

Tools and methodologies for calculating greenhouse gas emissions for FCDO programme planning

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Question

What tools and methodologies are available to calculate greenhouse gas (GHG) emissions of FCDO programming in sectors such as Water Supply and Sanitation; Social Services and Infrastructure; Economic Infrastructure; Production Sector; Environment Protection; Development Planning

Contents

1. Summary
2. Carbon accounting in development organisations
3. Infrastructure
4. Water and Sanitation
5. Agriculture
6. Finance and governance sectors
7. References

The K4D helpdesk service provides brief summaries of current research, evidence, and lessons learned. Helpdesk reports are not rigorous or systematic reviews; they are intended to provide an introduction to the most important evidence related to a research question. They draw on a rapid desk-based review of published literature and consultation with subject specialists.

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1. Summary

This report provides a snapshot of available tools and methodologies for calculating greenhouse emissions for development projects outside of the energy and forestry sector. Since the topic is broad, it was not possible to do a systematic search for literature within the scope of a helpdesk. A rapid search was undertaken with snowball searching. It is a complicated area, and the findings and summaries here make a start in covering the resources being used. The report is presented as an annotated bibliography.

Searching for development project GHG emission accounting tools identified information from the Inter-America Development Bank, the International Financial Institution (IFI) Technical Working Group (TWG), the European Investment Bank, and the Asian Development Bank (specifically on transport infrastructure).

A number of tools were identified in the infrastructure sector, including a calculator used by the United Nations Environment Programme, whole-life carbon assessment from RICS, life-cycle assessment tools, an Excel tool used by the UK Environment Agency, a publicly available UK-based tool for highway asphalt, and an Excel tool used by Highways England.

There is an experience of carbon accounting in the Water, Sanitation, and Hygiene sector from the Sustainable Sanitation Alliance. There is also a tool assessing water and wastewater emissions from Water and Wastewater Companies for Climate Change.

Two resources on carbon accounting in agriculture are included: i) a methodology used in USAID projects and ii) a carbon accounting tool for sustainable land management, including agriculture but with a focus on forestry. For reference, there is a document on GHG accounting in the finance sector and an accounting tool for assessing local government authority operations in the UK.

2. Carbon accounting in development organisations

Inter-American Development Bank (IDB)

IDB GHG accounting manual

Buttazzoni, M. & Leal, R. (2021). Inter-American Development Bank.

<https://publications.iadb.org/publications/english/document/IDB-GHG-Accounting-Manual.pdf>

The Inter-Development Bank guidance document is aimed at project teams and executing agencies during the project design phase.

After defining project boundaries and identifying emission sources, an estimation approach must be selected. "Project teams are advised to use the 2006 IPCC Guidelines for National Greenhouse Gas Inventories¹, which were refined in 2019², and the IFIs sector specific

¹ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>. The guidelines include volumes on energy; industrial processes and product use; agriculture, forestry and other land uses; and waste.

² <https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html>

guidelines (for net calculations such as in renewable energy, energy efficiency and transportation projects)³ (p23).

IDB uses a number of calculation tools based on Clean Development Mechanism⁴, and Voluntary Carbon Standard⁵ methodologies. Different workbooks are available for different project types. These include fossil fuel power plants, renewable energy, energy sector transmission line development, biofuels (agricultural), bus rapid transit system construction, canal construction, road construction, airport construction, urban development housing, waste and sanitation, E-government, Forestry, and IDB invest sectors (supporting the private sector). The workbooks are not in the public domain, so IDB would have to be contacted to obtain them.

More details are available in the manual on a selection of tools.

The construction tools estimate construction-related emissions, including emissions from land-use change and fuel used during construction. Road building includes emissions for streetlights and electric signposts. The canal construction tool includes estimated emissions from increased shipping traffic.

For urban and building development, GHG estimation (an analytical software tool) is used. It is provided by EDGE (Excellence in Design for Greater Efficiencies).⁶ This helps to identify cost-effective options for designing low-GHG buildings.

The IDB calculation tool for solid waste management estimates emissions from construction, incineration, landfills operation, and waste transport. The tool for wastewater emission calculation is based on aerobic and anaerobic treatment processes. It also estimates emissions from nitrogen content and digester gas.

