The AFD Carbon Footprint Tool for projects

User's Guide and Methodology

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Summary

AFD (*Agence Française de Développement*) aims to promote low-carbon development through the projects it finances, in line with France's commitment to combat climate change and AFD's strategic orientation plan. AFD's multi-pronged policy rests, in part, on measuring financed projects' carbon footprints.

In 2007, AFD created its own Carbon Footprint Tool to quantify its projects' greenhouse gas (GHG) emissions and reductions. The Tool drew on the work of Jean-Marc Jancovici and the French Environment and Energy Management Agency's Bilan Carbone™, which the World Bank's International Finance Corporation subsequently adapted for its own needs. In 2011, AFD worked with the consulting firm, Carbone4, to develop a new, easier to use version of the Tool, featuring updated data and new functionalities. The Tool uses its built-in database to calculate a future project's likely GHG emissions and/or reductions, and directly gives the resulting estimates.

The Tool determines a project's carbon footprint by first estimating the amount and kind of emissions the project's construction and operations are likely to generate. It then compares the difference in emissions between the project and a reference situation; this so-called baseline is based on an estimate of the amount and type of emissions that would probably occur if the project were not implemented. The net difference in emissions between the two scenarios – doing the project or not doing the project – determines whether the project is likely to have a positive or negative impact on climate change overall.

Furthermore, these estimates of its financed projects' climate change impacts serve to reinforce AFD's accountability to its shareholders and the public.

In addition, since the AFD Carbon Footprint Tool's calculation of GHG emissions estimates a project's fossil fuel consumption, it also serves as a device to warn of a project's dependency on energy resources that may be subject to future supply and/or price shocks.

This guide has three sections:

I. A description and explanation of the principles governing the measurement of AFD's projects' carbon footprints, so calculations can be standardised and consistent, ensuring comparability and transparency.
II. A user's guide for the AFD Carbon Footprint Tool.
III. A series of 27 factsheets that describe four key calculation factors for each major project category that is eligible for AFD financing; 1) assumptions underlying emissions calculations; 2) sources of emissions to include in a calculation; 3) sources of negligible emissions not used in the calculation; and 4) the calculation methodology's limitations.

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Introduction: Why measure GHG emissions?

As part of AFD's general policy of quantifying and assessing the potential impacts of every project it finances via pre-project reviews, AFD makes an effort to quantify potential climate impacts as a complement to accounting for the funds it spends on fighting climate change. AFD measures a project's potential greenhouse gas (GHG) emissions and reductions, and uses the findings to better understand the relationship between development and the climate, integrating climate impacts in its pre-project analyses.

AFD's primary goal is to harmonise development activities and their climate impacts by seeking a better compromise between a beneficiary country's needs, the risks and benefits accrued to those needs, the country's ability to implement innovative climate-related solutions, and AFD's desire – as a French agency – to be ambitious in fighting climate change.

This choice to emphasise development and the climate assumes both notions are complementary, not conflicting. In fact, countries around the world are gradually changing their development paths to create fewer GHG emissions to fight global warming generally and to prepare for the effects of climate change.

To be sustainable, growth in developing and emerging countries must rest on development strategies that limit GHG emissions and ensure less dependence on fossil fuels and carbon-intensive infrastructure. It is in these countries' interest to act now; otherwise, it will be difficult for them to prosper in a world constrained by depleted fossil fuel stocks.

In this context, the AFD Carbon Footprint Tool aids in understanding a development project's ramifications by:

- Quantifying the project's impact on GHG emissions and clarifying the relationship between the project's development impacts and the climate.
- Clarifying the primary sources of a project's GHG emissions, allowing other ways of reducing emissions to be identified and studied during the pre-project review.
- Serving as a warning device and providing quantitative elements to help evaluate a project's fossil fuel dependency and/or potential cost increases. (GHG emissions can serve a as proxy for estimating fossil fuel consumption; such fuels remain susceptible to price and supply shocks and subject to per-tonne charges according to current and possibly future regulations governing worldwide emissions.)
- Supplying crucial quantitative elements needed to assess a project's 'climate efficiency'. (If need be, qualitative elements can complement such quantitative analyses).

I. Measurement principles

I.1. The AFD Carbon Footprint Tool's general principles

A. The AFD Carbon Footprint Tool's guiding principle

The AFD Carbon Footprint Tool's accounting method uses a project's or an activity's operational data to estimate its GHG emissions. A carbon footprint calculation is created by making an inventory of a project's activities, using physical data inputs, e.g., kilowatt-hours (kWh) of electricity and/or tonnes of diesel consumed; quantities of cement, steel and/or plastic used; amount of waste produced or the number of people transported, etc. The quantities are entered in a spreadsheet that directly computes each item's emissions in carbon dioxide equivalents (CO_2e) via a scientifically determined 'emission factor' embedded in the spreadsheet. As it multiplies the activity's 'observable' physical data values by this emission factor, the spreadsheet instantly converts each physical value into its CO_2e using kilograms and/or metric tonnes as a unit of measure.

Some examples of emission factors follow:

- 1 kWh of electricity consumed in China equals 0.74 kilograms (kg) of CO_2e emissions (source: International Energy Agency, 2009).
- Producing one metric tonne of cement emits 862 kg CO_2e.
- A short-haul 500-kilometer (km) airplane flight in business class generates 330 kg CO_2e.

When using the Tool calculator it is important to keep in mind the relatively high or low levels of certainty for each emission factor: the calculated result remains an approximation. The AFD Carbon Footprint Tool aims for flexibility and ease of use more than accuracy so that information representing orders of magnitude can inform pre-project analyses and support decision-making.

B. Gases measured

The AFD Carbon Footprint Tool's emissions inventory counts the six main greenhouse gases identified in the Kyoto Protocol:

- **Carbon Dioxide** (CO_2), which results primarily from combusting fossil fuels and from producing aluminium, steel, cement and glass.
- **Methane** (CH_4), which results from burning and/or decomposing biomass (organic material) and from producing and/or refining gasoline and natural gas.
- **Nitrous Oxide** (N_2O), which results from incinerating solid waste, spreading fertilizers, and/or various transportation means.
- **Hydrofluorocarbons** (HFC), which occur as a by-product of industrial processes making insulation, refrigeration and air conditioning.
- **Perfluorocarbons** (PFC), which occur as a by-product of aluminium production.
- **Sulphur hexafluoride** (SF_6), which is used for insulation and current interruption in electricity transmission and distribution equipment and electronic systems.

In addition, the Tool counts GHG emissions from air travel, such as water vapour trails in the stratosphere, various forms of condensed water, nitrogen oxides (NO_x), and methane, which combined create **Ozone** (0_3): these gases are included in the emission factors.

C. CO_2 equivalent: a common measurement unit for GHG impacts

Each type of greenhouse gas has a different potency and atmospheric global warming potential. For instance, sulphur hexafluoride is the most potent greenhouse gas in existence. It has a global warming potential 23,900 times greater than carbon dioxide; one-half kilo of SF_6 has the same global warming impact as 11 tonnes of carbon dioxide.

To reconcile the differences between the warming potentials of various gases and have a consistent measure for varying warming impacts, a specific measurement unit – the **tonne CO_2 equivalent** or **tCO_2e** – is used. It expresses the equivalency of one metric tonne of GHG to the number of metric tonnes of CO_2 needed to generate the same warming effect over one-hundred years. (For more information, see the 2007 Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, page 36: http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf)

D. Sources of emissions

AFD's methodology and the AFD Carbon Footprint Tool use the same sources of emissions and nomenclature as the ISO 14069 standard for the 'Carbon Footprint of Organisations'. Emissions are separated into two distinct categories according to the project's phase – construction vs. operation – and further sub-categories, as follows:

- Project 'Construction Phase' emissions sources:
  - Clearing: deforestation
  - Construction materials: production of cement, steel, metals, etc.,
  - Construction energy consumption: fuel and electricity used during construction

- Project 'Operating Phase' emissions sources:
  - Fuel consumption: combustion of fossil fuels
  - Electricity/heat consumption
  - Other process emissions: includes non-energy producing processes, especially decarbonation from cement clinker production, methane released from mining and dam reservoirs, methanization of organic waste and wastewater, nitrous oxide released by spreading fertilizer or from industrial gases, particularly coolants
  - Purchase of goods and services: includes the production of products consumed due to the project's activity, especially metals, plastics, glass, paper and cardboard, and chemical and agricultural products
  - Freight: moving commodities, inputs and/or finished products by road, rail, air or ocean
  - Passenger transport
  - Waste and wastewater
  - Land use: changing how land is used, resulting in emissions from biomass and soil
  - Utilisation: people's use of utilities and infrastructure and/or factories or other buildings. Includes the mix of their use of transportation, electricity, fuels, products, etc., and their waste
  - End of life: disposing of built or produced objects

I.2. AFD's principles for measuring its projects' climate impacts

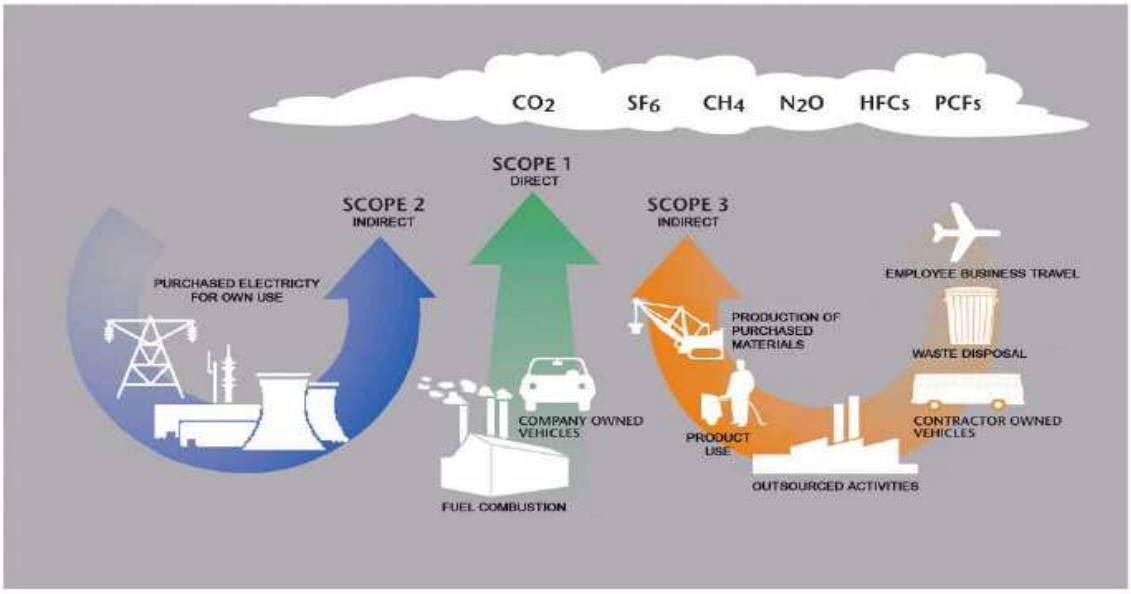
A. Transparency

A common thread ties the AFD Carbon Footprint Tool methodology together: the principle of transparency. The assumptions and data sources used for a project's carbon footprint calculations must be explained clearly to ensure a transparent audit trail from the operational data, through the assumptions, to the resulting estimates.

