UNITED NATIONS

GreenHouse Gas Calculator

User Manual 1.0

Specifications on best-available methodologies

An office tool developed by the UNEP Environment Management Group, UN Department of Field Support and the World Resources Institute.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The UN Greenhouse Gas Calculator is the result of staff collaboration from over a dozen organizations across the UN system who have pooled their expertise, skills and knowhow in service of the organization as a whole and the international efforts to UNite to Combat Climate Change.

The calculator has been specially designed for the UN agencies, funds and programmes to facilitate the preparation of their baseline greenhouse gas inventories as a first step in their move towards climate neutrality. It aims to ensure that the inventories of the UN organizations are consistent, comparable to each other, transparent and based on the best available information sources.

It also draws upon internationally recognized methodologies for calculating greenhouse gas emissions from buildings and transport. The United Nations Environment Programme (UNEP) Environment Management Group, which coordinated this undertaking, would like to acknowledge the information and data from the World Resources Institute (WRI), the Intergovernmental Panel on Climate Change (IPCC), the United States Environmental Protection Agency (US EPA) Climate Leaders Programme and the International Energy Agency (IEA).

Countless hours of work have gone into the preparation of the calculator. A special commendation goes to staff of the United Nations Department of Field Support/Information and Communications Technology Division (DFS/ICTD), for their efforts, expertise, creativity and commitment.

The contributions are also acknowledged of staff from the United Nations Development Programme (UNDP), the United Nations Department of Field Support/Department of Peace Keeping Operations (DFS/DPKO), the United Nations Populations Fund (UNFPA), the Food and Agriculture Organization of the United Nations (FAO) and the World Bank for stimulating discussions and their willingness to share ideas and practical experience.

Last but not least, thanks to the UN Secretariat at Headquarters, the International Finance Corporation (IFC), World Food Programme (WFP) and the United Nations Framework convention on Climate Change (UNFCCC) for taking part in the pilot group.

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Chair, Environment Management Group

Executive Director, UNEP

WHY ACCOUNT FOR GREENHOUSE GAS EMISSIONS?

Increasing emissions from human activities have led to a marked increase in atmospheric greenhouse gas concentrations. This is a concern for all of us, from individuals to large multinational companies, because atmospheric greenhouse gases are contributing to global warming and ultimately climate change.

We know that climate change is happening. The Intergovernmental Panel on Climate Change (IPCC) says that many parts of the planet will be warmer. Droughts, floods and other forms of extreme weather will become more frequent and threaten food supplies. The environmental, economic and political implications of climate change are thus profound.

The cost of this climate change will be borne by all of us and hence the responsibility lies with all of us.

Large multinational organizations have a substantial potential to damage or protect the climate. The reason is simply their size. The climate impact of their actions is bigger than the impacts caused by individuals and small organizations.

The UN agencies, funds and programmes have recognized their particular responsibility and have decided to take action by joining forces to reduce greenhouse gas emissions collectively.

The UN Greenhouse Calculator is a result of this initiative. The tool, developed by the UN agencies for the UN agencies, represents the first crucial step towards reducing greenhouse gas emissions. It will help UN organizations to compile and analyze their greenhouse gas emissions and drive prioritized actions for emission reductions and offsets.

GLOSSARY OF TERMS

Activity Data	Data on the magnitude of a human activity resulting in GHG emissions. Data on energy use, miles travelled, input material flow and product output are all examples of activity data that might be used to compute GHG emissions.
Average Weather	Average weather may include average temperature, precipitation and wind patterns.
Biomass	Non-fossilized and biodegradable organic material originating from: • Plants, animals, and micro-organisms, including products, byproducts, residues and waste from agriculture, forestry and related industries • Non-fossilized and biodegradable organic fractions of industrial and municipal wastes, including gases and liquids recovered from the decomposition of non-fossilized and biodegradable organic material.
Biomass CO2	Emissions from the combustion of biofuels such as wood and ethanol. Emissions from biomass fuels are to be reported separately from fossil fuel emissions.
CH4	Methane. A Kyoto Protocol greenhouse gas.
Climate Change	Climate change is any long-term significant change in the average weather of a region or the earth as a whole. For more information, see average weather.
Climate Neutrality	Climate neutrality is a term that refers to an entity with no net greenhouse gas emissions. Achieved by reducing greenhouse gas emissions as much as possible and by using carbon offsets to neutralize the remaining emissions.
CO2	Carbon dioxide. A Kyoto Protocol greenhouse gas.
Combined Heat and Power (CHP)	An energy conversion process in which more than one useful product, such as electricity and heat or steam, is generated from the same energy input stream (cogeneration).
CO2 Equivalent (CO2e)	The universal unit for comparing emissions of different GHGs, expressed in terms of the global warming potential (GWP) of one unit of carbon dioxide. For more information, see GWP.
Direct Emissions	Emissions from sources within the reporting entity's organizational boundaries that are owned or controlled by the reporting entity, including stationary combustion emissions, mobile combustion emissions, process emissions and fugitive emissions.
Emission Factor	GHG emissions expressed on a per unit activity basis. For example, metric tons of CO2 emitted per million Btus of coal combusted or metric tons of CO2 emitted per kWh of electricity consumed.
Fugitive Emissions	Emissions that are not physically controlled, but result from the intentional or unintentional releases of GHGs. They commonly arise from the production, processing transmission storage and use of fuels and other chemicals, often through joints, seals, packing, gaskets, and so on.

Greenhouse Gas (GHG)	The earth receives energy from the sun and returns the energy by reflecting light and emitting heat. Part of the outgoing heat flow is absorbed by greenhouse gases and re-irradiated back to the earth. While carbon dioxide is the greatest contributor to global warming, there are several reasons for opting to include the six gases covered by the Kyoto Protocol, namely CO2, CH4, N20, HFCs, PFCs and SF6.
GHG Inventory	A quantified list of an organization's GHG emissions sources.
Global Warming Potential (GWP)	The ratio of radiative forcing that would result from the emission of one unit of a given GHG compared to one unit of carbon dioxide (CO2).
HFCs	Hydrofluorocarbons. HFCs are Kyoto Protocol greenhouse gases.
HHV	Higher Heating Value.
Indirect GHG Emissions	Emissions that are a consequence of the activities of a company but that occur at sources owned or controlled by another company. Indirect emissions include scope 2 and scope 3 emissions. For more information see the related definitions.
Intergovernmental Panel on Climate Change (IPCC)	International body of climate change scientists. The role of the IPCC is to assess the scientific, technical and socio-economic factors relevant to understanding the risk of human-induced climate change (*www.ipcc.ch*).
LHV	Lower Heating Value.
Mobile Combustion Emissions	Emissions from the combustion of fuels in: • Transportation sources, such as cars, trucks, buses, trains, airplanes, and marine vessels. • Emissions from non-road equipment, such as equipment used in construction, agriculture, and forestry. *Note: A piece of equipment that cannot move under its own power but that is transported from site to site, an emergency generator for example, is a stationary, not mobile, combustion source.*
N2O	Nitrous oxide. A Kyoto Protocol greenhouse gas.
PFCs	Perfluorocarbons. PFCs are Kyoto Protocol greenhouse gases.
RAC	Refrigeration and Air-Conditioning.
Radiative Forcing	The degree of warming of the atmosphere. A positive forcing (more incoming energy) tends to warm the system, while a negative forcing (more outgoing energy) tends to cool it.

