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INTERNATIONAL FINANCIAL INSTITUTIONS TECHNICAL WORKING GROUP ON GREENHOUSE GAS ACCOUNTING

IFI TWG - AHSA-001

GHG Accounting for Grid Connected Renewable Energy Projects

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1. Overview

1. This note sets out a harmonized approach for assessing the mitigation benefits, or net greenhouse gas (GHG) emissions, of renewable energy (RE) projects in accordance with the International Financial Institution (IFI) Framework for a Harmonized Approach to Greenhouse Gas Accounting.[1] A Technical Working (TWG)[2] Group of IFIs has agreed to use a common set of emissions factors for GHG accounting of electricity production from Renewable Energy (RE) projects.[3] The purpose is to harmonize GHG accounting through the application of common emissions factors to RE GHG calculations. Further iterations of this approach note will include the treatment of off-grid RE activities.

2. Definition

1. For this document, the definition of renewable energy (RE) for electricity production follows the RE project typology defined by the Common Principles for Climate Mitigation Finance Tracking:[4]

    (a) Wind power.

    (b) Geothermal power.

    (c) Solar power (concentrated solar power, photovoltaic power).

    (d) Biomass, liquid biofuels, or biogas power.

    (e) Ocean power (wave, tidal, ocean currents, salt gradient, etc.).

    (f) Hydropower.[5]

2. If the pre-investment facility has not reached the end of its technical life, the approach set out in the “IFI Approach to GHG Accounting for Energy Efficiency Projects[6]” shall be followed.

3. Scope for calculations

3. GHG calculations should take the following points into consideration, where applicable/appropriate:

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[1] Available here.

[2] The IFI TWG for this methodology includes technical specialists from ADB, AfDB, AFD, EBRD, EIB, GEF, GIB, NIB, NEFCO, IDB, IFC, and WB, with support from the UNFCCC secretariat; to be widened to include more IFIs as work progresses. This note will be reviewed and updated periodically by the TWG.

[3] This approach is generally consistent with similar approaches to account for GHG emissions from a broader set of power generation projects.

[4] Available here (link 1; link 2).

[5] Pumped storage is not considered renewable energy for the purpose of this document.

[6] Available here.

(a) Construction emissions for RE projects may be excluded, where forms of renewable energy are generally acknowledged to have low construction/lifecycle emissions.

(b) Include GHG emissions from large reservoirs associated with hydropower projects.

(c) Include biomass feedstock-related life-cycle emissions.[7]

(d) Include geothermal fugitive emissions.

4. Project Output

4. Assumptions for power generation capacity (MW) and project energy output (MWh) should be based on the project appraisal documentation and the due diligence documentation of IFIs.

5. Baseline Emissions Factors

5. The main principles and assumptions for the baseline emissions factors include:

(a) Electricity produced from renewable sources and supplied to a grid, unless otherwise specified[8], will avoid emissions that would otherwise be generated wholly or partly from more carbon-intensive sources.

(b) For the purpose of promoting greater harmonization, the IFI GHG Accounting TWG (IFI TWG) maintains a common dataset containing Default Emissions Factors (DEFs) for countries and interconnected grids where applicable. The default emissions factors apply to electricity generation in a country and currently do not consider the impact of interconnections with neighbouring countries. The impact of a project on a country with interconnections is determined on a case-by-case basis by the IFI. Where IFIs co-finance such projects, harmonisation of the assumptions is encouraged. The approach to determine default emissions factors will be further refined as more data/information become available for countries with a significant level of interconnection with neighbouring countries (including countries, which are part of a power pool).

(c) The common dataset of DEFs will be updated at-least once in two years under the responsibility of the TWG. Where an IFI has conducted its own country baseline study, the results of this study may be submitted to the TWG for consideration of inclusion in the common dataset during future annual updates.

(d) In those cases, where a project is replacing specific planned or existing generation capacity, each IFI is free to conduct its own assessment, which may be shared with the TWG. In all other cases, the DEF approach and the common dataset described will apply.

[7] Life-cycle emissions may include emissions due to storage, biomass collection, processing and transportation.

[8] See Scope for Calculations (section 3).

6. Methodological Approach for the Common Data Set

6. 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)[9] 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.

7. Calculation of the OM

7. The International Energy Agency's (IEA) energy statistics database[10] 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.[11]

8. 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.

9. 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 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

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

[10] The IEA CO_2 Emissions from Fuel Combustion Statistics provide information on fuel combustion and CO_2 emissions by sector, including electricity generation, for 142 countries and territories. A 3-year rolling average of the most recent statistics is used to smooth annual variations.

[11] 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.

OM on a pro-rata basis.[12] Coal-based power plants contribute to the OM only when coal generation exceeds 50% of the total fossil fuel generation mix.[13]

10. "Other" power plants enter the operating margin when non-fossil fuel generation exceeds 50% of the total generation mix.[14] An adjustment factor based on CDM methodology[15] is used to determine the contribution of "other" fuels in the OM.

11. 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.

8. Calculating the BM

12. 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 forecast period. The common dataset uses an average of the annual emission intensities of new electricity generation projected over the next 8 years under the New Policy Scenario (NPS) of the most recent WEO as an estimate of the BM[16]. The NPS assumes a continuation of the energy policies already adopted by governments and implementation of current commitments and plans and incorporates assumptions on fuel prices, technology costs and technological progress.

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[12] 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 (50% 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 gas (40/60=2/3), oil (20/60=1/3).

[13] 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 (50% 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.

[14] 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."

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

[16] 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.

13. WEM projections of CO_2 emissions from new electricity generation cover 25 large countries and regions. To create a common dataset that is consistent with the projections of the NPS 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.[17] 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")[18] and the country's GDP per capita.[19] The regression analysis demonstrates a high correlation between these proxy variables and the emission intensities projected by the WEM[20].

14. The grid factors for most countries are based on the IEA's energy statistics. GDP/capita[21] is obtained from the World Bank's World Development Indicators (WDI) and the UN Database.

15. 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.

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

16. The common dataset combines the OM and the BM into a CM, using the following weighting:

    (a) For variable generation (e.g. wind and solar PV), the weighting is 75% OM: 25% BM.

    (b) For firm generation (e.g. hydropower, Concentrated Solar Power, geothermal and biomass), the weighting is 33% OM: 67% BM.

17. Over time, the TWG in coordination with the UNFCCC secretariat, will consider future modifications of the weights applied between OM and BM to account for additional factors, such as countries with high or low demand growth.[22]

[17] For the following 12 countries, the 8-year average of the annual projections of emissions intensities of new electricity generation are used directly: USA, Canada, Mexico, Brazil, Chile, Russia, China, Japan, South Korea, Indonesia, India and South Africa.

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

[19] "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.

[20] A high correlation between these proxy variables and the projected emissions intensities, as demonstrated by the adjusted R^2 of the linear regression and the normal distribution of the residuals.

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

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

10. Calculating Baseline Emissions

18. In the calculation, the electricity output from RE project is multiplied by the CM emissions factor in tCO2e/MWh or equivalent.

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Document information

Version	*Date*	*Description*
02.0	July 2019	Revision of the approach to calculate Build Margin Emission factor based on the IEA's projected CO_2 emission intensities of countries/regions including further clarifications on definitions and scope for Baseline calculations.
01.0	July 2016	Initial adoption.

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