B. Scope of emissions

The AFD Carbon Footprint Tool calculation is compatible with the definition of 'Scopes' 1, 2 and 3 in the GHG Protocol[1] (see Figure 1).

Figure 1. GHG Operational Boundaries and 'Scopes'



Source: Greenhouse Gas Protocol, *Corporate Accounting and Reporting Standard*, Chapter 4 'Setting Operational Boundaries' (April 2004)

Scope 1 = Direct GHG emissions, from sources directly related to a project's activity, e.g., combustion, etc.
Scope 2 = Electricity indirect GHG emissions, from the generation of purchased electricity and/or heat needed for the project's activity.
Scope 3 = Other indirect GHG emissions, from the production of materials purchased from other parties and used in the project's activity, e.g., production and/or extraction of purchased materials, waste disposal, and use of sold products and services.

The methodology used to measure the GHG emissions of AFD-financed projects accounts for direct and indirect emissions, both up- and downstream from a project, as per Scopes 1, 2 and 3.

[1] AFD's methodology draws from Chapter 4 (Setting Operational Boundaries) in the *Corporate Accounting and Reporting Standard* of the Greenhouse Gas Protocol Initiative.
http://www.ghgprotocol.org/standards/corporate-standard

The scope of a project's indirect emissions can be quite large, and the difficulty of obtaining suitable data can hamper including them in an AFD Carbon Footprint Tool calculation. The Tool helps resolve these issues as follows:

- All emissions sources that can be quantified with a reasonable effort are included in the calculation's scope
- Indirect sources that are too difficult to quantify are not included in the calculation, but can be the subject of a complementary qualitative analysis
- The factsheets in the last section of this guide indicate which direct and indirect emissions sources are deemed critical to include – and which are not – for each primary project type

Why measure direct and indirect GHG emissions?

Measuring indirect emissions can pose problems: the risk of double counting, no 'ownership' or control over them, and regulatory frameworks that only cover direct emissions, such as the European Union Emission Trading System.

Notwithstanding these issues, AFD's choice to measure carbon footprints using the largest scope is in line with its goal to clarify the link between development and the climate, and follows a widespread trend:

- in the same way that a project's development impacts are measured via indirect effects, e.g., the number of children in school or extent of road or air traffic, etc., understanding a project's emissions must include its indirect emissions, e.g., vehicle or airplane emissions, final energy use, etc.
- a project's vulnerability to higher costs for fuel and/or tonne of CO_2 is tied to direct emissions and to the upstream and downstream value chain, e.g., a carbon-intensive supplier and/or changes in demand due to such price increases.

For example, in the transportation sector, it would not be pertinent to assess a project's carbon footprint without accounting for the emissions that would result once the infrastructure project was built. Thus the AFD Carbon Footprint calculation for a proposed airport or road project includes data about the airport's or road's activity, i.e., the plane or vehicle traffic that serves as the main source of the project's emissions.

C. Certainty and accuracy

The AFD Carbon Footprint Tool's purpose lies in providing an order-of-magnitude accounting for the GHG emissions that a future project will create or abate. An approximate accounting is sufficient; the inherent uncertainties in some emission factors – as indicated in the AFD Carbon Footprint Tool – and the uncertainty of data means it is sometimes hard to determine precise values, especially since the calculation is made *ex-ante*. However, for most projects, usually the main emissions sources are limited in number so any quantitative uncertainty will not affect their relative ranking and should not impede taking action in any way. Consequently, for each primary project type financed by AFD, the Tool's calculation accounts for only the main GHG emissions sources; they are indicated later in this document.

A carbon footprint measurement – even if approximate – helps AFD analyse projects and guides investment and financing decisions; an order-of-magnitude accounting suffices for that.

D. Conservativeness

AFD, similarly to the GHG Protocol,[2] uses a 'conservative' approach in measuring the carbon footprints of the projects it finances. The assumptions and values used to calculate the carbon footprint must tend towards overestimating emissions and underestimating reductions, especially if data inputs are uncertain.

E. Project lifetime

The calculation of GHG emissions resulting from a project covers the project's entire lifetime, which the AFD Carbon Footprint Tool user determines. The project lifetime includes both construction and operating phases:

- Construction phase: If building the project will generate negligible emissions, its construction phase is not included in the accounting. If the project's construction proves emissive, the Tool uses a one-year duration by default.
- Operating phase: For ease of comparison, standardised lifetimes for each type of project are suggested below; the Tool user can change them on a case-by-case basis as needed. The standard lifetimes are set as:
    - 50 years for dams
    - 30 years for transportation infrastructure
    - 20 years for other projects

Annual GHG emissions are determined by dividing the project's total lifetime (construction + operation) emissions by the total lifetime of the project.

F. Emissions aggregated over time

A project's carbon footprint calculation is presented as follows:

- Emissions generated during the construction phase in tCO_2e
- Emissions generated or abated annually during the operating phase in tCO_2e per year

To aggregate data and compare different projects, the values for the construction and/or operating phases will be added together to show the **average annual emissions over the project's lifetime**. No discount rate is applied to annual emissions.

G. Measurable projects

AFD's Tool for measuring carbon footprints can be used only for a certain type of project, i.e., a 'measurable' and 'significant' project, as defined in the third category below.

AFD categorises projects in three ways:

- **Projects that *cannot* be measured with the AFD Carbon Footprint Tool**

  This category includes budget support, financial intermediation, budgetary financing for local governments, and capacity-building projects. In the future, changes to the Tool or new methodologies may allow measurement of these types of financing, but at present, the Tool can be used only with 'direct' financing.

[2] See *The GHG Protocol for Project Accounting*, December 2005, Chapter 4, GHG Accounting Principles, p.22.

AFD is currently developing tools and methods to measure emissions for its intermediated financing operations; the difficulty of accurately attributing funds to one project or another poses a challenge.

- **Projects that *can* be measured with the AFD Carbon Footprint Tool that have a *negligible* carbon footprint**

This category includes projects in sectors that AFD has identified as being weakly emissive that AFD chooses not to measure, to avoid slowing down the project cycle. Among such projects, the following sectors stand out:

- Healthcare
- Education

- **Projects that *can* be measured and that have a *significant* carbon footprint**

Other qualified project types are measurable and generate emissions significant enough to justify calculating their carbon footprint. This category includes any project that will reduce more emissions than it generates during its lifetime (see Box 1)

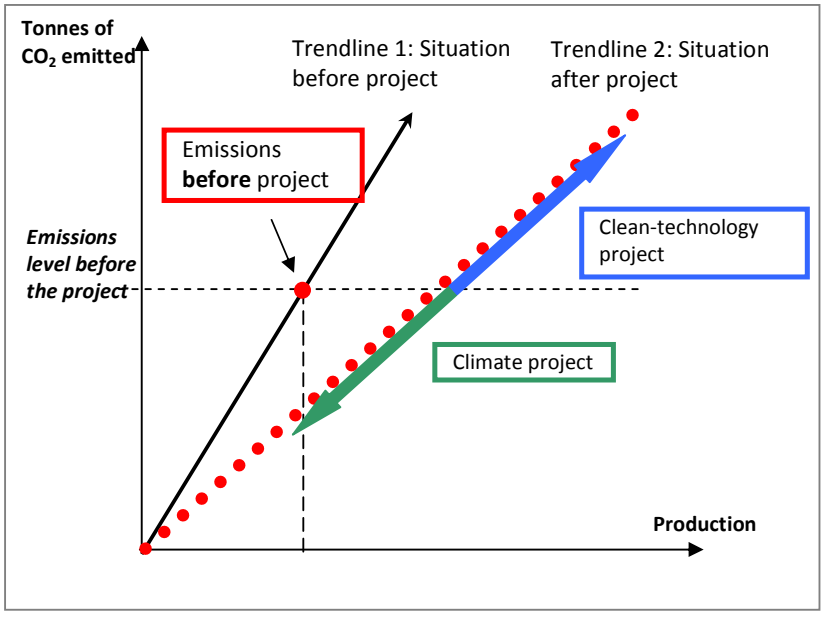
H. Project typology and designation

AFD has adopted a definition for GHG emissions mitigation projects to improve the transparency of climate-friendly actions:

> A project contributes to mitigating GHG emissions when the emissions it reduces are greater than the emissions it generates over its lifetime.

This definition helps clarify the border between projects that reduce GHG emission in absolute terms and those that improve an activity's carbon intensity – especially by using more efficient 'clean' technology – but which increase emissions overall, as seen in Box 1 below.

Box 1: Moving from a carbon-intensive to a low-carbon technology.



AFD qualifies projects as 'climate' projects when total GHG emissions reach a lower level after the project is implemented than was reached before.

If GHG emission levels are higher after a project is implemented, e.g., after an increase in production capacity, AFD does not give it the 'climate' project label.

If the carbon-intensity of the project is weaker, AFD labels it a 'clean-technology' project.

I. Emissions attributions

To remain consistent with current carbon footprint measurement methodology, all emissions or emission reductions related to AFD-financed projects are counted without being pro-rated to the amount of funding AFD commits and without regard to the funding beneficiary's emissions' ownership or scope, i.e., including Scope 3 indirect emissions. AFD uses the AFD Carbon Footprint Tool to measure a project's total carbon footprint to understand a project's whole impact, not just that part of it attributable to AFD's financing activity.

J. Definition and selection of baseline (reference situation)

Since the objective in measuring a project's carbon footprint is to estimate the emissions that it will generate or abate, the scenario where the project is financed, built and operated must be compared to a 'reference situation', i.e., a baseline that estimates what would happen if the project didn't exist.

The reference situation is defined as the most likely situation to occur in the project's absence.

Since it is possible to construct a multitude of scenarios, AFD proposes some standardised ones so that the results can be compared internally and decisions made about the best strategy to follow. A standardised scenario will be used as the reference situation unless a special case justifies a customised scenario; in such cases, the AFD Carbon Footprint Tool user must signal use of a customised reference situation and explain its basis.

Note: The scope for calculations in the reference situation is the same as for the project.