Scope 1 Emissions	All direct GHG emissions, with the exception of direct CO2 emissions from biogenic sources.
Scope 2 Emissions	Indirect GHG emissions associated with the consumption of purchased electricity, heating, cooling, or steam.
Scope 3 Emissions	All indirect emissions not covered in Scope 2. Examples include: • Upstream and downstream emissions • Emissions resulting from the extraction and production of purchased materials and fuels • Transport related activities in vehicles not owned or controlled by the reporting Entity • Use of sold products and services • Outsourced activities • Recycling of used products • Waste disposal
Stationary Combustion Emissions	Emissions from the combustion of fuels to produce electricity, steam, heat, or power using equipment, such as boilers, furnaces, etc., in a fixed location.
UN Interface to the ICAO Carbon Emissions Calculator	The International Civil Aviation Organization (ICAO) Carbon Emissions Calculator is a tool for estimating CO2 emissions from official air travel. The UN interface to the ICAO tool complements the UN Greenhouse Gas Calculator.

Glossary Source : WRI

1 ABOUT THE UN GREENHOUSE GAS INVENTORY

1.1. Introduction

The UN Secretary-General, Ban Ki-Moon, has referred to climate change as the "defining challenge of our time" and called for the UN to lead by example by adopting an outstanding approach to climate neutrality for its premises and operations worldwide.

In October 2007, the UN Chief Executives Board for Coordination (CEB) adopted a decision to move towards a climate neutral United Nations. This decision essentially means three action points for the UN agencies, funds and programmes:

1. To compile an organization-wide GHG inventory,
2. To reduce GHG emissions as much as possible, and
3. To consider the purchase of carbon offsets to neutralize the remaining GHG emissions.

A greenhouse gas inventory is the first crucial step towards reducing greenhouse gas emissions. The inventory is important because it enables data analysis and hence actions for running the organization in a smarter and more efficient way.

The use of agreed methodologies ensures that data can be aggregated and compared across all UN agencies. The UN agencies, funds and programmes are therefore strongly encouraged to use the UN Greenhouse Gas Calculator when compiling their greenhouse gas inventory. The tool ensures consistent, transparent and comparable inventory data and progress reports. It allows for meaningful aggregation across the UN and inter-temporal comparisons. It is also compatible with the GHG Protocol Corporate Standard, a widely-used international accounting tool to understand, quantify and manage greenhouse gas emissions.

The UN Greenhouse Gas Calculator guides each organization through the UN agreed minimum boundaries for greenhouse gas accounting. After the required activity data is entered into the tool, it will automatically estimate the greenhouse gas footprint by applying a set of default emission factors, allowing flexibility to enter better data, where available. However, any customized data must always be explained and referenced properly by the organization. The tool also accommodates optional emissions sources.

A specially designed data-mining tool and database is available for extracting data from the UN Greenhouse Gas Calculator and the UN interface to the International Civil Aviation Organization (ICAO) Carbon Emissions Calculator. The data mining tool will automatically collect data from pre-defined cells in the tool and report them into a separate stand-alone database, which itself can be used to generate customized reports. The data-mining tool will thus serve to make data management and reporting easy, regardless of the number of reporting duty stations.

The tools and further information can be downloaded from the *www.unemg.org/climateneutralun* web site.

Any questions on how to use the UN Greenhouse Gas calculator should be directed to the Climate Neutral Focal Point in your organization. A list of the Climate Neutral Focal Points in the UN agencies, funds and programmes may be found on the *www.unemg.org/climateneutralun* web site.

To ensure the highest standards, the total inventory, that is, emissions from air and road travel and office activities, should be reviewed and verified once completed by an independent external party, consistent with the International Organization for Standardization (ISO) 14064 standard for GHG emissions and inventories and the ISO 14065 standard with requirements for validation and verification bodies.

1.2. The UN Greenhouse Gas Boundary

Energy consumption, in mobile and stationary sources, is the single most important activity resulting in GHG emission, in particular because most of it is produced from fossil fuels such as oil, gas and coal.

The UN has agreed on a common minimum boundary for its greenhouse gas inventory. The minimum agreed boundary defines the activities, emission sources and greenhouse gases to include:

Activities

The October 2007 decision of the CEB limits the boundary of the UN to facility operations and travel. The UN agencies, funds and programmes should therefore account for greenhouse gas emissions from headquarters, centres and field offices.

The inventory should include emissions from UN facility operations and official travel, which can be influenced by management-level decisions. These include activities implemented by the UN including those funded through extra-budgetary sources.

Activities funded both through the regular budgets and through extra-budgetary sources are within the minimum agreed boundary of the UN and emissions resulting from them should be included in the inventory. For example, in some organizations, these extra-budgetary activities are referred to as projects.

If an organization provides a direct financial transfer to other entities to implement an activity or programme, for example a grant to a government, the emissions resulting from these activities should not be included in the footprint.

The inventory can exclude the following activities:

- Emissions associated with decisions for which individual staff members are responsible and that relate to their personal sphere,
- Grants provided by other institutions,
- Military activities conducted under the auspices of the UN, and
- Emissions from projects implemented by external entities.

Emission Sources

Each operation or activity can have a number of greenhouse gas emission sources. The inventory should as a minimum include the following emission sources:

- Mobile fuel combustion, such as emissions from official air or road travel
- Stationary fuel combustion, such as energy consumption in buildings for electricity, heating, hot water and cooking, and so on.
- Fugitive emissions, such as leakage of greenhouse gases from refrigeration and air-conditioning equipment

The minimum agreed boundary does not include emissions from personnel commuting to and from the work place, electricity losses, courier, mail, embodied carbon in for instance food, beverages, paper and computers, shipping, construction and military fleets, and facilities. Emissions from these sources may be included on a voluntary basis. The recommended best practice is to document any sources of greenhouse gas emissions that are not included in the inventory, including an explanation.

Greenhouse Gases

The organization's emissions of greenhouse gases should include, to the extent possible, all six Kyoto protocol gases: CO2, CH4, N2O, HFC, PFC and SF6.

> *Note: SF6 is not expected to be a significant part of the normal footprint, because it relates mostly to industrial activities.*

The emissions should be reported both separately for each greenhouse gas and aggregated as carbon equivalents (CO2e).

1.3. Data Gaps

A greenhouse gas inventory should be as complete as possible. Therefore, all data gaps have to be identified and managed.

Where data is not readily available, estimates of GHG emissions could still be made based on clearly defined assumptions and proxies. Examples are:

- Emissions (CO2e) or energy consumption (kWh) per square metre of office floor space. Such proxies can be derived from real data collected from other buildings in the region.
- Values for average travel distance to and from airport or train terminals.