International Financial Institution (IFI) Technical Working Group (TWG) methodologies

These methodologies focus on the energy sector.

IFI Joint approach to GHG assessment in the Transport Sector

UNFCCC (2015)

https://unfccc.int/sites/default/files/resource/Transport_GHG%20accounting.pdf

This document agrees with principles for assessment. On tools it states:

³ <https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies>

⁴ <https://cdm.unfccc.int/methodologies/index.html>

⁵ <https://verra.org/>

⁶ [https://www.buildup.eu/en/learn/tools/excellence-design-greater-efficiencies-edge-0#:~:text=Excellence%20in%20Design%20for%20Greater%20Efficiencies%20\(EDGE\)%20is%20a%20green,certification%20system%20for%20emerging%20markets.&text=Through%20bringing%20together%20those%20who,new%20paradigm%20for%20the%20future.](https://www.buildup.eu/en/learn/tools/excellence-design-greater-efficiencies-edge-0#:~:text=Excellence%20in%20Design%20for%20Greater%20Efficiencies%20(EDGE)%20is%20a%20green,certification%20system%20for%20emerging%20markets.&text=Through%20bringing%20together%20those%20who,new%20paradigm%20for%20the%20future.)

“The choice of specific assessment tool and/or methodology should be left to the discretion of each IFI, as long as the tool and/or methodology adheres to the basic principles laid out in this document.” (p3).

European Investment Bank

EIB Project Carbon Footprint Methodologies. Methodologies for the Assessment of Project GHG Emissions and Emission Variations.

EIB (2020)

https://www.eib.org/attachments/strategies/eib_project_carbon_footprint_methodologies_en.pdf

This document describes how the carbon footprinting of investment projects are calculated and presented. Carbon footprinting is mainstreamed in European Investment Bank projects and remains under regular review. The methodologies are based on the IFI’s Framework for a Harmonised Approach to Greenhouse Gas Accounting, Intergovernmental Panel on Climate Change (IPCC) Guidelines, and the WRI GHG Protocol.

The Bank carried out a 3-year pilot phase from 2009-2011, measuring GHG emissions from the investment projects it finances. There are methodologies for two estimations: total sequestration of a project, and emissions variations under different project scenarios.

The guiding principles are completeness, consistency, transparency, conservativeness, balance, accuracy, and relevance.⁷ The Bank decided on a minimum project threshold for inclusion so that projects with a footprint below 20,000 tonnes CO₂e per year for absolute emissions and/or below 20,000 tonnes CO₂e per year (positive or negative) for relative emissions do not need to be included.

GHGs included are carbon dioxide (CO₂); methane (CH₄); nitrous oxide (N₂O); hydrofluorocarbons (HFCs); perfluorocarbons (PFCs); sulphur hexafluoride (SF₆); and nitrogen trifluoride (NF₃). A quantification process converts all GHG emissions into tonnes of carbon dioxide called CO₂e (equivalent).⁸ The selected examples of GHG emission sources are largely from industrial activity, although wastewater treatment and solid waste incineration are included (pp5-6). Several footprint boundary clarifications are outlined for different project types.

Absolute emissions should be calculated using project-specific data where possible and if not, then default factors based on sector-specific activity may be used. Default methodologies are compiled in the Annex of the EIB document and categorised into combustion emissions and emissions that do not involve combustion.

⁷ see p3 of the EIB document for more details.

⁸ This is done using Global Warming Potentials (GWP). Details of which are in table A1.9 in the Annex of the document.

Asian Development Bank

Guidelines for Estimating Greenhouse Gas Emissions of Asian Development Bank Projects: Additional Guidance for Transport Projects

ADB (2016)

<https://www.adb.org/sites/default/files/institutional-document/219791/guidelines-estimating-ghg-emissions-transport.pdf>

This document includes guidelines for road construction/maintenance, rail, public transport, ports, and airports.

Management and appraisal of road development uses the Highway Development and Maintenance Management Model (HDM-4).⁹ It is an industry-standard software package and documentation for economic analysis and planning of road maintenance. It estimates vehicle operating costs which can be converted into GHG emissions.

“In a typical case, the improvements in road quality brought about by the project would reduce fuel consumption (and thereby GHG) per vehicle-kilometer. However, these savings would be partially or wholly offset by the increase in total vehicle-kilometers due to traffic generation.” (p8).