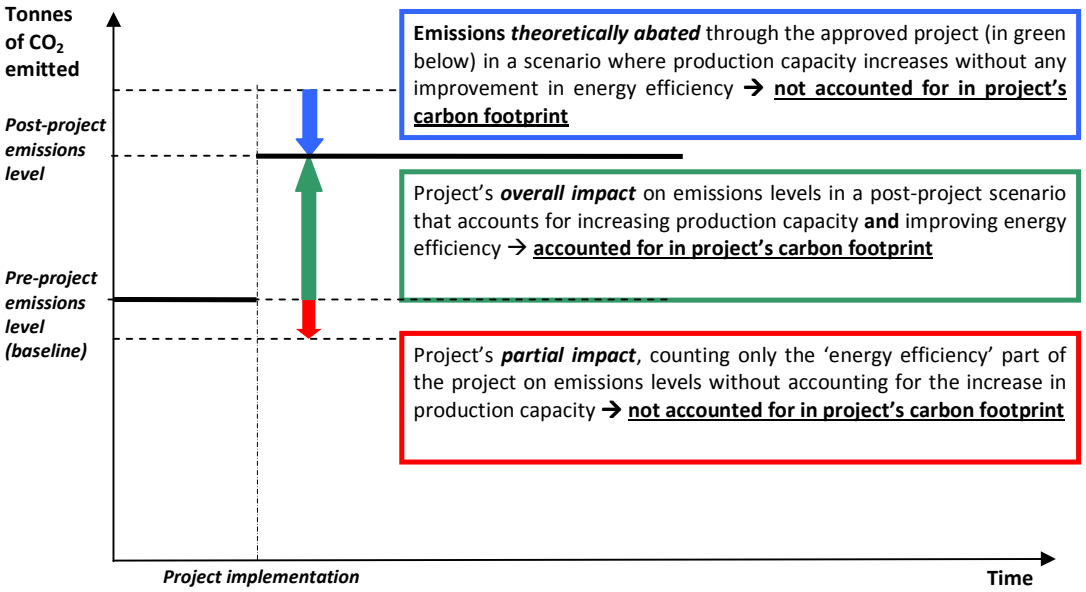
Generally, **the standard reference situation represents a situation without the project**. (See Figure 1) EXCEPT for renewables, **where the reference situation represents the country's energy mix**.

Choosing such reference situations makes projects aim for an ambitious counterfactual; this shows AFD's ambition to be a strong actor in addressing climate change, one who shuns 'greenwashing' and/or underestimating the emissions of projects it finances.

For example, if a factory-refurbishing project increases energy efficiency, it is expected GHG emissions will be reduced, but if the project also increases the factory's production capacity, it is expected GHG emissions will increase accordingly. Hence, the AFD Carbon Footprint Tool calculation will account **for both of the project's effects**, i.e., not only the emission reductions. Figure 2 illustrates this case:
1) the red arrow only accounts for the effects of energy efficiency improvements, but not increased production (the red arrow shows the decrease in emissions);
2) the blue arrow accounts for the theoretical effect of the increased efficiency on post-project production capacity;
3) the green arrow shows the net change in GHG emissions and therefore accounts for both effects, the effect of energy efficiency improvements *and* production capacity increases

In this example, the reference situation adopted by AFD implies that the carbon footprint of the project is equal to the green arrow i.e., the difference between the 'before project' situation and the 'after project' situation)

Figure 2. Examples of baselines for an energy efficiency + increased production project and AFD's choice of baseline



II. How to use the AFD Carbon Footprint Tool calculator

II.1. Step-by-step calculations

Step 1. Complete the 'General Info' worksheet to provide background information

A. Begin by entering background information about the project proposed for financing:

- Project name
- Use drop-down menu to indicate project's location by region or country
- Use drop-down menu to indicate project type

Enter additional background information where indicated, as per the list below, for the following project types: power plants, renewable energy, cement plants, urban and inter-city rail, solid waste treatment, wastewater treatment plants, and forestry projects.

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- Total capital expenditures (CAPEX)
- Operating expenses (OPEX) in first year of full operations
- Final-year operating expenses (i.e., final year of analysis period)
- Date construction work commences
- Duration of construction phase (construction lifetime; one-year by default)
- Duration of operational phase (operating lifetime)

Unless otherwise indicated, the following lifetimes will be ascribed to these projects by default: Dams = 50 years; Transportation infrastructure = 50 years; All other projects = 20 years. For more information, see the project type's worksheet.

- Description of proposed project
- Description of reference situation, with details about underlying assumptions to ensure the calculation's transparency and audit trail
- Name of person performing the AFD Carbon Footprint Tool calculation
- Date the carbon footprint calculation was made

The yellow 'Important Remarks' box shows important constraints, assumptions, and methodological choices, if warranted by the type of project. This important information will be repeated during each step of the calculation.

B. If the reference situation refers to an alternative project, enter the following data at the bottom of the worksheet under the heading 'Alternative to the Project'.

- Total capital expenditures (CAPEX)
- Operating expenses (OPEX) in first year of full operations
- Final-year operating expenses (i.e., final year of analysis period)

Step 2. Complete the 'Project' worksheet to estimate the proposed project's emissions

A. In the upper left corner, different colours indicate the relative importance of emissions sources.

Construction Phase	Operational Phase
Clearing	Fuel consumption
Construction materials	Electricity / heat consumption
Construction energy	Other process emissions
	Purchase of goods and services
	Freight
	Passenger transport
	Waste and wastewater
	Land Use
	Utilisation
	End of life
	Other calculations

Orange indicates a primary emissions source. Such emissions must be accounted for to get an idea of the project's carbon footprint size.

Yellow indicates a secondary emissions source. Such emissions are small enough that if data is not reasonably available, the source can be left out of the calculation.

Blue indicates negligible emissions.

The Tool automatically assigns a colour to emissions sources as determined by the project type selected in Step 1, 'General info.' If the project type was not entered in Step 1, the Tool user must determine the main and secondary emissions sources in this Step 2.

B. Emissions source sub-categories are found by clicking on the + sign in the grey margin to the far left of the worksheet. (See example of + sign at right.)

C. In the C column, select the data type and unit from the 'Sub-category' drop-down menus. Choose from one of two data processing modes, 'Simple' or 'Advanced'. Use the Simple mode when detailed data about the project's activity is unavailable and/or a quick assessment is desired; Simple mode uses prescribed ratios. Use the Advanced mode when precise data is available.

The green boxes are for the 'Simple' data processing mode.
Under the heading, 'Specific ratios for dedicated projects (simple mode for a quick assessment)' use the drop-down menus and fill in the requested information.

Emissions category	Sub-category	Input Data	Input Data	Unit (prescribed)
> Fuel consumption				
	Specific ratios for dedicated projects (simple mode for a quick assessment)			
	(Please select from drop-down list)			
	(Please select from drop-down list)			
	(Please select from drop-down list)			
	Note: Fossil fuels in cement plant calculations use data entered in 'General info' worksheet			

- **The boxes on the pale blue background are for the 'Advanced' data processing mode.**

Emissions category	Sub-category	Input Data	Input Data	Unit (prescribed)
> Clearing				
	Pre-project situation			
	(Please select from drop-down list)			
	(Please select from drop-down list)			
	(Please select from drop-down list)			

→ For more information about these two modes, please refer to detailed explanations of how the Tool works in Part II.2.

D. In the D column, 'Input data', enter the values.

→ For the Construction Phase, enter information for the entire phase lifetime.
→ For the Operating phase, enter annual information.

E. In the O Column, 'Project-related comments (non compulsory)', enter notes or titles if need be to improve the audit trail, data verification and/or understanding of the underlying assumptions.

F. Repeat steps B-E for each orange emissions source and for each yellow emissions source if data is available.

→ In Column H, the Tool will calculate the result for each emissions source input.

Clearing	0
Construction materials	0
Construction energy	0
Tot Construction (tCO2-eq)	**0**
Fuel consumption	0
Electricity / heat consumption	0
Other process emissions	0
Purchase of goods and services	0
Freight	0
Passenger transport	0
Waste and wastewater	0
Land Use	0
Utilisation	0
End of life	0
Other calculations	0
Tot Operation (tCO2-eq/yr)	**0**

→ At the top of Column H, the project's emissions will be summarised, source by source, as show in the graphic at left.
Construction Phase emissions are shown in tCO_2e, for all emissions during the construction phase lifetime.
Operating Phase emissions are shown tCO_2e/yr i.e., *per year*.

G. In Column K, consistency and completeness tests are shown. The tests check five aspects of the calculation:

- Use of Simple mode (less accurate than Advanced mode)
- Presence of double entries
- Completeness, i.e., that data was input for all of the project's important emissions sources
- Country consistency, i.e., project country (or region) is correctly inputted everywhere applicable
- Unintentional disappearance of an emission factor

Step 3. Complete the 'Reference Situation' worksheet

The 'Reference Situation' worksheet set-up is the same as the 'Project Emissions' worksheet. Enter the important and available data for the Reference Situation (as defined in Part I.2 Section J of this guide)

A. Follow Step 2 A-G.

Step 4. Analyse energy-cost risks in the 'Energy & OPEX' worksheet

The 'Energy & OPEX' worksheet allows the Tool user to input scenarios for future fossil fuel and/or CO_2 prices to see their potential impact on project operating expenses (OPEX). For a detailed description of this worksheet's assumptions and functions, please see Part 'II.2. For more information about using the calculator', below.

A. Enter all of the information and scenario assumptions for the calculation in lines 41 through 85.

1. *Scenarios for the project's OPEX cost trends and Alternative Project (if applicable) cost trends*

The 'General info' worksheet already shows the operating expenses for the project and for an alternative project, if it exists. In the 'Energy & Opex' worksheet, the user can input the type of trend line operating expenses will follow as the project is used, e.g., constant, linear, exponential or S-curve, and the expenses' annual fluctuations and the scale (in %) of the change.

2. *Scenarios for CO_2 price trends*

In the 'Energy & Opex' worksheet, the user can input a scenario for the price of CO_2 in the form of a carbon tax, the market price or the economic value of CO_2's negative externalities. S/he can also input the date the CO_2 price started. Just as with operating expenses, the user can input the type of trend line CO_2 prices will follow, e.g., constant, linear, exponential or S-curve, and the prices' annual fluctuation and the scale (in %) of the change.

3. *Scenarios for oil, gas and coal price trends*

In the 'Energy & Opex' worksheet, the user can input a scenario for the price of each of the three main fossil fuels (oil, gas and coal), using the initial price(s), the end price(s), and the type of trend line, e.g., constant, linear, exponential or S-curve terms, and the prices' annual fluctuation(s) and the scale (in %) of the change(s).

4. *Share of CO_2 emissions from each type of fossil fuel in producing electricity, in the construction sector, and in other industries.*

	Oil	Natural Gas	Coal	Other
Share of emissions by type of fuel (energy use only)				
Mix - electricity	1%	9%	91%	0%
Mix - rest of industry	16%	18%	41%	25%
Mix - building materials	8%	10%	48%	34%

The Tool presents default data for the share of emissions generated by each primary type of fossil fuel used in three major sectors (see example at left). The user can modify if s/he has data that are more accurate.