The UN has agreed to accept the use of documented proxies for likely GHG emissions from offices with less than five members of staff. If the offices are excluded altogether from the inventory, the data gap must be stated clearly together with a plan on how to account for small offices in the future.

2 USING THE UN GREENHOUSE GAS CALCULATOR

This section is a step-by-step guide on how to use each sheet in the UN Greenhouse Gas Calculator. For detailed information about selected emission methodologies and default emission factors, see section 3, Calculating Emissions on page 22.

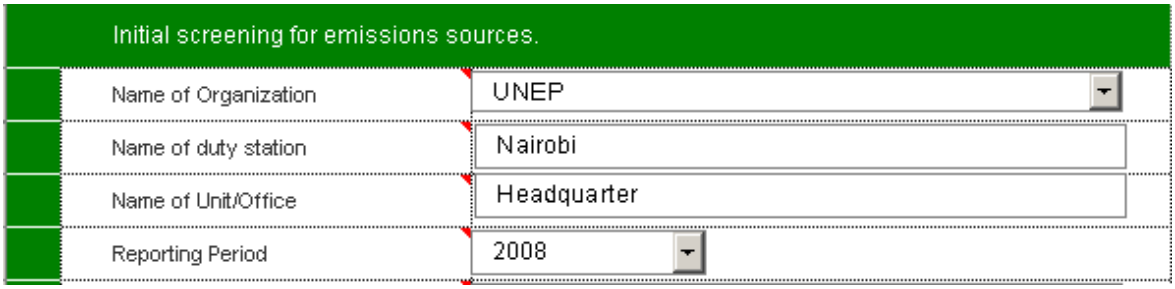
The UN Greenhouse Gas Calculator is a Microsoft® Excel file that has three types of data fields:

- **Guideline fields:** *Fields that explain how to understand and use the calculator.*
- **User entry fields:** *Fields where you can enter activity data, information sources or explain assumptions made.*
- **Non-user entry fields:** *These are fields with pre-defined drop-down menus or calculations. The methodology applied by the calculator is explained in section 3.*

If the calculator does not have the information necessary to describe a particular activity, use the Assumptions and Comments field or the Data Record tab for additional information.

2.1. Emission Sources and Data Quality

The calculator has an introduction, where you identify the organizational boundary and the reporting period. This is done by filling in information about the organization, duty station and unit, and by stating the correct reporting year. Please see the following example illustration:



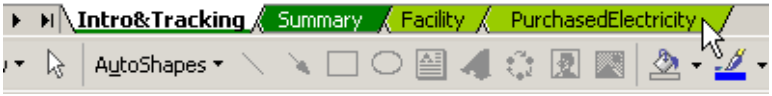
The contact person listed will be responsible for the data quality and must be able to answer questions on the data collection process, the data quality and any other assumptions.

It is important that the information be as correct as possible and that the contact person makes sure that nothing is omitted or redundant. The contact person must for instance avoid adding any activity data that belongs to a different duty station or organization.

The calculator also asks you to identify relevant emission sources and appropriate methodologies. This is done by providing yes or no answers to a list of statements regarding possible activities and available activity data. A positive response results in a new tab being displayed in the calculator. Click on the new tab to enter the relevant activity data, as illustrated below:

Step 1

Step 2



The calculator will, next to the statements in the Intro&Tracking tab, display how the CO2e emissions are adding up as the different emissions sources or tabs are finalized.

Please make sure that any data gaps are identified and explained as prompted by the Intro&Tracking tab. The responsible person must be able to answer questions on how data gaps will be managed in the future.

2.2. Facility Data

The organization has to provide information about buildings reported and the total number of personnel. The information is necessary to:

1. Compute performance indicators and hence emissions reductions targets
2. Calculate energy consumption in shared buildings.
3. Provide a list of buildings included in the inventory for reporting purposes.

The building name could be the name of the building or street address. The data on personnel numbers and office space allocated to the organization in the building identified is used by the calculator to report the organization's greenhouse gas performance. It is therefore important that the data entered be correct.

Please see the following example illustration:

Name of Building	Office/Unit name	Number of organization's personnel working in building	Area of building used by the Organization
		headcount	m^2
Gigiri	Headquarter	380	10000
Totals		380	10000

The facility data can also be used to find the reporting office's energy consumption in shared buildings. Enter the total area of the building in addition to the area used by the reporting office.

2.3. Road and Rail Travel

The UN Greenhouse Gas Calculator has tabs for road travel in UN controlled vehicles, as well as road and rail travel by public transport.

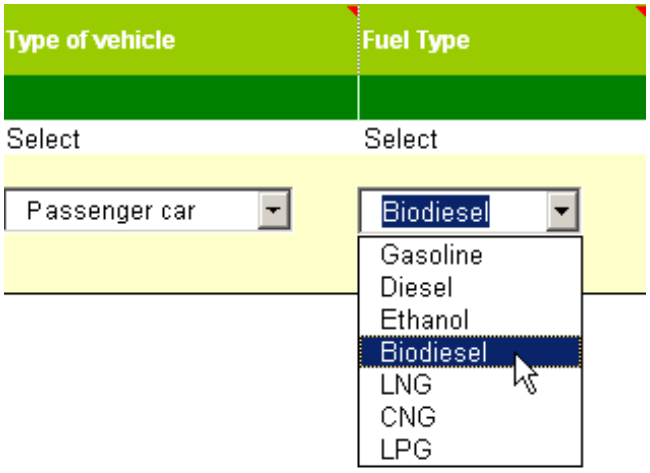
The organization must account for all official road travel in vehicles controlled by the organization, such as owned or leased cars. In addition, the organization will also have to account for official road and rail travel by public transport. This would typically be distance travelled to and from airports and train terminals.

The necessary activity data is total fuel consumed and distance travelled. Such information is normally available from the following data sources:

- Fleet records and invoices
- Employee mileage calculations/claims
- Information from car rental firms
- Tax returns from declarations and fleet monitoring records
- Travel agency invoices and records
- Freight handler invoices
- Company vehicle log books

The data source should always be stated in the tool for future performance assessments.

Organizations are asked to select the closest available vehicle and fuel type from drop-down lists, as illustrated below. Any assumptions or additional information should be stated in the Comments and Assumptions data field, as illustrated below:



2.3.1. UN Owned or Leased Vehicles

Transport in UN vehicles applies to all instances where personnel are travelling for official business or missions and are using a UN-owned vehicle for this purpose. Transport of staff commuting to and from the work place, transport by airplanes and transport by using military vehicles is excluded.