Other tools used by the ADB on road projects include Motor Vehicle Emission Simulator (MOVES), a modelling system estimating emissions for mobile sources covering a broad range of sources. And Transport Emissions Evaluation Model for Projects (TEEMP), a road model evaluating carbon emissions from three types of road (expressways, urban roads, and rural roads).

Tools recommended for railway GHG assessment include a Railway Handbook¹⁰ with information on energy use and emission statistics. And a rail tool from the United States Environmental Protection Agency worksheet with demos and guidance.¹¹

Available tools for urban transport are listed. These include propriety macrosimulator tools and software; and several Clean Development Mechanism for bus rapid transit project methodologies.

Methodology for Estimating Carbon Footprint of Road Projects – Case Study: India

ADB (2010)

<https://www.adb.org/publications/methodology-estimating-carbon-footprint-road-projects-case-study-india>

Frameworks and pilot findings from estimating the carbon footprint of road construction, operation and maintenance phases in India.

⁹ <https://trlsoftware.com/products/economic-appraisal/hdm-4/>

¹⁰ https://uic.org/IMG/pdf/iea-uic_railway_handbook_2016.pdf

¹¹ <https://www.epa.gov/sites/production/files/2021-04/2021-sw-rail-tool-v2-0-20-datayear2020.xlsm>

Challenges included a large amount of effort for manual data collection, communicating with contractors and authorities in local languages, considerable research required to select appropriate and context-specific carbon values and emission factors, and small sample size.

Estimation of Greenhouse Gas Emissions from Land-Use Changes due to Road Construction in the Republic of Korea

Kim, B, Lee, H, Park, H, and Kim, H. (2013)

[https://ascelibrary.org/doi/abs/10.1061/\(ASCE\)CO.1943-7862.0000620](https://ascelibrary.org/doi/abs/10.1061/(ASCE)CO.1943-7862.0000620)

This study quantified GHG emissions and sequestration from land-use changes due to road construction at 18 sites in Korea following guidelines of the IPCC.

3. Infrastructure

The eMob calculator

United Nations Environment Programme

<https://www.unep.org/resources/toolkits-manuals-and-guides/emob-calculator>

This tool estimates the potential emission savings from shifting to electric mobility for motorcycles, light-duty vehicles, and buses.

Whole Life Carbon Assessment for the Built Environment, 1st edition

RICS professional standards and guidance, UK (2017)

<https://www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment/>

“This guidance mandates a whole life approach to reducing carbon emissions within the built environment. It sets out specific mandatory principles and supporting guidance for the interpretation and implementation of EN 15978 methodology.¹²

It is intended primarily for a UK audience. However, while the numeric assumptions are based on UK locations and standard practices, geographic adjustments are highlighted to enable the requirements and guidance to be applied in other countries.”

Environment Agency Carbon Calculator

<https://data.gov.uk/data/contracts-finder-archive/download/355422/39ef8800-9ca6-43b3-b893-5b6399cf7374>

This is an excel sheet which allows the user to input the amount of a material being used, the distance between source and site, and the mode of transport to estimate the carbon footprint of different materials - including aggregate, timber, metals, plastic and glass.

¹² <https://www.thenbs.com/PublicationIndex/Documents/Details?DocId=299697>

DuboCalc

<https://www.dubocalc.nl/en/what-is-dubocalc/>

“DuboCalc is a Sustainable Construction Calculator developed by Rijkswaterstaat to calculate the sustainability and environmental costs of procurement and compare. DuboCalc calculates all effects of material and energy from cradle to grave, or from extraction to the demolition and recycling phase. As a result, the securities are denominated in euros, the Environmental Cost Indicator (MKI). The calculations are then considered all relevant environmental impacts throughout the entire life cycle. The method is based on the methodology of Life Cycle Analysis (LCA) according to ISO 14040 standard and Environmental Assessment Method Buildings and Construction.”

A license must be purchased to use the calculator.

Moata Carbon Portal

<https://www.mottmac.com/digital/moata-carbon-portal#?nocache=1620828859281>

This is an industry tool for embodied carbon accounting. "Moata Carbon Portal allows detailed embodied carbon accounting and planning at all stages of the project. Our Carbon Portal is globally compliant with PAS2080 certification. The Portal delivers rapid calculations and insights that highlight major opportunities for innovation, efficiency and competitive advantage for clients and aligns these with their end goal of reducing their carbon emissions.”