Step 5. Reading the AFD Carbon Footprint Tool 'Results' worksheet

A. *Project overview.*

Project name	Test cement plant
Country	Please specify the country on the 'General Information' worksheet
Date of completion	Please specify date of completion on the 'General Information' worksheet
Project CAPEX	5000000 €
Project OPEX (1rst yr)	1000000 €
Project duration	42 years

Project description

Reference situation description

In the upper left corner of the 'Results' research, the project's key information items are re-presented, drawn from the 'General Information' worksheet, i.e., project name, country, CAPEX, OPEX, etc. To the right of the summary, the pale yellow box, 'Important assumptions / restrictions' automatically shows the project's underlying hypotheses and limitations.

B. Results display

Below the summary box, the blue 'Project Emissions' box shows results for each project phase, emissions sources, scope and combined total.

Project emissions		
Construction Phase	(tonne CO2-eq)	
	Total	
Clearing	*0*	
Construction materials	*0*	
Construction energy	*0*	
TOTAL	**0**	

Construction Phase results are shown for the phase's entire duration.

Operating Phase results are shown on a yearly basis, as tCO_2e per year.

The tan box shows the project's total accumulated lifetime emissions and an annual average.

Operational Phase	(tonne CO2-eq / yr)			
	Scope 1	*Scope 2*	*Scope 3*	***Total***
Fuel consumption	*0*	*0*	*0*	**0**
Electricity / heat consumption	*0*	*0*	*0*	**0**
Other process emissions	*0*	*0*	*0*	**0**
Purchase of goods and services	*0*	*0*	*0*	**0**
Freight	*0*	*0*	*0*	**0**
Passenger transport	*0*	*0*	*0*	**0**
Waste and wastewater	*0*	*0*	*0*	**0**
Land Use	*0*	*0*	*0*	**0**
Utilisation	*0*	*0*	*0*	**0**
End of life	*0*	*0*	*0*	**0**
Other Calculations	*0*	*0*	*0*	**0**
TOTAL	**0**	**0**	**0**	**0**

TOTAL emissions over project duration	**0**	**tCO2e**
Average annual emissions	**0**	**tCO2e/yr**

To the right of the 'Project Emissions' box, the blue 'Reference situation emissions' box shows results for each phase of the reference situation, emissions sources, scope and combined total, plus Construction and Operating phases.

In case of a climate change mitigation project, additional indicators are shown: emissions abated during the project's entire (construction + operating) lifetime, and average emissions abated annually. The cost of each tCO_2 is calculated as all of the CAPEX and OPEX costs divided by the emissions abated during the project's lifetime.

If climate mitigation project

Abated emissions during project lifetime:	tCO2	Gross cost of abated tCO2 (excl. discount rate) :	€ / tCO2
Average annually abated emissions:	tCO2/yr		

The tan box summarises the 'Energy & OPEX' worksheet's results on lines 79-76, i.e., the total quantity of fossil fuel required for the project's lifetime of operations, and its average annual fossil fuel consumption.

TOTAL emissions over project duration	**35 000 000**	**tCO2e**
Average annual emissions	**1 100 000**	**tCO2e/yr**

The yellow-green box shows possible increased project and/or reference situation costs, according to the scenarios used for fossil fuel and CO_2.

Energy prices	
Oil	90$ / bbl in 2012 and 153$ / bbl in 2050
Gas	7€ / MWh in 2012 and 9,8€ / MWh in 2050
Coal	100€ / metric ton in 2012 and 150€ / metric ton in 2050
CO2	20 € / tCO2e in 2015 and 40 € / tCO2e in 2050

Impact on the project and on the reference situation OPEX

The project OPEX may be expected to increase by 3% by 2050 because of energy pri
The reference situation OPEX may be expected to increase by 0% by 2050 because o
energy prices

II.2. For more information about using the calculator

Identifying emissions sources that should be counted, by project type.

The first step in using the Tool requires filling out the 'General info' worksheet. The information entered feeds through to the 'Project' worksheet calculations. Emissions sources for each type of project are colour coded: orange indicates the biggest sources of GHG emissions, yellow indicates secondary sources, and blue indicates negligible sources. Data must be provided for the orange-coloured sources. Data may be provided for the yellow-coloured sources if it is easily accessible. The other emissions sources and source sub-categories may be completed if additional information is available *or* if the project's nature requires it, e.g., cross-sector programmes or 'hybrid' projects.

For example, for a cross-sector project that has both water supply and disposal components, the user starts with the 'General info' worksheet and selects 'Water supply and wastewater networks' in the drop-down menu. The user then moves to the 'Projects' worksheet to fill in the items coloured orange, plus the yellow and blue ones if data is readily available. The user then returns to the 'General info' worksheet to select 'Solid waste treatment' from the drop-down menu, and goes to the 'Project' worksheet to fill in the coloured items with data.

NB: If the project type is not selected in the 'General info' worksheet, the user must determine the project's biggest emissions source(s) for the Tool to work.

Inputting activities' data

The 'Project' worksheet shows the orange-coloured emissions sources that must be included in the calculation in a summary box at the top of the worksheet, lines 11-24. The same orange-coloured sources reappear as line items under the summary box in Column B. To access source sub-categories and input related operating data, click on the + sign at the far left of the worksheet. The emission source and its related sub-categories will show: fill data into Column D. Before filling in the white cells in Column D, choose the type of data that will be entered into Column D from the drop-down menus in Column C. In Column O, 'Project-related comments,' details about the data, e.g., origin, assumptions, etc., can be noted.

For example, when project includes large civil engineering projects (dams, bridges, roads, etc.) that will create sufficiently large emissions or reductions, the 'construction energy' source will be coloured orange. Choose the type of fuel used from the sub-category drop-down menu, and write in the fuel's prescribed measurement unit in Column F. For example, litres are used to measure diesel fuel consumed by heavy equipment building a solar power plant. When the number of litres consumed is inputted in the 'Input Data' columns, the calculator will automatically convert it to tCO_2e in Column H.

Simple mode / Advanced mode

The AFD Carbon Footprint Tool calculation can be performed in Simple or Advanced mode.

To use Simple mode, input data into the green box, '*Specific ratios for dedicated projects (simple mode for a quick assessment)'.*

Alternatively, Advanced mode can be used by directly inputting data in the other blue boxes (that are not marked 'Simple mode').

Choosing Simple or Advanced mode depends on the quality of available data. In a project's early days, data may be inaccurate or completely lacking. In such cases, Simple mode provides orders of magnitude using predetermined ratios drawn from previous experience with like-kind projects and GHG measurements. Although the Simple mode's output is less accurate than the Advanced mode's, it provides an first look at the project's CO_2e, allowing emissions sources to be ranked so the largest (relative to other sources) can be identified. Subsequently, efforts can be made to find more accurate data to make more precise calculations for the largest sources, while Simple mode approximations can suffice for weaker ones.

The 'C4 Ratios' worksheet shows the ratios calculated by the Tool's database. If additional, more precise and/or recent data needs to be added to the database, the modification must take place in the worksheet so that the updated data will flow through to other worksheets and the calculator. (See 'Database' below for more information.)

'Project' worksheet: sub-head 'other calculations'

Lines 396-401 on the Project worksheet provide an open box where the user can indicate additional emissions source(s) if absolutely necessary. It is preferable that the box remain blank; the Tool already includes all possible emissions sources for a given type of project. Note that the scope of any added source(s) must be indicated in Column M.

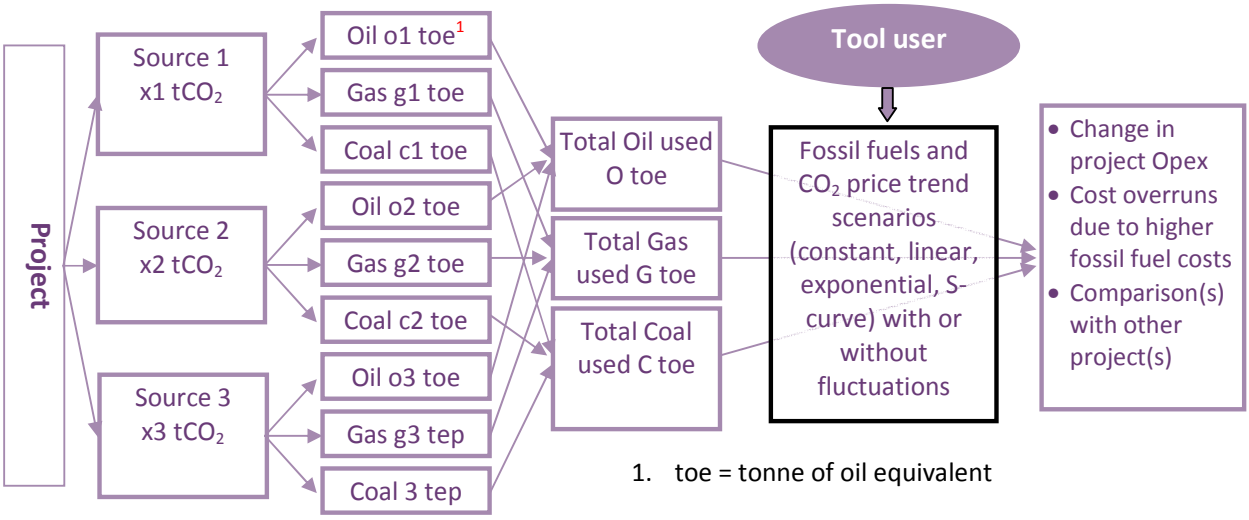
'Energy & Opex' worksheet

The Energy & Opex worksheet allows the Tool to quantitatively estimate the effect of fluctuations in fossil fuel and CO_2 prices – especially increases – on the project's operating expenses. The impact(s) of CO_2 price changes can be calculated in terms of market prices set by a carbon tax or a market for carbon credits, or via an economic value for CO_2's negative externalities.

Note that this functionality provides complementary analytical elements to understand the project better, but that it is not meant to be a predictive tool. The user must enter his/her own assumptions about future energy and CO_2 prices; the Tool is cannot forecast price trends.

The Energy & Opex worksheet rests on a simplified model that determines the quantity of fossil fuels required to emit CO_2. The model can be summarised as follows in Figure 3:

Figure 3. Fossil Fuel to CO_2 Calculation Model



1. toe = tonne of oil equivalent

The model rests on the following assumptions:

- Higher fossil fuel and/or CO_2 prices increase costs along the entire value chain to the end consumer.

- For electrical power generation, the user has an option to pass all or part of fossil fuel and/or CO_2 price increases on to the final price of electricity.