You are asked to select the type of vehicle and the type of fuel. Depending on data availability, organizations can choose between three different methods:

Method 1 (most preferred):

This method should be used if the reporting office has activity data for both fuel consumption and distance travelled. Activity data on fuel consumption is used to calculate CO2 emissions, whereas activity data on distance travelled (km) is used to calculate CH4 and N2O emissions. Please see the following example illustration:

Type of vehicle	Fuel Type	Fuel Used	Distance Traveled
		litre	kilometre
Select	Select	Specify	Specify
Passenger car	Gasoline	680	7000

Method 2:

This method should be used if the organization has activity data for fuel consumption only. Activity data on fuel consumed is used to calculate CO2 emissions, whereas proxies are used for CH4 and N2O emissions. Please see the following example illustration:

Type of vehicle	Fuel Type	Fuel Used	Distance Traveled
		litre	kilometre
Select	Select	Specify	Specify
Passenger car	Gasoline	680	0

Method 3 (least preferred):

This method should be used if the organization has activity data for distance travelled only. Activity data on distance travelled is used to calculate N2O and CH4, whereas proxies are used for CO2 emissions. Please see the following example illustration:

Type of vehicle	Fuel Type	Fuel Used	Distance Traveled
		litre	kilometre
Select	Select	Specify	Specify
Passenger car	Gasoline	0	7000

2.3.2. Public Transport

The organization will have to account for official road travel by public transport. This is typically official travel by passenger trains, buses or cars paid for by the organization. In some instances, a proxy will be necessary to calculate average distances travelled to and from airport and train terminals.

2.4. Energy Consumption in Buildings

Information about energy consumed in UN owned or leased buildings is normally available from the following sources:

- Utility provider reports and contracts
- Electricity bills
- Invoices for fuel deliveries
- Meter readings (estimated from invoices if meter readings are not available)
- Gas bills
- Pipeline measurements
- Energy management software

The data source should always be stated in the tool for future performance assessments.

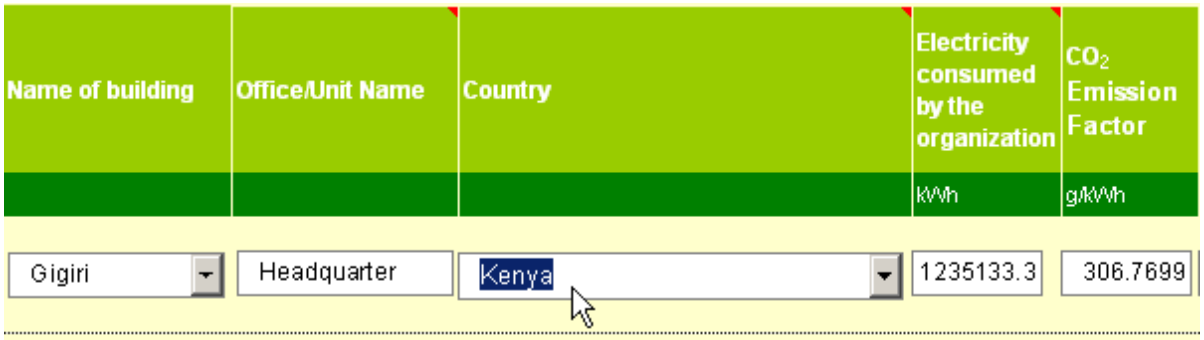
2.4.1. Purchased Electricity

The organization is to report indirect GHG emissions, if purchasing electricity for equipment or operations controlled by the organization.

The UN Greenhouse Gas Calculator will estimate indirect emissions from the electricity supplier, only if activity data on the amount of electricity consumed by the organization has been provided.

Where the organization shares a building and has no separate meters that can provide data on the amount of electricity consumed by the organization, you can use the Facility tab to calculate organization specific consumption.

Emission levels from publicly-generated electricity are highly dependent on the national energy mix used to produce the electricity. It is therefore important that the correct country is selected, as illustrated below:



The calculator attempts to provide as many country emission factors as possible. If your country is not shown, then the default value for the geographical region should be used.

You are encouraged to use government data on local electricity emission factors. Region-specific emission factors are available. For example:

- Brazil: *http://www.mct.gov.br/index.php/content/view/index.php*
- USA: *http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html*

If the reporting office has access to local electricity emission factors, the local emission factors should be entered manually. Additionally, the data source should be stated and explained in the Comments and Assumptions field. Please see the following example illustration:

Name of building	Office/Unit Name	Country	Electricity consumed by the organization	CO_2 Emission Factor
			kWh	g/kWh
Gigiri	Headquarter	Kenya	1235133.3	298.3

2.4.2. Purchased Steam

The organization is to report indirect GHG emissions if purchasing steam or heat for equipment or operations controlled by the organization. This sheet estimates indirect greenhouse gas emissions associated with steam or heat purchased from an external supplier.

The method for calculating emissions from an external Combined Heat and Power (CHP) plant requires information from both the organization and the CHP supplier.

The organization will have to provide activity data for its own steam or heat consumption. In addition, the tool allows for two approaches dependent on the type of activity data available from the CHP supplier:

Method 1

This method should be used when steam emission factors, in units of kg CO2/kWh, kg CH4/kWh and kg N2O/kWh, are available from the CHP supplier. The method is selected in the Intro&Tracking tab. For information about how to derive the steam emission factors, see section 3, Calculating Emissions on page 22.

Please see the following example illustration of the fields for the supplier's activity data:

Type of fuel used by Supplier	Amount of purchased heat/steam by organization	CO_2 Emission Factor	CH_4 Emission Factor	N_2O Emission Factor
	kWh	kg/kWh steam produced	kg/kWh steam produced	kg/kWh steam produced

Method 2

This method should be used when the CHP provider is not able to provide steam emission factors. This method is selected in the Intro&Tracking tab. The following data is required from the CHP supplier:

- Type of fuel used by the supplier
- Annual amount of fuel consumed by the supplier (tonne)
- Annual amount of electricity generated by the supplier (kWh)
- Annual amount of steam/heat generated by the supplier (kWh)

Please see the following example illustration of the user entry fields for the supplier's activity data:

Type of fuel used by Supplier	Amount of purchased heat/steam by organization	CO_2 Emission Factor	CH_4 Emission Factor	N_2O Emission Factor
	kWh	kg/kWh steam produced	kg/kWh steam produced	kg/kWh steam produced

In both preceding methods, you are asked to select the closest available fuel type from a drop-down list. Any assumptions or additional information should be stated in the Comments and Assumptions data field.

Method 3

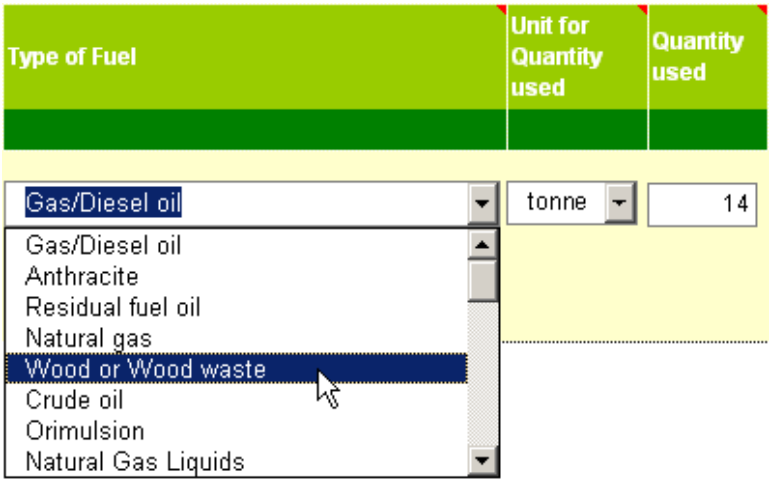
A third method would be to use local proxies for emission factors. You could make use of local proxies, only if there are sufficient grounds for accepting their credibility and accuracy. For example, if the proxies have been developed by a government statistical agency, it would be considered sufficient grounds.