Asphalt Pavement Embodied Carbon Tool (asPECT)

<https://trl.co.uk/permanent-landing-pages/asphalt-pavement-embodied-carbon-tool-aspect/>

A UK-based methodology to calculate the life cycle greenhouse gas emissions or ‘carbon footprint’ of asphalt used in highways. It is a publicly available, downloadable, and spreadsheet-based calculator.

Build Carbon Neutral Tool

<http://www.buildcarbonneutral.org/>

The tool estimates the embodied carbon of a construction project and carbon amounts released during the process of construction. It was initially produced for projects in the United States but can be used as an estimation for other regions. It is a basic and free tool.

eToolLCD

<https://etoolglobal.com/about-etoollcd/>

A tool for life cycle design and assessment. Free to use for basic purposes and then offers subscription services for more features and services. It complies with international standards.¹³

Highways England's Carbon Tool

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/899358/Highways_England_Carbon_Tool_v2.3.xlsm

Excel spreadsheet requires macros to be enabled. It includes step-by-step instructions for carbon accounting for Highways England projects, including their maintenance, construction and operational. It is possible to [request in an accessible format](#) for users of assistive technology.

There is a [guidance note](#) and an [e-learning training programme](#).

Carbon Calculations over the Life Cycle of Industrial Activities (CCaLC)

<https://tinyurl.com/4x5uc2s6>

A database of carbon footprint data items for materials, energy, transport, packaging and waste. Requires Excel. Appropriate for various geographies.

Embodied Carbon. The inventory of Carbon and Energy (ICE)

Hamond, G. & Jones, C. (2011). BSRIA.

<https://greenbuildingencyclopaedia.uk/wp-content/uploads/2014/07/Full-BSRIA-ICE-guide.pdf>

Looking at how much carbon is embodied into materials.

4. Water and Sanitation

Opportunities for sustainable sanitation in climate action

Andersson, K. Reckerzuegl, T., Michels, A. & Rüd, S. (2019).

https://www.pseau.org/outils/ouvrages/susana_opportunities_for_sustainable_sanitationin_climate_action_2019.pdf

Examples of climate assessment and planning tools include a community-based risk screening tool, risk reduction integration guidance, and ecosystem-based assessment focusing on adaptation. A carbon accounting tool for the urban water cycle is described: "The Energy Performance and Carbon Emissions Assessment and Monitoring (ECAM) tool, offers water and wastewater utilities a solution to quantify direct and indirect GHG emissions of the urban water cycle and to identify potential climate mitigation measures. ECAM was developed to be consistent with the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National

¹³ EN 15978 and ISO 14044

Greenhouse Gas Inventories. ECAM helps link monitoring, reporting and verification of mitigation action in the water sector to the national level.” (p13).

ECAM (Energy Performance and Carbon Emissions Assessment and Monitoring Tool)

Water and Wastewater Companies for Climate Change (WaCCliM)

<https://wacclim.org/ecam-tool/>

“ECAM offers unique capabilities for assessing greenhouse gas emissions and energy consumption at a system-wide level. Gain greater insights by identifying areas to reduce greenhouse gas emissions, increase energy savings and improve overall efficiencies to reduce costs.”

It appears to be primarily a tool for programmes that are underway rather than prospective programming.

It is based on IPCC; free and open source; secure and trustworthy; and includes online training materials.

5. Agriculture

A methodology for greenhouse gas emission and carbon sequestration assessments in agriculture Supplemental materials for info note series analysing low emissions agricultural practices in USAID development projects

Grewer, U., Bockel, L., Galford, G., Gurwick, N., Nash, J., Porilli, G., and Wollenberg, E. (2016). FAO.

<http://www.fao.org/3/i6422e/i6422e.pdf>

This document presents a series of case studies of a methodology used in USAID development projects. It is a rapid assessment technique for estimating GHG impacts at project scale, emissions by agricultural practice, and emissions per unit of output. It is adapted to a context of data scarcity.