- A simplified model distinguishes between each type of fossil fuel: coal, oil, gas. Each emission factor comes from Column G in the 'Emission factors' worksheet for the six following categories: coal, gas, oil, electricity, industry, construction. The default percentage of fossil fuel in each category's emissions follows:

	Oil	Gas	Coal	Notes
Oil	100%			Includes transportation (that doesn't use natural gas)
Gas		100%		
Coal			100%	
Electricity	Depends on country's energy mix			Source: IEA, 2009
Industry	16%	18%	41%	Percentage values are worldwide averages for all industries except electrical power generation and construction. Values calculated by the Carbone4 consultancy based on IEA data. Tool user can change these default values.
Construction	8%	10%	48%	Percentage values are worldwide averages for production of all building materials. Values calculated by the Carbone4 consultancy based on IEA data. Tool user can change these default values.

- The model does not differentiate between expenses borne by the project operator and those borne by the project user. For some infrastructure projects, especially transportation, the user (traveller) rather than the operator bears the majority of costs directly. In these specific cases, the model's results should be used with care.

The model does not account for how a large increase in operating costs affects production. It is possible to imagine a scenario where increased fossil fuel prices increase project operating costs by several or even hundreds of basis points, possibly resulting in decreased production. Such analyses of potential impacts on production exceed the Tool's primary objective, and have not been integrated into the model. The Tool does alert the user that such risks may exist in a volatile energy environment, and provides quantitative data about them.

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<u>Adding a line to the 'Project' and/or 'Reference situation' worksheets</u>

In the Project and Reference Situation worksheets, the user can input three different emissions sources for each emissions category, on three different lines. If needed, more lines can be added by selecting the second line of the emissions category in question, making a right click with the mouse and choosing 'copy' from the mouse menu. Then right click again on the same line and select 'insert copied cells' from the menu. A new line will appear, with the same formulae and drop-down menus. As many lines as needed may be added in this way.

***

Other worksheets

Database

The 'Emission factors' and 'C4 ratios' worksheets contain the Tool's databases. All of the emission factors that appear in the 'Project' and 'Reference situation' worksheets draw on them.

A menu in each database worksheet provides hypertext links to various emission factors categories to facilitate navigation within the database, as follows:

Construction	Land use
Energy	Solid waste
Process emissions	Wastewater
Incoming goods and services	Utilisation
Freight	End of life
Passenger transport	

The 'Emission factors' worksheet contains an emission factors database. The data come from recognised sources – IPCC, IEA, ADEME, GHG Protocol, EcoInvent – which are indicated alongside the measurement unit for each source.

→ If the user wants to modify the emission factors database, s/he should add a new line to the database in the relevant emissions category and not modify the database's 'original' emission factors.

The 'C4 ratios' worksheet contains a database of ratios calculated by Carbone 4, the consultancy retained by AFD to create the AFD Carbon Footprint Tool. The ratios are based on the experience of projects similar to AFD's. They derive an equivalency between an activity's aggregated data (e.g., total power generated by a dam) and its tCO_2e output. This is in contrast to an emission factor, where the equivalency is 'direct'. In other words, instead of having to input a data point for a specific activity, such as 'litres of gas consumed during the construction phase', to get a result via the Emission Factor database, the user can simply input the size of the dam project (for example) that s/he is reviewing to get the quantity of GHG emissions emitted by heavy equipment during the dam's construction phase via a ratio.

→ The ratio's calculation is based on standard projects that are typical for each industry. Nevertheless, the user can modify these default calculations by modifying the blank (white) cells to use other parameters.

'Type of data to collect' worksheet

The 'Type of data to collect' worksheet reuses content from the factsheets in Part III of this guide: it is a reminder of the type of data needed to perform the calculation.

A spreadsheet provides the following details for each of the 27 project types treated by the Tool and the guide:

- Project phase (construction or operation)
- Emission's source
- Emissions category
- Relative importance of the emission for project type
- Order of magnitude
- Required input data to gather
- Emission factor unit measurement(s)

'Parameters' worksheet

The Parameters worksheet centralises all of the lists that make up the Tool's drop down menus, i.e., emissions sources lists, project lists, country lists, etc. It also includes the 'administrator's' data, i.e., the colour codes used to prioritise emissions sources for each type of project. The Tool user must not change the Parameters worksheet.

'Misc' worksheet

The 'Misc' worksheet provides some extra tools and data the Tool user may find helpful, as follows:

- A toolkit to convert measurement units, particularly for UK and/or US measurements
- Default data for the breakdown of household trash contents by each of the world's main regions and/or by type of country
- Information about the wastewater treatment situation by world region and/or type of country
- Clearing and land use information by country.

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III. Factsheets for each type of project

This section provides a number of factsheets to assist in making the AFD Carbon Footprint Tool calculations for each main type of project AFD finances.
To see how the reference situation's construction phase and operating phase emissions were calculated, refer to the appropriate factsheet.
Keep in mind that the information presented in these factsheets are general indicators; actual results will vary according to each project's specific features.

Mine

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a mine. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating	*Fuel consumption and/or Electricity/ heat consumption*	Energy consumed for ore extraction and processing (Scopes 1 and 2)	High	From several to hundreds of thousands of tCO_2e per year	Electricity and fossil fuel consumption for extracting and processing NB: In cases where the mine uses a captive thermal power station, help for calculating its emissions can be found in the 'General info' worksheet
	Other process emissions	Fugitive emissions from coal production (Scope 1)	High	Only for a coal mine	¤ Annual coal production ¤ Type of coal mined
	Freight	Energy required to transport ores (Scope 3)	Low	Up to several thousand tCO_2e per year	¤ Quantity of material transported ¤ Distance ¤ Means of transportation
Construction	*Clearing*	Deforestation	Low	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
Operating – Emissions from using ores after they are mined	These downstream emissions can represent a large order of magnitude if the ores are used in highly energy-intensive industries. The situations can vary greatly depending on the type of industry and products that use the ore. Thus, the AFD Carbon Footprint Tool cannot offer help for these downstream calculations, but downstream emissions source(s) should be integrated into the calculation as much as possible. Therefore, a complementary qualitative analysis is required.				

Fossil fuel power plant

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a fossil fuel powered thermal power station. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Combustion is by far the most dominant emissions source for this type of project; other sources may be ignored.

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating	*Fuel consumption*	Fossil fuel consumption (Scope 1)	High	Varies from several hundreds of thousands to millions of tCO_2e per year	¤ Type of fuel (natural gas, heavy fuel oil, lignite, coal) ¤ Projected fuel consumption per year **OR** ¤ Electricity produced per year + power station's average yield NB: help for calculating these emissions is available in the 'General info' worksheet
Construction	*Clearing*	In some cases, deforestation related to installing electrical lines for grid connections	Low	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
Operating	*Freight*	Transporting fuel to the power station (Scope 3)	Low	Up to several thousand tCO_2e per year	Means of transportation and distance covered

Natural gas and oil production and transportation

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing infrastructure for producing and/or transporting oil and/or natural gas. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

The main source of emissions arises from the produced fuel's use and transport (Scope 3) and, eventually, emissions reductions from switching distribution to a less carbon-intensive combustible, e.g., natural gas. Because of this, all other operating phase emissions sources are categorised as being of "middle" importance. Nevertheless, if the goal is to reduce Scope 1 and 2 emissions, these secondary emissions sources must be examined, especially fugitive emissions and those arising from electricity and fuel consumption.

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Utilisation*	Combustion of more highly emissive fossil fuel in the reference situation (Scope 3)	High	From several hundreds of thousands to millions of tCO_2e per year	¤ Type of fossil fuel used in the reference situation ¤ Quantity of fuel used per year in the reference situation
Operating (project situation)	*Utilisation*	Combustion of natural gas / oil produced and/or transported (Scope 3)	High	From several hundreds of thousands to millions of tCO_2e per year	¤ Type of fossil fuel produced and transported ¤ Quantity of fossil fuel produced and transported per year
	Other process emissions	Fugitive emissions (gas leaks / flaring / ventilation, etc.) (Scope 1)	Medium		Quantity of fossil fuel produced and transported per year
	Fuel consumption / Electricity/heat consumption	Electricity or fuel needed for combustible's extraction, transport and refining (Scope 1)	Medium		Ad hoc study
Construction	*Construction Energy Consumption*	Electricity and fuel consumed by construction	Low		Ad hoc study

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
		equipment			
	Construction Materials	Construction materials	Low		Ad hoc study

Photovoltaic solar power plant

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a solar PV power plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. As for all other renewables, the solar power plant is considered to be a replacement source of electricity production in a country's electricity mix, or grid electricity in countries affected by the project in the case of cross-border projects.
The default calculation is based on a 20-year operating lifetime. If specific information about the expected operating lifetime is available, this default duration can be modified.

Sources of emissions, their relative importance, and required input data

Carbon contained in solar panels (emitted when the panels are produced) is the main emissions source to account for in the project's emissions calculation.

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Electricity / heat consumption*	The energy mix's electricity production (Scope 2)	High	Depends on installed capacity: up to several thousand tCO_2e per year	Annual power production per year, in kWh per year
Construction (project)	*Construction Materials*	Production of photovoltaic solar panels (Scope 3)	High	Depends on installed capacity: up to several thousand tCO_2e per year	Energy required to produce panels **OR** Installed power in kW_c and technology type (NB: this second option is based on less accurate ratios)
	Construction Energy Consumption	Fuel and electricity consumed by construction equipment	Low		Ad hoc study
Operating – Emissions related to the panels' end of life.		The emissions related to recycling PV panels are not included in the calculation for lack of quantitative data.			

Hydroelectric dam

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a hydroelectric dam. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. As for all other renewables, the hydroelectric dam is considered to be a replacement source of electricity production in a country's electricity mix, or grid electricity in countries affected by the project in case of cross-border projects.
The default calculation is based on a 50-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Construction	*Clearing*	Deforestation (only non-submerged land)	High	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
	Other process emissions	Emissions from decomposing organic matter following flooding of the reservoir	High	Highly variable (see below)	¤ Surface area submerged underwater due to dam construction ¤ Climate **OR** Ad hoc study
Operating (reference situation)	*Electricity / heat consumption*	Electricity production in the country's energy mix (Scope 2)	High	Varies according to the country's energy mix	Quantity of electricity produced by the dam per year
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Medium	Several thousand tCO_2e per year during the construction phase	Quantity of fossil fuels consumed during construction **OR** Installed power (NB: this second option is based on less accurate ratios)
	Construction Materials	Production of construction materials (steel, cement, quarry stones, etc.)	Medium	Several thousand tCO_2e per year during the construction phase	Quantity of material(s) used during construction **OR** Installed power (NB: this second option is based on less accurate ratios)

NB: The reservoir's GHG emissions calculation is based on IPCC methodology (see http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/App_3a3_Wetlands.pdf), and reflects current scientific knowledge about the subject. However, the methodology remains very uncertain.