2.4.3. Power Generation

The organization is to report direct GHG emissions from stationary combustion, that is, the combustion of fossil fuels and biomass in boilers, furnaces and other types of stationary fuel technologies owned or controlled by the organization. To complete this section, information about fuel type and fuel consumption is required.

Select the closest available fuel type from a drop-down list as shown below. Any assumptions or additional information should be stated in the Comments and Assumptions data field.

Please see the following example illustration:



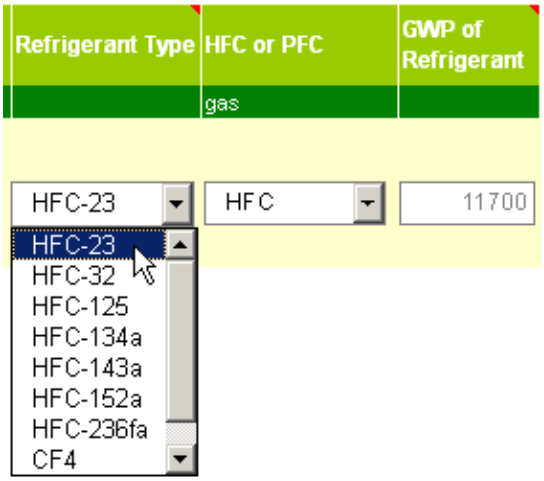
2.5. Fugitive Emissions

The reporting office is to report fugitive emissions from office buildings controlled by the organization. Fugitive emissions are gases that are not physically controlled, but result from the intentional or unintentional releases of GHGs. A typical source for fugitive emissions is refrigerants and air-conditioning equipment.

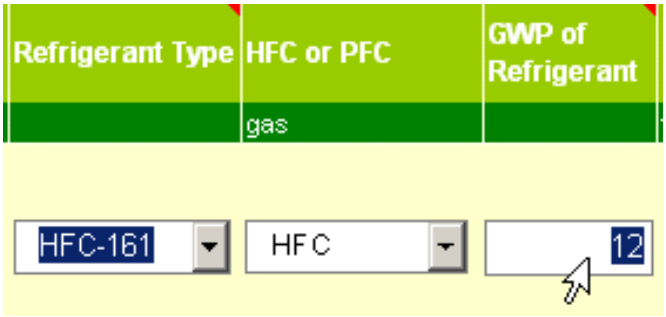
2.5.1. Refrigerants and Air-Conditioning (RAC)

Freezers and air conditioning equipment leak refrigerant gases. These refrigerants escape into the atmosphere as fugitive emissions during installation, maintenance and operational leakage.

You are asked to identify the type of gas used as refrigerants. The most common refrigerants are built-into a drop-down list. If one of the common refrigerants is selected, the GWP value will appear automatically in the GWP of Refrigerant column. Please see the following example illustration:



If the correct gas is not listed, please refer to Appendix II, table II.7 and provide the name of the correct gas in the Refrigerant Type column, select HFC or PFC, and type in the correct GWP value in the GWP of Refrigerant column. Please see the following sample illustration:



The reporting office should report emissions from RAC equipment, by reporting the amount of refrigerants lost during the reporting year. There are several ways of calculating loss of refrigerants. The tool proposes three different methods:

Method 1

This method should be used by reporting offices that maintain their own RAC-system and that have information about the annual amount of each type of refrigerant replaced. Data should be available from entity purchase records and service records.

Method 2

This method should be used by reporting offices that hire contractors to maintain their RAC system. Activity data must be obtained from the contractor, on the quantities of each type of refrigerant replaced annually.

Method 3

This method should be used by reporting offices that are not in a position to calculate their annual loss of refrigerants. The methodology provides a very approximate value for RAC emissions, and should therefore be used for screening purposes only. If the summary sheet indicates that the RAC emissions are greater than 5 % of total GHG emissions, method 1 or 2 should be used.

For detailed information about the three methodologies and for global warming potentials for less common refrigerants, see section 3, Calculating Emissions on page 22.

2.6. Optional Emissions

Some organizations may find that they have significant GHG emissions from sources outside the UN minimum agreed boundary. The organization can choose whether to include or exclude such emission sources. Either way, the final decision should be well documented.

The Optional Emissions tab of the UN Greenhouse Gas Calculator allows organizations to add sources that are not included elsewhere in the calculator.

Examples of optional emission sources could include, but are not limited to:

- Electricity losses
- Couriers
- Mail
- Shipping
- Military fleets and facilities

The organization is responsible for identifying the best available methodology for their optional emission sources. However, it is important that the optional emission sources are reported in the Optional Emission tab and not elsewhere in the tool.

Note: Emissions from biomass fuels are to be reported separately from fossil fuel emissions. You must, therefore, distinguish between biomass CO2 and fossil CO2 in the Optional Emissions tab. Please see the following example illustration below:

Biomass CO_2	Fossil CO_2
kg	kg
125	600

Biomass CO2 emissions are from the combustion of biofuels such as wood and ethanol, whereas fossil CO2 are from the combustion of oil and coal products. A list of biomass fuels can be found in Annex II, table II.4.

Calculation methods and other important references for the optional activities entered must be explained in the Comments and Assumptions field.

2.7. Reporting GHG Emissions

The summary sheet in the tool summarizes the GHG emissions from road transport and buildings.

The emissions of the six greenhouse gases that are to be included in the UN's greenhouse gas inventory are aggregated automatically by using an estimate of their contribution to global warming. The total greenhouse gas emissions are thus expressed in CO2e.

Note: Biomass CO2 is reported separately and is, therefore, not part of the CO2e totals.

If the tool displays no data on emissions per building floor space or personnel, please make sure that all data on personnel and surface area in the Facility tab is entered properly.

Before sending the GHG inventory to the Environmental Focal Point in your organization, please make sure that all relevant tabs are completed. The tool's validation status is shown in the Intro&Tracking tab.

Note: The UN Greenhouse Gas Calculator only accounts for road transport, and does not include air travel. Emissions from air travel will thus have to be added to get the total GHG inventory.

A specially designed data-mining tool will merge data from the UN Greenhouse Gas Calculator and in the UN interface to the ICAO Carbon Emissions Calculator and store it in the same database. The Climate Neutral Focal Point in the organization will be responsible for applying the data-mining tool and for building reports on an organizational level.

Further information is available on the *www.unemg.org/climateneutralun* web site.

