INTERNATIONAL FINANCIAL INSTITUTIONS TECHNICAL WORKING GROUP ON GREENHOUSE GAS ACCOUNTING

IFI TWG - AHG-001

Methodological Approach for the Common Default Grid Emission Factor Dataset

Version 01.1

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1. Overview

1. For the purpose of promoting greater harmonization, the IFI Technical Working Group (IFI TWG) on GHG accounting maintains a common dataset containing Default Emissions Factor (DEF) of the country's electricity grid including in-country interconnected grids. The DEFs apply to electricity generation in a country and currently do not consider the impact of interconnections with neighbouring countries.[1] The common dataset containing DEFs is constructed using a Combined Margin (CM) for the grid that is comprised of an Operating Margin (OM) and a Build Margin (BM). The OM and BM are terms defined under the clean development mechanism (CDM)[2] for grid connected electricity generation from renewable sources:

   (a) The OM represents the cohort of existing power plants whose operation will be most affected (reduced) by the project;

   (b) The BM represents the cohort of the prospective/future power plants whose construction and operation could be affected by the renewable energy project, based on an assessment of planned and expected new generation capacity.

2. Calculation of the OM

2. The International Energy Agency's (IEA) energy statistics database[3] provides country specific information on electricity generation from gas, oil, coal and "other" fuels and related CO_2 emissions that are used to calculate the OM emissions factor of most of the countries in the common dataset.[4]

3. In principle, the OM consists of generation from the power plants with the highest variable operating costs in the economic merit order dispatch of the electricity system. Natural gas and oil-based power plants have the highest variable operating costs, followed by coal. Nuclear power, hydropower, co-generation plants and other sources of power including waste to energy and other renewables are typically "must run" or low cost and therefore contribute to the OM only under special circumstances.

4. For the purposes of the common dataset, the default OM is defined as the plants producing the most-costly generation of the fossil fuel generation mix. Fossil fuel power plants in many countries provide firm power generation in base load or are must run and typically provide low cost power. To avoid including these power plants in the OM, only the top 50% or most costly half of the total fossil fuel generation mix is used. Gas and oil generation

[1] IFI TWG is undertaking further work to develop harmonized approaches for interconnection with neighbouring countries.

[2] ACM0002: Grid connected electricity generation from renewable sources available here.

[3] IEA CO_2 Emissions from Fuel Combustion Statistics provide information on fuel combustion and CO_2 emissions by sector, including gross electricity generation, for 142 countries and territories. A 3-year rolling average of the most recent statistics is used to smooth annual variations, and a correction factor for electricity consumed by the auxiliaries of thermal power plants is applied.

[4] As and when country specific data becomes available to the IFIs, e.g. through their detail country studies, such information can be used to replace IEA data to calculate operating margin emission factor but applying the same principle and methodology stipulated in this document.

are the most-costly and are the first to enter the OM. Due to fluctuations in oil and gas fuel prices, these sources are not differentiated and are assumed to contribute equally to the OM on a pro-rata basis.[5] Coal-based power plants contribute to the OM only when coal generation exceeds 50% of the total fossil fuel generation mix.[6]

5. "Other" power plants enter the operating margin when non-fossil fuel generation exceeds 50% of the total generation mix.[7] An adjustment factor based on CDM methodology[8] is used to determine the contribution of "other" fuels in the OM.

6. For countries not represented in the IEA energy statistics, research from publicly available sources is used to identify the mix of gas, oil, coal and other fuels used for electricity generation and default emissions factors for each fuel type are applied to define the OM according to the methodology described above.

3. Calculation of the BM

7. The IEA maintains a world energy model (WEM) that is the principal tool used to generate detailed sector-by-sector and region-by-region projections for the publication of the World Energy Outlook (WEO). Through the WEM, it is possible to project the CO_2 emissions of "new" electricity generation under various scenarios. New electricity generation comes from the cohort of power plants commissioned from the start of the projection period. The common dataset uses an average of the annual emission intensities of new electricity generation projected over the next 8 years under the Stated Policy Scenario (STEPS) of the most recent WEO as an estimate of the BM.[9] The STEPS assumes a continuation of the energy policies already adopted by governments and implementation of current and proposed commitments and plans and incorporates assumptions on fuel prices, technology costs and technological progress.

[5] For example, if a country fuel mix comprises 40% gas, 20% oil, 20% coal and 20% hydropower, fossil fuels contribute 80% of the generation mix. According to the methodology, the most-costly half of the fossil fuels within the total fossil fuel-mix contributes to the OM, i.e. 40% of the total generation (half of 80%). Gas & oil generation have the highest variable costs and together exceed half of the fossil fuel mix (40/80+20/80= 60/80). Therefore, the OM consists of gas and oil generation only, as a pro-rata mixture of two-thirds gas (40/60=2/3) and one-third oil (20/60=1/3).