Rural electrification via grid connections

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, bringing electricity to rural areas through connections to the electrical grid. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. Performing the calculation requires knowing or having assumptions about energy consumption before and after connection to the electrical grid, as well as the type of combustible used by households before connection.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Fuel consumption*	Fossil fuel and biomass consumption before the project (Scope 1)	High		¤ Type of combustible (natural gas, heavy fuel oil, lignite, coal, biomass) ¤ Consumption of combustible type(s) per year
Operating (project)	*Electricity / heat consumption*	National grid's energy consumption (Scope 2)	High		Post-project electricity consumption
Construction	*Clearing*	Deforestation due to installing electric lines	Medium	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest

Rural electrification (off-grid)

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a decentralised (off-grid) rural power system. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's, or a similar project's, absence. Performing the calculation requires knowing or having assumptions about energy consumption before and after connection to the off-grid electrical system, as well as the type of combustible used by households before connection.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Carbon footprint category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Fuel consumption*	Fossil fuel and biomass consumption before the project (Scope 1)	High		¤ Type of combustible (natural gas, heavy fuel oil, lignite, coal, biomass) ¤ Consumption of combustible type(s) per year
Operating (project)	*Electricity /heat consumption*	Energy consumption of decentralised production means (Scope 1)	High		¤ Post-project energy consumption ¤ Post-project energy source(s)

Other renewables connected to the grid

NB: Use this worksheet for renewable energy projects other than hydroelectric dams and/or PV solar power stations.

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a renewable energy project. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The renewable energy source is considered to be a replacement for non-renewable grid electricity production in a region's or country's electricity mix, or non-renewable grid electricity in countries affected by the project in cross-border projects.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Carbon footprint category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Electricity / heat consumption*	Electricity production by the energy mix (Scope 2)	High		Project's energy production in kWh
Construction	*Clearing*	Deforestation	Medium	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
	Construction Materials	Production of construction materials (steel, cement)	Low		Quantity of material(s) used during construction **OR** Installed power and length of electric lines built (NB: this second option is based on less accurate ratios)
	Construction Energy Consumption	Fuel and electricity consumed by construction equipment	Low		Quantity of fossil fuels consumed during construction **OR** Installed power and length of electric lines built (NB: this second option is based on less accurate ratios)

Food processing

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, building or expanding a food-processing plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. In the case of a plant expansion, only the emissions related to an increase in production should be included in the calculation.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Fuel consumption*	Energy consumption (Scope 1)	High		¤ Type of fuel ¤ Quantity of fuel consumed per year
	Electricity/heat consumption	Electricity consumption (Scope 2)	High		Quantity of electricity consumed per year
	Purchase of goods and services	Agricultural commodities production + glass, plastic and metal production (Scope 3)	Medium		Quantity of agricultural commodities used in the processing plant
	Freight	Transportation of inputs and finished products (Scope 3)	Medium		Means of transport and distance covered in tonne·kilometre (t·km)
	Other process emission	Emissions from industrial processes, particularly refrigeration (Scope 1)	Medium		Loss of liquid refrigerant (in tonnes) + type of refrigerant **OR** number of refrigeration units + type of refrigerant
	End of life	Methanization of organic waste produced by the processing plant	Medium		Tonnes of organic waste produced by the plant per year
	Waste and wastewater	Treatment of the plant's wastewater	Low		See "Wastewater treatment" worksheet
Operating – Emissions related to changing agricultural land use pre-processing plant		This emissions type can be of a high order of magnitude if land use changes include deforestation, clearing and/or changes in the soils carbon composition. However, they are complicated to estimate and the AFD Carbon Footprint Tool cannot provide any help. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			
Operating – Emissions related to using processed products		These emissions – primarily due to refrigeration and cooking – can be high. Nevertheless, the lack of an adequate methodology and supplementary data makes it impossible to include this emissions source in the Tool's automatic calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			

General manufacturing

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, building or expanding a factory. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. In the case of a factory expansion, only the emissions related to an increase in production should be included in the calculation. The methodology is to estimate the variation in emissions between the project situation and the reference situation.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Fuel consumption*	Energy consumption (Scope 1)	High		¤ Type of combustible fuel ¤ Quantity of fuel consumed per year
	Electricity/heat consumption	Electricity consumption (Scope 2)	High		Quantity of electricity consumed per year
	Purchase of goods and services	Inputs (glass, plastic, metal) (Scope 3)	High		Tonnes of material purchased per year (glass, plastic, metal) **OR** Materials expenses per year in Euro millions
	Other process emissions	Emissions from industrial processes (if applicable) (Scope 1)	Medium		Factory's annual production in tonnes
	Freight	Transportation of inputs and finished products (Scope 3)	Medium		Means of transport and distance covered in tonne·kilometre (t·km)
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Low		Ad hoc study
	Construction Materials	Production of construction materials (steel, cement)	Low		Ad hoc study
Operating - Emissions related to using manufactured products		These emissions can be high if using the product requires high amounts of energy. Nevertheless, the lack of an adequate methodology and supplementary data makes it impossible to include this emissions source in the Tool's automatic calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			

Cement production

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a cement plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Carbon footprint category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating	*Fuel consumption and/or Electricity/heat consumption*	Energy consumption (other than kilns)	High	Several hundred thousand tCO_2e	¤ Size in MW of captive power plant + its efficiency ¤ Combustible used in power plant, i.e., coal, heavy fuel oil, etc. NB: help for calculating these emissions is available in the 'General info' worksheet
	Other process emissions	Clinker production process	High	Several hundred thousand tCO_2e	Tonnes of cement produced per year + % of clinker in cement **OR** Quantity of clinker produced per year NB: help for calculating these emissions is available in the 'General info' worksheet
	Fuel consumption and/or Electricity/heat consumption	Kilns' energy consumption	High	Several hundred thousand tCO_2e	¤ Kilns' energy requirements, in MJ/t of clinker ¤ Combustible(s) used in the kilns NB: help for calculating these emissions is available in the 'General info' worksheet
	Freight	Transportation of inputs and cement (Scope 3)	Medium / Low	Up to several hundred thousand tCO2e per year.	Means of transport and distance covered in tonne·kilometre (t·km)
Operating - Emissions related to use of cement		These emissions can be of a high order of magnitude, but because cement's use can vary greatly, e.g., housing, businesses, infrastructure, etc., help for calculating them cannot be included in the Tool. Nevertheless, these emissions should be included in the calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			

Heavy industry

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case building or expanding a factory for manufacturing heavy equipment for construction, or a plant for chemicals, paper, mining, metals processing, etc. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. In the case of a factory expansion, only the emissions related to an increase in production should be included in the calculation.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Carbon footprint category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Fuel consumption*	Energy consumption (Scope 1)	High		¤ Type of combustible ¤ Quantity of combustible consumed per year
	Electricity/heat consumption	Electricity consumption (Scope 2)	High		Quantity of electricity consumed per year
	Other process emission	Emissions from industrial processes (if applicable) (Scope 1)	High		Factory's annual production, in tonnes
	Freight	Transportation of inputs and finished products (Scope 3)	Medium		Means of transport and distance covered
	Waste and wastewater	Treatment of factory's wastewater	Low		See "Wastewater treatment" worksheet
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Low		Ad hoc study
	Construction Materials	Production of construction materials (steel, cement, etc.)	Low		Ad hoc study
Operating - Emissions related to using manufactured products		These emissions can be high if using the product is used in industries or processes that require high amounts of energy, but because uses can vary greatly help for calculating these emissions cannot be included in the Tool. Nevertheless, these emissions should be included in the calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			

Energy efficiency

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing an energy efficiency project. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is to estimate the variation in emissions with or without the project, and to account for a possible increase in production levels that would lead to higher emissions levels. The GHG reductions generated by energy efficiency improvements are generally made up for in all or part by production increases. This production increase is included in the calculation. The emissions that the project creates or helps abate are found through comparisons with the reference situation.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation)	*Fuel consumption and/or Electricity/heat consumption*	Fossil fuel and electricity consumption in the reference situation (Scope 1)	High	Depends on project size: from several tCO_2e to several hundred thousand tCO_2e per year	Fossil fuel and electricity consumption before project implementation
Operating (situation project)	*Fuel consumption and/or Electricity/heat consumption*	Fossil fuel and electricity consumption in the project situation (Scope 1)	High	Depends on project size: from several tCO_2e to several hundred thousand tCO_2e per year	Fossil fuel and electricity consumption after project implementation
	Freight	Additional freight related to production increases	Medium		¤ Quantity of additional freight ¤ Distance covered ¤ Means of transport
	Purchase of goods and services	Consumption of additional input materials due to production increases	Medium		Quantity of additional materials consumed

Telecommunications

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case building or extending a telecommunications network. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Electricity / heat consumption*	Energy consumption by the network's equipment (Scope 2)	High	Several thousand tCO_2e per year	Electricity consumed by network per year in kWh **OR:** Number of telephones and/or lines connected
	Utilisation	Energy consumption by telecom appliances (mobile phones, landlines, computers, etc.) (Scope 3)	High		Electricity consumed by appliances per year, in kWh **OR:** Number of telephones and/or lines connected
		Production of telecom appliances, (mobile phones, landlines, computers, etc.) (Scope 3)	High		Number of appliances purchased and using the network
Construction (project)	*Construction Materials*	Production of construction materials, including electronic equipment	¤ High when new network is put in place ¤ Low otherwise		Quantity of materials used, including electronic equipment **OR** Number of new users
	Construction Energy Consumption	Fuel and electricity consumed by construction equipment	¤ Medium when new network is put in place ¤ Low otherwise		Energy consumption **OR** Number of machine days

Drinking water production

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a water purification plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. In addition, in cases where a water supply system is put in place at the same time as a water purification plant, the carbon footprint must be calculated using the "Water supply and/or wastewater management" worksheet. The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating	*Electricity / heat consumption*	Electricity consumption to treat and distribute water (Scope 2)	High		Energy consumed per year for water distribution and treatment **OR** Volume of water treated per year (NB: This second option is less accurate; precise ratios for the Tool have not been formulated yet, but will be added in the future.)
	Purchase of goods and services	Consumption of chemical agents (Scope 1)	High		Consumption of each type of chemical agent per year **OR** Volume of water treated per year (NB: This second option is less accurate; precise ratios for the Tool have not been formulated yet, but will be added in the future.)
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Low		Ad hoc study
	Construction Materials	Production of construction materials	Low		Ad hoc study
Operating – Emissions related to the water that is produced		These emissions – primarily due to heating the potable water produced – can be high. Nevertheless, the lack of an adequate methodology and supplementary data makes it impossible to include this emissions source in the Tool's automatic calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.			