3 CALCULATING EMISSIONS

This section describes the methods used by the calculator to quantify the emissions from six common sources: UN-owned (or leased) vehicles, public transport, purchased electricity, fuel combustion in stationary equipment such as boilers and furnaces (that is power generation), purchased steam, and refrigeration and air-conditioning equipment.

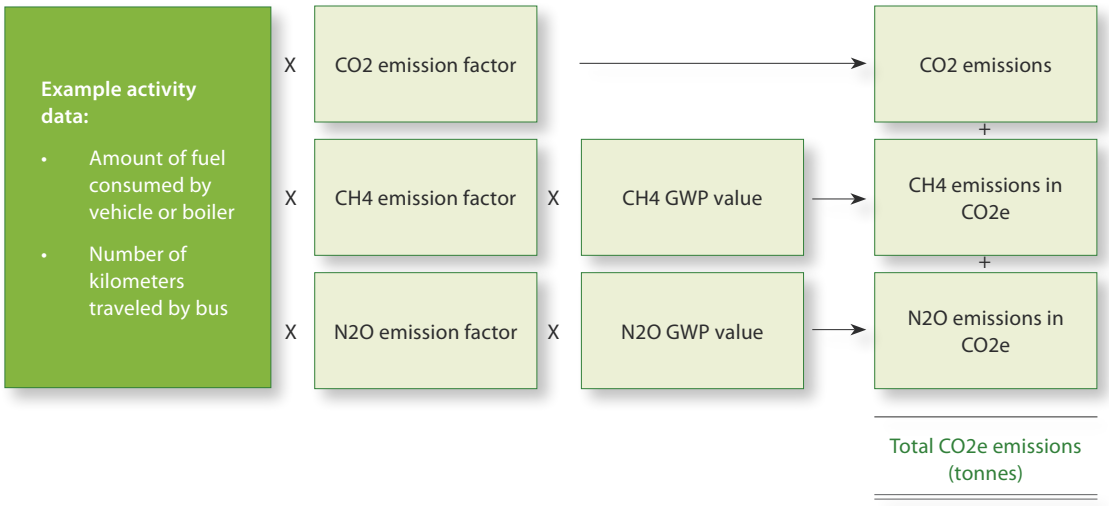
SCOPE		SOURCE	GREENHOUSE GAS
Direct Emissions	1	UN-owned (or leased) vehicles	CO2, CH4 and N2O
		Power generation	CO2, CH4 and N2O
		Refrigeration and air-conditioning equipment	HFCs and PFCs
Indirect Emissions	2	Consumption of purchased electricity	CO2
		Purchased steam	CO2, CH4 and N2O
	3	Public transport	CO2, CH4 and N2O

In general, the emissions are quantified by using methods that are based on emission factors; the only exception being refrigeration and air-conditioning equipment. Emission factors are coefficients that describe the amount of a specific GHG that is released from doing a certain activity, such as driving a vehicle one kilometre, or burning one tonne of fuel in a furnace. The tool uses default emission factors, each of which is based on a sample of representative data. As a result, the tool allows you to calculate emissions without the need to gather site-specific data on the quantity of emissions released. However, because these are default emission, they may not necessarily reflect the specific types of fuel combustion and emissions control technologies at each reporting office. Additional geographically- or technologically-specific emissions factors may result in more accurate calculations, and should be used by the reporting office as long as they are credible and as long as you can document their source.

> *Note: For certain sources, GHG emissions may be calculated in different ways to accommodate differences in the type of activity data available to individual reporting offices or to help ensure that the calculations are as accurate as possible. This chapter will explain when one alternative method should be used over another.*

Because different GHGs differ in the strength of their impact on the climate, the tool also adjusts the emissions of a specific GHG to reflect the actual impact of these emissions. This adjustment is done by using global warming potential (GWP) values, which convert the emissions of each GHG into a comparable units (tonnes CO2 -equivalent; CO2e). The total climate impact from an individual reporting office or facility is thus measured as the CO2e emissions from across all of the sources associated with that office. The default GWP values used in the tool are listed in Appendix III.

In summary, the emission-factor calculation approach involves the following:



Finally, all methodologies are based on guidance from the GHG Protocol and the IPCC, while emission factors are drawn from a range of sources, including, the IPCC, US EPA and the International Energy Agency (see Appendix I).

3.1. UN-owned (or leased) Vehicles

Scope 1 transport emissions result from vehicles that are either owned or leased by the UN reporting office. The CO2 emissions from transport sources are chiefly determined by the fuel's carbon content, which varies by fuel. In contrast, the CH4 and N2O emissions are a result of additional factors, especially the combustion and emission controls technologies used in the vehicle. Therefore, to ensure accurate calculations, the CO2 emissions are calculated by using fuel consumption data and fuel-specific emission factors; and the CH4 and N2O emissions are calculated based on distance travelled data and vehicle-specific emission factors.

The tool implements three alternative methods to accommodate different types of activity data (fuel use versus distance data) available to you:

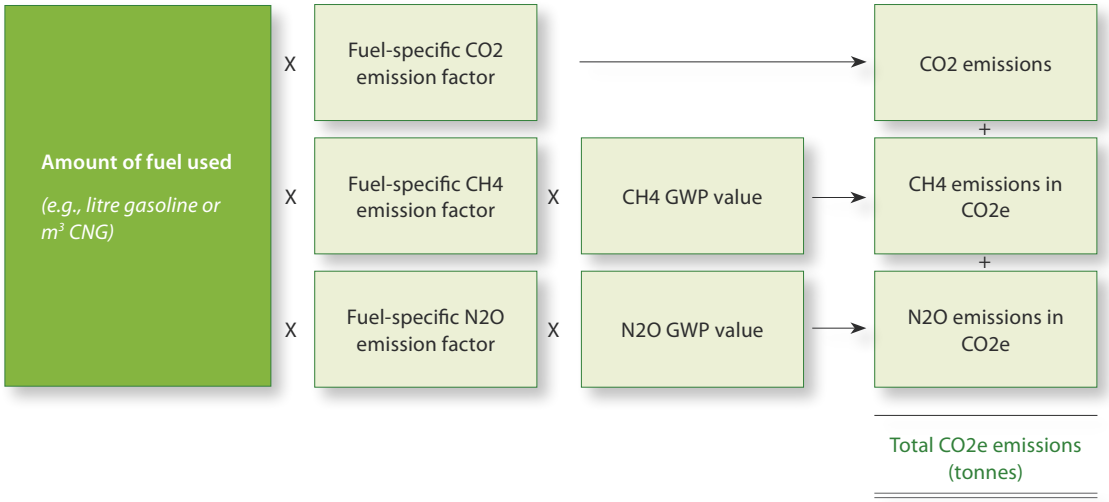
1. When only fuel use data are available.

The CO2 emissions are calculated using fuel- and GHG-specific emission factors (see Appendix II, Table II.1). In contrast the CH4 and N2O emissions are calculated in a two-step process:

1. The fuel use data is converted to distance data using vehicle-specific fuel economy factors (see Appendix II, Table II.2), and
2. These distance data is then multiplied by distance-based emission factors that are disaggregated by broad types of road vehicles (see Appendix II, Table II.3).

