300
2009	Vapor Carbon	Carbon	200
2010	Vapor Carbon	Carbon	300
2011	Ciclo Combinado	Gas Natural	300
2013	Ciclo Combinado	Gas Natural	300
2014	Vapor Carbon	Carbon	250
2015	Vapor Carbon	Carbon	125
2016	Vapor Carbon	Carbon	250
2017	Vapor Carbon	Carbon	400
2019	Vapor Carbon	Carbon	125
	Ciclo Combinado	Gas Natural	300
2020	Turbo Gas Natural	Gas Natural	300

Implemented

Unit	MW	Technology	Fuel	Start Operation
Pimentel 3	51.6	Diesel Engines	Fuel Oil No. 6	Jan-11
Pinalito	50.0	Hydropower	Hydro	Nov-09
Las Barias	0.8	Hydropower	Hydro	Nov-09
Pimentel 2	28.0	Diesel Engines	Fuel Oil No. 6	May-09
Magueyal	3.0	Hydropower	Hydro	Oct-08
Rio San Juan	1.9	Diesel Engines	Fuel Oil No. 2	Jun-08
Pimentel 1	31.6	Diesel Engines	Fuel Oil No. 6	Oct-06
Rosa Julia de la Cruz	0.9	Hydropower	Hydro	Aug-06
Los Mina V	13.0	Gas Turbines	Natural Gas	Sep-03
Domingo Rodríguez	3.6	Hydropower	Hydro	Aug-04
AES Andrés	319.0	Combined Cycle	Natural Gas	Jun-03

Inputs:

(a) Electricity Production

(b) Average Efficiency

(c) Fuel Type

(d) Fuel Consumption

(e) Fuel CO_2 emission factor

(f) Net Caloric Value (NCV)

Data Vintage

ex-ante: 1 most recent year with data available (2011).

Output:

EF*grid*,BM= 0.4512 t CO_2/MWh

CM Calculation

$$EF_{grid,CM,y} = EF_{grid,OM,y} \times w_{OM} + EF_{grid,BM,y} \times w_{BM}$$

where:

EFgrid,CM,y = Combiend margin CO_2 emission factor in year *y* (t CO_2/MWh)

EFgrid,OM,y = Operating margin CO_2 emission factor in year *y* (t CO_2/MWh)

EFgrid,BM,y = Building margin CO_2 emission factor in year *y* (t CO_2/MWh)

wOM = Weighting of operating margin emissions factor (per cent)

wBM = Weighting of building margin emissions factor (per cent)

Project Type	wOM	OM	wBM	BM	CM
Wind and Solar	0.75	0.8223	0.25	0.4512	**0.7295**
Otrher Projects	0.50	0.8223	0.50	0.4512	**0.6367**

Results and Discussion

Extension

- To update the calculated factor
- To include the off-grid generation
- To standardize a sectorial baseline

Expansion

- To develop factors in other sectors
- To promote the climate portfolio
- To create a framework for research

Thanks!!!

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