Water supply and wastewater treatment

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a water supply and wastewater management system. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating	*Electricity / heat consumption*	Electricity consumption (Scope 2)	High		Quantity of energy consumed by pumps per year **OR** Quantity of water pumped and height of pumping station (NB: This second option is less accurate; precise ratios for the Tool have not been formulated yet, but will be added in the future.)
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Medium		Quantity of fossil fuel consumed during the construction phase
	Construction Materials	Production of construction materials	Medium		¤ Type of piping ¤ Length of system ¤ Ad hoc ratios provided by the Tool

Roads

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, building a road. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in the emissions of people that use the new road if the project is built, and their emissions in the reference situation, i.e., if the road doesn't exist. A further assumption is that people who do not use the new road will move about in the same way whether the project is built or not, i.e., using the same origin and destination and same means of transport. This estimate of the modal shift i.e., people using new road instead of some other route and/or means shows the emissions that can be abated if the project is built.
The default calculation is based on a 30-year operating lifetime, taking into account yearly changes in traffic for both the reference situation and the project situation.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project and reference situation)	*Utilisation*	People moving about (Scope 3)	High	From a few to several thousand tCO_2e per year	Average consumption of fuel per year with and without project implementation **OR** Average traffic per year in vehicle·kilometre with and without project implementation **OR** Average traffic per year in vehicle·kilometre and by type of vehicle (two wheels, private auto, bus) and by gas or diesel, with or without project implementation
	Utilisation	Merchandise transport (Scope 3)	High	From a few to several thousand tCO_2e per year	Average consumption of fuel per year with and without project implementation **OR** Average volume of merchandise transported per year in tonne·kilometre and breakdown by type of truck, with and without project implementation
Construction	*Clearing*	Deforestation	Medium	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
	Construction Energy Consumption	Fuel and electricity consumed by construction equipment	Medium	A few thousand tCO_2e during the construction phase	Quantity of fuel consumed during construction phase **OR** Length and type of road constructed (NB: the second option uses less accurate ratios)

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Construction	*Construction materials*	Construction materials (steel, cement, asphalt)	Medium	A few thousand tCO_2e during the construction phase	Quantity of material consumed during construction phase **OR** Length and type of road constructed (NB: the second option uses less accurate ratios)
Operating	*Purchase of goods and services*	Maintenance (Scope 3)	Low		Ad hoc study required
	Electricity/heat consumption	Related energy consumption (lighting, etc.)	Low	A few hundred tCO_2e during the construction phase	Ad hoc study required
Operating - Emissions related to economic development and spatial planning of the area where project is implemented	These emissions can be of a higher order of magnitude than those outlined in the above table, but are excluded from the AFD Carbon Footprint Tool calculation because they are hard to quantify. A complementary qualitative analysis is required.				

NB: The vehicles' emissions factors are based on available data for current fleets, and do not include future improvements to technologies. This approximation does not invalidate the order of magnitude of a project's carbon footprint. In the future, a specific tool for the roadways sector may be developed to integrate future technology evolutions.

Airport

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, building or expanding an airport. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in emissions between a project situation where the airport is implemented and the reference situation where it doesn't exist, to compare projected traffic and emissions with or without the project. In cases where an existing airport is enlarged, only the emissions related to an increase in traffic are counted. An airplane's emissions are counted along the entire distance it travels. The default calculation is based on a 30-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation et situation project)	*Utilisation*	Energy required for air travel by passengers and freight	High	More than 100 kilo tonnes CO_2e per year for an international airport	¤ Traffic projections with and without project implementation: weight of airfreight and number of passengers, landings frequency, number of kilometres flown (or origin and destination, national/international or short/long haul)
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	Medium		Ad hoc study
	Construction Materials	Production of construction materials	Medium		Ad hoc study
	Clearing	Deforestation	Medium	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
Operating	*Electricity / heat consumption*	Consumption related to the airport's operation	Low		Ad hoc study
	Passenger transport	Feeder plane traffic	Low		Ad hoc study
Operating - Emissions related to the economic activity associated with the project	The emissions arising from an increase in economic activity driven by the increase in plane traffic are hard to quantify, e.g., emissions of a tourist during a visit to a country. The situations can be very different, so it is impossible for the Tool to provide help. Nevertheless, these emissions should be included in the calculation. Therefore, a complementary qualitative analysis is required to include this emissions source in the overall calculation.				

NB: Emissions factors for airplanes are based on available data about existing fleets and do not account for future technological improvements. However, this approximation does not invalidate the order of magnitude of such projects' carbon footprints. Eventually, a specific tool dedicated to the transportation sector may be developed to integrate future improvements.

Port

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, building or expanding a port. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in emissions between a project situation where the port is implemented and the reference situation where it doesn't exist, to compare projected traffic and emissions with or without the project. In cases where an existing port is enlarged, only the emissions related to an increase in traffic are counted. A ship's emissions are counted along the entire distance it sails.
The default calculation is based on a 30-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (reference situation + situation project)	*Utilisation*	Fuel needed to transport cargo	High	More than 100 kilo tonnes CO_2e per year for an international port	¤ Port traffic projections with and without project implementation: cargo volumes by weight, traffic, number of kilometres sailed ¤ Type of ship(s)
Construction	*Construction energy consumption*	Fuel and electricity consumed by construction equipment	Medium	Several thousand tCO_2e during the construction phase	Ad hoc study
	Construction materials	Construction materials production (steel, cement, quarry stones, etc.)	Medium	Several thousand tCO_2e during the construction phase	Ad hoc study
Operating	*Electricity / heat consumption*	Consumption by port operations	Low		Ad hoc study
Operating – Cargo freight		Emissions due to pre- and post-port cargo freight are hard to quantify; they are not included in the AFD Carbon Footprint Tool. Pre-port emissions (cargo/merchandise production) and post-port emissions (use of cargo/merchandise) are equally hard to quantify, so a complementary qualitative analysis is required.			

NB: Emissions factors for ships are based on available data about existing fleets and do not account for future technological improvements. However, this approximation does not invalidate the order of magnitude of such projects' carbon footprints. Eventually, a specific tool dedicated to the transportation sector may be developed to integrate future improvements.

BRT/Light rail

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a light-rail or rapid-transit bus (BRT) system. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in emissions between a project situation where passengers take the BRT/Light rail and a reference situation where they do not. A further assumption is that people not taking the BRT/Light rail will move about in the same way whether the project is built or not, i.e., using the same origin and destination and same means of transport. This estimate of the modal shift, i.e., people taking the BRT/Light rail instead of some other means of transport shows the emissions that can be abated if the project is built.

The default calculation is based on a 30-year operating lifetime, taking into account yearly changes in traffic for both the reference situation and the project situation.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Passenger transport*	People moving about (Scope 3)	High		Automobile traffic between a site and a BRT/Light-rail station
	Fuel consumption OR *Electricity / heat consumption*	BRT/Light rail fuel or electricity consumption (Scope 1 or 2)	High	From several hundred to several thousand tCO_2e emitted per year	¤ Energy used by the BRT/Light-rail engines ¤ BRT/Light rail energy consumption per year **OR** Total distanced covered by the BRT/Light rail and its consumption per kilometre
Operating (reference situation et project)	*Passenger transport*	People moving about in the reference situation and the project situation	High	¤ From several hundred to several thousand tCO_2e emitted per year ¤ Several thousand tCO_2e per year abated by modal shift	¤ Consumption of energy (fuel, electricity) per year per original means of transport (cars, bus, etc.) and the number of passengers ¤ Share of passengers or vehicles shifting to BRT/Light rail
Construction (project)	*Construction Energy Consumption*	Construction	Medium	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of line **OR** Quantities of fuel consumed during the construction phase

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
	Construction Materials	Materials	Medium	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of line **OR** Quantities of fuel consumed during the construction phase
		Manufacture of rolling stock	Medium		The Tool proposes standard ratios for tCO_2e per line OR per million Euros of rolling stock
Operating	*Electricity/heat consumption*	Related energy consumption (lighting, etc.)	Low	Several hundred tCO_2e per year	Ad hoc study required
Operating - Emissions related to urban development associated with the project		These abated or emitted emissions are of a potentially larger order of magnitude than those due to a modal shift. However, they are not included in the AFD Carbon Footprint Tool calculation because they are too difficult to quantify. Therefore, a complementary qualitative analysis is required.			

NB: Emissions factors for metro train engines are based on available data about existing fleets and do not account for future technological improvements. However, this approximation does not invalidate the order of magnitude of such projects' carbon footprints. Eventually, a specific tool dedicated to the transportation sector may be developed to integrate future improvements.

NB2: Help for making this calculation is available in the 'General info' worksheet, where the Tool user can enter the percentage of modal shift to the BRT/Light rail for each type of vehicle and the ridership rate for various types of vehicles. This allows the user to determine the traffic avoided for each type of vehicle in the "Reference situation" worksheet according to the BRT/Light rail passenger kilometres (category "Passenger transport").

Metro/Subway

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a metro or subway system. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in emissions between a project situation where passengers take the metro/subway and a reference situation where they do not. A further assumption is that people not taking the metro will move about in the same way whether the project is built or not, i.e., using the same origin and destination and same means of transport. This estimate of the modal shift i.e., people taking the metro instead of some other means of transport shows the emissions that can be abated if the project is built.
The default calculation is based on a 30-year operating lifetime, taking into account yearly changes in traffic for both the reference situation and the project situation

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project and reference situation)	*Passenger transport*	People moving about (Scope 3)	High	Several thousand tCO_2e per year abated by changing mode of transport	¤ Projections for traffic due to modal shift: number of passengers using the metro per year, percentage of passengers coming from the analysed transport mode, e.g., motorised and non-motorised two-wheelers, cars, buses, etc.) ¤ Average distance covered per day or per year and the fuel consumed per kilometre for various vehicles and the metro, to get the fuel consumption for the reference situation via the former and the project situation via the latter.
	Electricity / heat consumption	Metro's electricity consumption (Scope 2)	High	From several hundred to several thousand tCO_2e emitted per year	Metro's consumption of energy per year **OR** Total distance metro covers and its fuel consumption per kilometre
Construction	*Construction Energy Consumption*	Fuel and electricity consumed by construction equipment	High	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of rail line OR per number of machine days **OR** Quantities of fuel consumed during the construction phase

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
	Construction Materials	Construction materials (steel, cement, quarry stones, etc.)	High	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of rail line OR per number of underground stations **OR** Quantities of material consumed during the construction phase
		Rolling stock manufacture	Low		Quantity of materials OR number of rolling stock units OR number of trains OR cost of rolling stock in millions of Euros
Operating (project)	*Electricity / heat consumption*	Related energy consumption (lighting, etc.)	Low	Several hundred tCO_2e per year	Ad hoc study required
Operating - Emissions related to the urban development associated with the project		These emissions are of a potentially larger order of magnitude than those due to a change in transport means, both in terms of emissions and abated emissions. Nevertheless, the AFD Carbon Footprint Tool excludes them because they are hard to quantify. Therefore, it is necessary to do a complementary qualitative analysis.			