These distance-based emission factors are based on the relative abundance of different types of emission control technologies in the US in 2004; reporting offices may be able to supply emission factors that better match the types of vehicles that they operate.

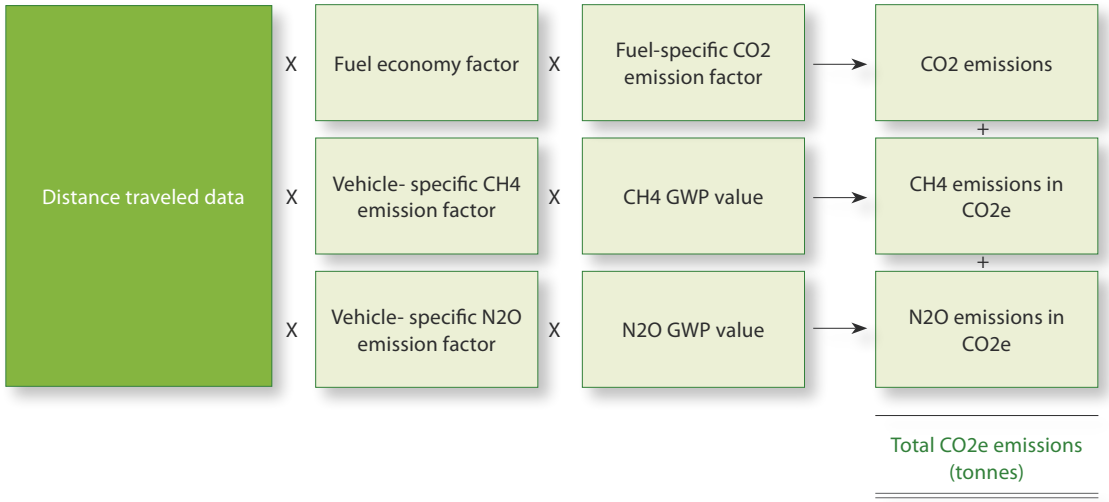
Fuel-use data can be obtained from fuel purchase records, and the emissions are calculated as follows:



2. When only distance data are available.

The tool first estimates the amount of fuel used over the distance driven by applying a default fuel economy factor (see Appendix II, Table II.2); it then calculates the CO2 emissions using fuel-specific CO2 emission factors as Method 1. The CH4 and N2O emissions are calculated directly using distance-based emission factors.

Distance data can be obtained from driver logs, odometers or invoices. The emissions are calculated as follows:



3. Where both distance and fuel use data are available.

In this case, the CO2 emissions are calculated as Method 1, while the CH4 and N2O emissions are calculated as Method 2.

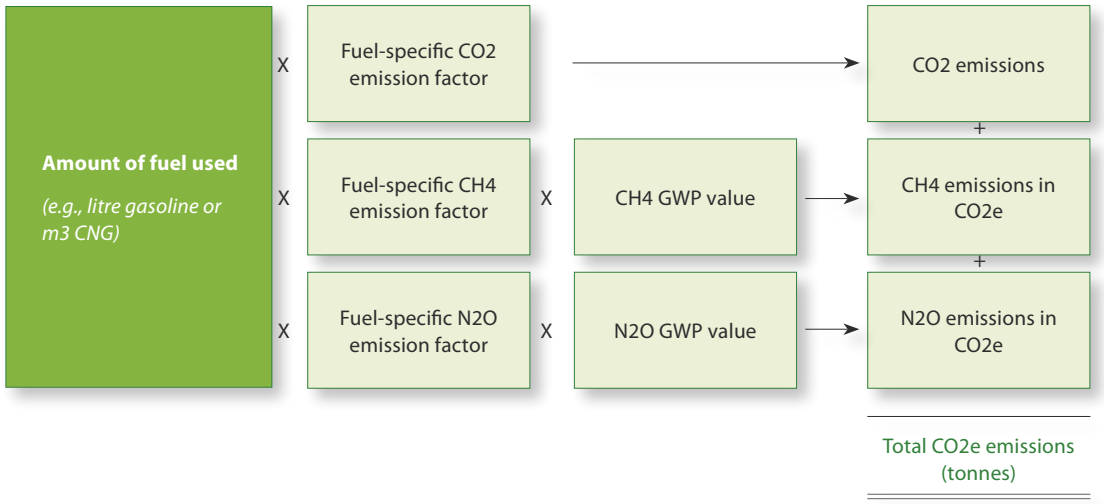
3.2. Power Generation

Scope 1 emissions also result from the on-site generation of power from the combustion of fuels in stationary equipment, such as boilers and furnaces.

As with UN-owned vehicles, power generation mainly results in the release of CO2. CH4 and N2O are emitted in smaller amounts. Again, the CO2 emissions are mainly determined by fuel carbon content, whereas the N2O and CH4 emissions depend not only upon fuel characteristics, but also upon the technology type, the combustion characteristics, the maintenance and operational practices, as well as other factors. The default emission factors for CO2, N2O and CH4 are listed in Appendix II, Tables II. 4-6.

The tool allows you to input fuel use data in units of energy (such as, GJ and kWh), mass (such as, tonnes), and volume (such as, m3 and litres). However, you should be aware that fuel density information is not available for some fuels. In these cases, you may only be able to input data in units of energy or mass.

The GHG emissions are calculated as:



3.2.1. Heating Values

Heating (or calorific) values are important if fuel use data is provided in energy units; for example, GJ and kWh of fuel burnt. Heating values measure the energy content of fuels and are expressed using either Higher Heating Values (HHVs), also known as Gross Calorific Values, or Lower Heating Values (LHVs),

also known as Net Calorific Values. Before emissions can be calculated properly, the fuel consumption data and corresponding emission factors must be expressed in the same way, that is, either in HHV units or in LHV units, but not both. This applies only to fuel use data that have been expressed using energy units, but not if they have been supplied in mass or volume units. As a general rule, HHVs are used in Canada and the USA, whereas LHVs are used elsewhere; however, exceptions to this rule may occur, and you should ask their fuel suppliers to clarify which heating value method they use.

The default emission factors implemented in the tool are based on LHVs. No adjustments are therefore necessary if fuel use data is supplied on a LHV basis. If fuel use data is supplied on a HHV basis instead, then these data should be first multiplied by the following factors to convert them to a LHV basis and the converted values can then be entered into the tool:

State of Fuel	Correction factor the IPCC HHV is multiplied with to express the heating value on a LHV basis
Solid or Liquid	0.95
Gaseous	0.9

Source: IPCC 2006 Guidelines for National Greenhouse Gas Inventories

3.3. Refrigeration and Air-Conditioning Equipment

Refrigeration and air-conditioning (RAC) equipment leak refrigerants during installation, maintenance, operation and disposal. Because many refrigerants are GHGs with high GWP values, RAC equipment may be a significant emissions source for some reporting offices.