[6] For example, if a country fuel mix comprises 20% gas, 10% oil, 50% coal and 20% hydropower, fossil fuels contribute 80% of the generation mix. According to the methodology, the most-costly half of the fossil fuels within the total fossil fuel-mix contributes to the OM i.e. 40% of the total generation (half of 80%). Gas and oil generation have the highest variable costs but are less than half of the fossil fuel mix. Therefore, gas, oil and coal generation contribute to the OM. All of the gas and oil contribute as a pro-rata mixture (20/40+ 10/40 =30/40) and rest of the OM is coal generation (1-30/40= 10/40). The OM is a mixture of one-half of gas, one-fourth of oil, and one-fourth of coal.

[7] The power plants represented in the IEA statistics as "other" fuels generally use low cost or low carbon fuels that are likely to be "must-run" resources in most countries. The CDM Tool 07 (see footnote below) defines must-run resources as "power plants with low marginal generation costs or dispatched independently of the daily or seasonal load of the grid. They include hydro, geothermal, wind, biomass and waste combustion, nuclear and solar generation."

[8] Clean Development Mechanism Methodological Tool (Tool 07): "Tool to calculate the emission factor for an electricity system" (v.7) available here.

[9] To offset the annual fluctuations of emission intensity from new power plants dispatched or operated a bit more or bit less in one year than in a previous one, the estimate of the BM uses an average of the 8 years of annual emission intensities.

8. WEM projections of CO_2 emissions from new electricity generation cover 26 large countries and regions. To create a common dataset that is consistent with the projections of the STEPS with granularity at the country level for all countries, a mathematical relationship to estimate the BM is used for the countries represented by a region.[10] The calculation of the BM is based on a regression analysis of the projected emission intensities of the WEM and two proxy variables – the most recent 3-year average emissions factor of the country's electricity grid (the "grid factor")[11] and the country's GDP per capita.[12] The regression analysis demonstrates a high correlation between these proxy variables and the emission intensities projected by the WEM.[13]

9. The grid factors for most countries are based on the IEA's energy statistics. GDP/capita[14] is obtained from the World Bank's World Development Indicators (WDI) and the UN Database.

10. For countries not represented in the IEA energy statistics, WDI or UN databases, research from publicly available sources is used to identify the mix of gas, oil, coal and other fuels used for electricity generation and default emissions factors, as well as recent data on GDP/capita, are applied to define the BM according to the methodology described above.

4. Combining the OM and BM to construct the CM EF

11. When combining the OM and BM to calculate the CM EF, generally the weighting ratio provided in the sector-specific approaches should be followed[15], for example:

    (a) For renewable energy projects, follow the guidance contained in "AHSA-001: IFI Approach to GHG Accounting for Renewable Energy Projects" (available here);

    (b) For energy efficiency projects, follow the guidance contained in "AHSA-002: IFI Approach to GHG Accounting for Energy Efficiency Projects" (available here);

    (c) For grid electricity consumption, follow the guidance contained in "AHG-002: Methodology/approach to account project emissions associated with grid electricity consumption" (available here).

[10] For the following 13 countries, the 8-year average of the annual projections of emissions intensities of new electricity generation are used directly: United Kingdom, USA, Canada, Mexico, Brazil, Chile, Russia, China, Japan, South Korea, Indonesia, India and South Africa.

[11] The "grid factor" represents a proxy for the influence of domestic fuel resources, existing fuel import infrastructure and technical experience with fuels and technologies – all of which contribute to the current emissions intensity and are likely to influence the BM.

[12] "GDP/capita" represents a proxy for the influence of a country's economic development on the potential rate of decarbonisation. Countries with higher levels of economic development are generally more capable of implementing effective decarbonisation policies, accommodating the technical challenges of a higher penetration of renewables, and have the capacity and experience to commission the more advanced technologies associated with low carbon and high efficiency power plants.

[13] A high correlation between these proxy variables and the projected emissions intensities, as demonstrated by the adjusted R2 of the linear regression and the normal distribution of the residuals.

[14] GDP is on real term (constant USD).

[15] Until more definitive guidance is available, the IFI should transparently document and share with the TWG any alternative weighting or other correction proposal for a specific country or region.

5. Process and timeline for the update

12. The common DEF dataset will be updated at least once in two years under the responsibility of the TWG.

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Document information

Version	*Date*	*Description*
01.1	20 January 2022	Minor revision. • To reflect the latest nomenclature used by IEA in its projections, i.e. New Policies Scenario (NPS) is changed to Stated Policy Scenario (STEPS). • Update of footnote 10 to list the 13 countries instead of earlier 12 countries for which WEM projections are now provided. • Addition of AHG-002.
01.0	18 May 2020	Initial adoption. Information on "IFI TWG Methodological Approach for the Common Default Grid Emission Factor Dataset" was extracted from "AHSA-001: IFI Approach to GHG Accounting for Renewable Energy Projects" and placed as a separate document for ease of reference in accordance with the decision of 3rd IFI TWG virtual meeting (6 May 2020).