NB: Emissions factors for metro train engines are based on available data about existing fleets and do not account for future technological improvements. However, this approximation does not invalidate the order of magnitude of such projects' carbon footprints. Eventually, a specific tool dedicated to the transportation sector may be developed to integrate future improvements.

NB2: Help for making this calculation is available in the 'General info' worksheet, where the Tool user can enter the percentage of modal shift to the metro for each type of vehicle and the ridership rate for various types of vehicles. This allows the user to determine the traffic avoided for each type of vehicle in the "Reference situation" worksheet according to the metro's passenger kilometres (category "Passenger transport").

Railway

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a railroad line. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence. The methodology is based on estimating the variations in emissions between a project situation where passengers take the train and a reference situation where they do not. A further assumption is that people not taking the train will move about in the same way whether the project is built or not, i.e., using the same origin and destination and same means of transport. This estimate of the modal shift i.e., people taking the train instead of some other means of transport shows the emissions that can be abated if the project is built.
The default calculation is based on a 30-year operating lifetime, taking into account yearly changes in traffic for both the reference situation and the project situation.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project and reference situation)	*Passenger transport*	Moving people (Scope 3)	High	Up to several thousand tCO_2e per year	¤ Projections for traffic due to modal shift: number of passengers using the train per year, percentage of passengers coming from the analysed transport mode, e.g., motorised and non-motorised two-wheelers, cars, buses, etc.) ¤ Average distance covered per day or per year and per kilometre fuel consumption of various vehicles and the train to get the fuel consumption for the reference situation via the former and the project situation via the latter.
	Freight	Freight (Scope 3)	High	Up to several thousand tCO_2e per year	Projections for traffic due to modal shift: volume of cargo transported per year by train, percentage of cargo coming from the other transport means analysed, e.g., trucks, etc. ¤ Average distance covered per day or per year and per kilometre fuel consumption of various vehicles and the train to get the fuel consumption for the reference situation via the former and the project situation via the latter.

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
	Electricity / heat consumption + Fuel consumption	Train's energy consumption (Scope 2 or 1)	High	From several hundred to several thousand tCO_2e per year	¤ Type of energy propelling the train; generally electricity or diesel ¤ Train's yearly energy consumption OR total distance covered by the train and its energy consumption per kilometre
Construction (project)	*Clearing*	Deforestation	Medium	Varies according to the region, climate and vegetation	¤ Surface area ¤ Climate ¤ Type of forest
	Construction Energy Consumption	Fuel and electricity consumed by construction equipment	Medium	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of rail OR per machine day **OR** quantities of fuel consumed during the construction phase
	Construction materials	Construction materials (steel, cement, quarry stones, etc.)	Medium	Several thousand tCO_2e during the construction phase	The Tool proposes standard ratios in tCO_2e per kilometre of rail OR per number of underground stations **OR** Quantities of material consumed during the construction phase
		Rolling stock manufacture	Low	Several thousand tCO_2e during the construction phase	Quantity of materials OR number of rolling stock units OR number of trains OR cost of the rolling stock in millions of Euros
Operating		Related energy consumption (lighting, etc.)	Low	Several hundred tCO_2e per year	Ad hoc study required
Operating - Emissions related to the economic activity associated with the project		These emissions are of a potentially larger order of magnitude than those due to a change in transport means, both in terms of emissions and abated emissions. Nevertheless, the AFD Carbon Footprint Tool excludes them because they are hard to quantify. Therefore, it is necessary to do a complementary qualitative analysis.			

NB: Emissions factors for train engines are based on available data about existing fleets and do not account for future technological improvements. However, this approximation does not invalidate the order of magnitude of such projects' carbon footprints. Eventually, a specific tool dedicated to the transportation sector may be developed to integrate future improvements.

NB2: Help for making this calculation is available in the 'General info' worksheet, where the Tool user can enter the percentage of modal shift to the train for each type of vehicle and the ridership rate for various types of vehicles. This allows the user to determine the traffic avoided for each type of vehicle in the "Reference situation" worksheet according to the train's passenger kilometres (category "Passenger transport").

Solid waste treatment

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a garbage dump or landfill. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

NB: Default values for the average volumes of solid waste produced per country or region are provided in the "Misc" worksheet to help the Tool user.

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Other process emissions*	Methane and N_2O emitted as the waste is dumped, incinerated, composted, and/ or during methanization	High		¤ Quantity of solid waste produced per year ¤ Means of solid waste treatment
	Freight	Transport of waste	Medium		¤ Quantity of waste transported per year ¤ Means of transportation and distance covered
	Electricity / heat consumption + Fuel consumption	Consumption of fuels by the solid waste treatment plant	Low		Ad hoc study
In cases where waste produces energy: Operating (reference situation)	*Electricity / heat consumption*	Combustion of methane produced by solid waste and electricity produced instead of drawing on grid	High		Quantity of methane (CH_4) captured per year **OR** - *Landfill:* quantity and types of waste produced, type of landfill and way it is used (recycling, biogas production, etc.) - *Incineration:* quantity and type of solid waste produced

Wastewater treatment

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a wastewater treatment plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project)	*Fuel consumption* or *Electricity / heat consumption*	Consumption of power by the wastewater treatment plant	High		¤ Annual consumption of electricity and/or natural **OR** ¤ Volume of wastewater treated per year (NB: the latter depends on less accurate ratios; more precise rations have not yet been determined and will be integrated into the Tool in the future)
	Purchase of goods and services	Consumption of chemical agents	High		¤ Quantity of chemicals consumed per year **OR** ¤ Volume of wastewater treated per year (NB: the latter depends on less accurate ratios; more precise rations have not yet been determined and will be integrated into the Tool in the future)
	Other process emissions	Methane and N_2O releases	High		¤ Type of wastewater ¤ Volume or size of affected population ¤ Type of treatment
	Freight	Transport of sludge	Medium		¤ Quantity of sludge transported per year ¤ Means of transportation and distance covered
	End of life	Treatment and use of sludge	Medium		Quantity of sludge produced per year and way they are used (fertilizer, compost, incineration)
Operating (reference situation)	*Electricity / heat consumption*	Method for using captured methane	High		Quantity of methane captured per year Method for using methane

NB: Estimates for GHG emissions produced by wastewater purification systems remain highly approximate, but reflect the current level of scientific knowledge.

Forestry

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case implementing a new forest plantation. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Construction	*Clearing*	Deforestation (Scope 3)	High		¤ Surface area cleared ¤ Climate ¤ Type of forest
Operating	*Land use*	Carbon sequestration in biomass	High		¤ Surface area ¤ Type of crop(s) ¤ Climate ¤ Growing period before harvest ¤ Percentage of reduced biomass NB: help for calculating these emissions is available in the 'General info' worksheet
		Carbon sequestration in soil	High		¤ Surface area ¤ Type of soil ¤ Changes in land use
	Fuel consumption	Fuel consumed by farm and forestry equipment	Medium		Annual fossil fuel consumption **OR** Number of machine days

Plantations

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing new crop plantations. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Construction	*Clearing*	Deforestation (Scope 3)	High		¤ Surface area cleared ¤ Climate ¤ Type of forest
Operating	*Land use*	Carbon sequestration in biomass	High		¤ Type and surface area of crop(s) ¤ Climate ¤ Growing period before harvest ¤ Decrease in biomass (%) ¤ Speed of biomass growth (optional) ¤ Maximum biomass volume (optional) NB: help for calculating these emissions is available in the 'General info' worksheet
		Carbon sequestration in soil	High		¤ Surface area ¤ Type of soil ¤ Changes in land use
	Other process emissions	Nitrous oxide (N_2O) emissions from spreading fertilizer	High		Quantity of fertilizer spread per year and percentage of nitrogen in fertilizer mix **OR** Type of crop(s) + surface area
	Purchase of goods and services	Fertilizer and pesticide production	High		Tonnes of fertilizer and pesticides purchased per year
	Fuel consumption	Fuel consumed by agricultural and forestry equipment	Medium		Annual fossil fuel consumption **OR** Number of machine days

Biofuel

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing a biofuels production plant. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.
For a biofuels production project, emissions are abated by substituting a biofuels for a fossil fuel. The volume of emissions abated depends on the quantity of GHG that are produced in making biofuels, e.g., mainly the combustion of fossil fuels and carbon emissions from land use changes. The AFD Carbon Footprint Tool proposes a detailed approach, because it intends to define all of these biofuel production emissions sources (combustion, land use, etc). The approach requires a great deal of data and cannot be implemented at the beginning of a project review. At a later date, a change to the Tool will allow it to make a direct calculation based on standard ratios that will give the emissions reduction attributable to each type of biofuel.

Sources of emissions, their relative importance, and required input data

Project phase	Emissions category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Construction	*Clearing*	Deforestation	High	Varies according to the region, climate and vegetation	¤ Surface area cleared ¤ Climate ¤ Type of forest
	Land use	Change in land use following project completion	High		¤ Surface area subject to change in land use ¤ Land use before and after
Operating (reference situation)	*Utilisation*	Fossil fuel emissions replaced by biofuels	High		¤ Type and quantity of fossil fuels replaced by biofuels
Operating (project)	*Purchase of goods and services*	Fertilizer and pesticide production	High		Type and quantity of fertilisers purchased annually
	Other process emissions	Spreading fertilizer and pesticides	High		Type and quantity of fertilisers used annually
	Freight	Product transport	High		Means of transportation and distance covered
	Fuel consumption	Fuel consumption by farming equipment	Medium		Quantity of fuel
	Electricity / heat consumption and/or Fuel consumption	Processing crops	Medium		¤ Source of energy ¤ Quantity of energy consumed per year

Agroecology

Basis for calculations

Measuring a project's carbon footprint requires comparing a reference situation to one with the project; in this case, implementing agricultural development using agroecology techniques. The reference situation is what exists before the project is implemented, i.e., the most likely situation to occur in the project's absence.
The default calculation is based on a 20-year operating lifetime.

Sources of emissions, their relative importance, and required input data

Project phase	Carbon footprint category	Emissions' source(s) / Scope(s)	Importance	Order of magnitude	Required input data
Operating (project / reference situation)	*Land use*	Carbon sequestration in biomass	High		¤ Surface area ¤ Type of crop(s) ¤ Climate NB: help for calculating these emissions is available in the 'General info' worksheet
		Carbon sequestration in soil	High		¤ Surface area ¤ Type of soil ¤ Changes in land use NB: help for calculating these emissions is available in the 'General info' worksheet
	Purchase of goods and services	Fertilizer and pesticides production	Medium		Quantity of fertilizer and pesticides purchased Type(s) of fertilisers and pesticides
	Other process emissions	Nitrous oxide (N_2O) emissions when fertilizer is spread	Medium		Quantity of fertilizer spread per year + percentage of nitrogen in the fertilizer mix **OR** Crop type + surface area
	Fuel consumption	Fuel consumption by farming equipment	Medium		Annual quantity of fuel consumed by the project