Carbon Accounting Tools for Sustainable Land Management

Toudert, A., Braimoh, A., Bernoux, M., St-Louis, M., Abdelmagied, M., Bockel, L., Ignaciuk, A., and Zhao, Y. (2018) World Bank

<https://openknowledge.worldbank.org/bitstream/handle/10986/31062/132767-6-12-2018-14-1-54-SLMFullReportFINAL.pdf?sequence=1>

This report compares the relative performance of available GHG accounting tools for sustainable land use management.

Most of the tools are focused on forestry but there are some for agriculture, including Climate Change, Agriculture, Food Security Mitigation Options Tool (CCAFSMOT),¹⁴ and Cool Farm Tool (CFT).¹⁵

6. Finance and governance sectors

Understanding the issues around quantifying GHG emissions in the financial sector

ADEME (2016)

https://www.banktrack.org/download/understanding_the_issues_around_quantifying_ghg_emissions_in_the_financial_sector_1/fichier_v_1_eng_understanding_the_issues_around_quantifying_ghg_emissions_in_the_financial_sector.pdf

This guide maps a range of approaches and methodologies (pp11-14). The main focus is on assessing the emissions of investment portfolios and includes financial companies, financial institutions, sovereign bonds, and loans to small- and medium-sized enterprises.

Greenhouse Gas Accounting Tool

Local Partnership. Web-based, accessed 24.5.21

<https://localpartnerships.org.uk/greenhouse-gas-accounting-tool/>

It is a tool developed for local government authorities in the UK to calculate their carbon emission baseline. Table and charts help to identify the most significant emission sources. Prospective users can register their email address to download for free.

7. References

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<https://www.adb.org/sites/default/files/institutional-document/219791/guidelines-estimating-ghg-emissions-transport.pdf>

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https://www.banktrack.org/download/understanding_the_issues_around_quantifying_ghg_emissions_in_the_financial_sector.pdf

¹⁴ <https://ccaafs.cgiar.org/research/projects/mitigation-options-tool-agriculture-ccaafs-mot>

¹⁵ <https://coolfarmtool.org/>

ons_in_the_financial_sector_1/fichier_v_1_eng_understanding_the_issues_around_quantifying_ghg_emissions_in_the_financial_sector.pdf

Andersson, K. Reckerzuegl, T., Michels, A. & Rüd, S. (2019). Opportunities for sustainable sanitation in climate action
https://www.pseau.org/outils/ouvrages/susana_opportunities_for_sustainable_sanitationin_climate_action_2019.pdf

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<https://publications.iadb.org/publications/english/document/IDB-GHG-Accounting-Manual.pdf>

EIB (2020). EIB Project Carbon Footprint Methodologies. Methodologies for the Assessment of Project GHG Emissions and Emission Variations
https://www.eib.org/attachments/strategies/eib_project_carbon_footprint_methodologies_en.pdf

Grewer, U., Bockel, L., Galford, G., Gurwick, N., Nash, J., Porilli, G., and Wollenberg, E. (2016). FAO. A methodology for greenhouse gas emission and carbon sequestration assessments in agriculture Supplemental materials for info note series analysing low emissions agricultural practices in USAID development projects.
<http://www.fao.org/3/i6422e/i6422e.pdf>

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[https://ascelibrary.org/doi/abs/10.1061/\(ASCE\)CO.1943-7862.0000620](https://ascelibrary.org/doi/abs/10.1061/(ASCE)CO.1943-7862.0000620)

RICS (2017). Whole Life Carbon Assessment for the Built Environment, 1st edition. RICS professional statement, UK.
<https://www.rics.org/uk/upholding-professional-standards/sector-standards/building-surveying/whole-life-carbon-assessment-for-the-built-environment/>

Toudert, A., Braimoh, A., Bernoux, M., St-Louis, M., Abdelmagied, M., Bockel, L., Ignaciuk, A., and Zhao, Y. (2018) World Bank. Carbon Accounting Tools for Sustainable Land Management.
<https://openknowledge.worldbank.org/bitstream/handle/10986/31062/132767-6-12-2018-14-1-54-SLMFullReportFINAL.pdf?sequence=1>

UNFCCC (2015). IFI Joint approach to GHG assessment in the Transport Sector.
https://unfccc.int/sites/default/files/resource/Transport_GHG%20accounting.pdf

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