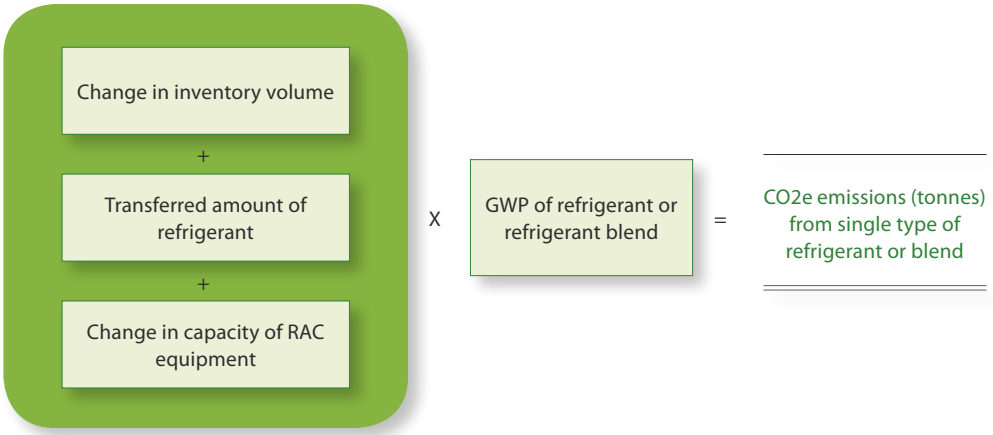
To calculate the emissions from RAC equipment, the tool implements three alternative methods to calculate or estimate the refrigerant losses associated with installation, maintenance, operation and disposal. You should choose amongst these methods based on the available data. You should be aware that individual refrigerants may be GHGs themselves, that is, the refrigerant may be an HFC or a PFC. Alternatively, the refrigerants may be blends of different chemicals, only a portion of which are PFCs or HFCs. You should be careful to calculate the emissions separately for each GHG or refrigerant blend.

In calculating emissions, the tool allows you to select from a list of the most commonly used refrigerants or refrigerant blends. The GWPs of these refrigerants or blends are then automatically used to calculate the CO2e emissions.

Method 1. Detailed mass balance method.

This method should be used by reporting offices that maintain their own equipment. The method estimates HFC and PFC emissions based on the amount of refrigerant purchased and used by the equipment user, and it requires data that should be available from entity purchase and service records. You should input this data in kilogrammes.

The GHG emissions from a single refrigerant (or blend) are calculated as follows:



Where:

- Change in inventory volume includes only gas stored on-site (i.e. cylinders) and not within equipment. Change in inventory volume is calculated as:

  Inventory at beginning of year –

  Inventory at end of year

- Transferred amount =

  Refrigerant purchased from producers/distributors in bulk +

  Refrigerant provided by manufacturers with or inside equipment +

  Refrigerant added to equipment by contractors +

  Refrigerant returned after offsite recycling or reclamation -

  Sales of refrigerant (in bulk, not equipment) to other entities -

  Refrigerant left in equipment that is sold to other entities -

  Refrigerant returned to suppliers -

  Refrigerant sent-offsite for recycling or reclamation -

  Refrigerant sent off-site for destruction

- Change in capacity of RAC equipment =

  Total new charge of new equipment +

  Total full charge of equipment retrofitted to use this refrigerant –

  Original total full charge of equipment that is retired or sold to other entities -

  Total full charge of equipment retrofitted away from this refrigerant to a different refrigerant

  This calculation process is repeated for each refrigerant or blend of refrigerants.

Method 2. Simplified mass balance method

This method is a simplified version of Method 1. It should be used by reporting offices that hire contractors to maintain their RAC equipment. The activity data that are supplied must be obtained from the contractor. If notified in advance of the need for this information, the contractor should be able to provide it.

Method 2 tracks emissions from the installation, servicing and disposal of RAC equipment as follows:

$$\textit{Emissions of individual GHG or loss of refrigerant blend} = (P_N - C_N + P_S + C_D - R_D) \times GWP$$

Where:

- P_N = Purchases of refrigerant used to charge new equipment (omitted if the equipment has been pre-charged by the manufacturer)
- C_N = Total full capacity of the new equipment (omitted if the equipment has been pre-charged by the manufacturer)
- P_S = Quantity of refrigerant used to service equipment
- C_D = Total full capacity of retiring equipment
- R_D = Refrigerant recovered from retiring equipment

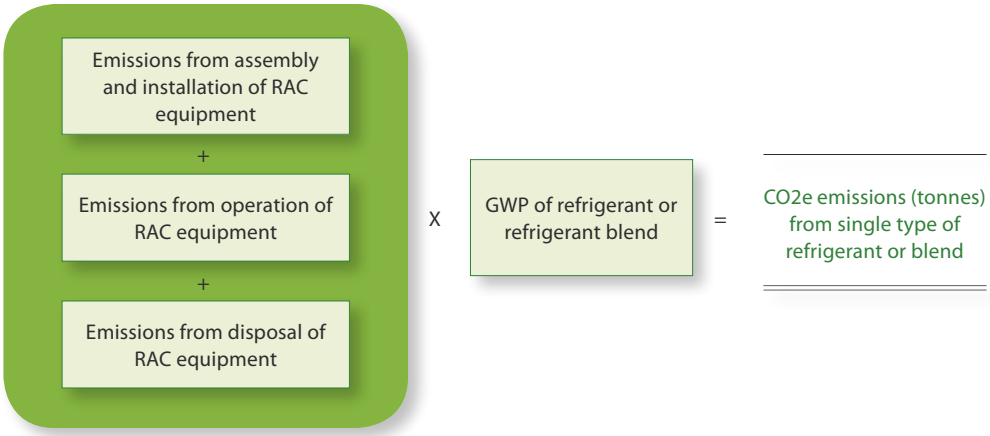
You should input data in kilogrammes, and this calculation process should be repeated for each refrigerant or blend of refrigerants.

Method 3. Emission-factor based approach

Method 3 uses default emission factors to separately calculate the emissions of individual GHGs or refrigerant blends, associated with the assembly, installation, operation and disposal of RAC equipment. The default emission factors implemented in the tool are specific to broad categories of RAC equipment, such as domestic and commercial refrigerators.

Method 3 is likely to be less accurate than either Method 1 or Method 2. As a result, Method 3 is recommended as a screening method to determine the significance of the emissions from RAC equipment. If RAC equipment is deemed to be a significant component of the reporting office's inventory, then the reporting office should strive to collect the activity data necessary for either Method 1 or Method 2. Otherwise, the GHG emissions estimated with Method 3 can be reported.

For each type of RAC equipment, the emissions of an individual GHG, or refrigerant blend, are calculated as:



Where:

- Emissions from the assembly or installation of RAC equipment (kg) =

  Number of RAC units of type x •

  Original refrigerant charge in each unit (kg) •

  Emission factor for the assembly and installation of RAC equipment of type x (% of original charge / year).

- Emissions from the operation of RAC equipment (kg) =

  Number of RAC units of type x •

  Original refrigerant charge in each unit (kg) •

  Annual leakage rate for RAC equipment of type x (% of original charge / year).

- Emissions from the disposal of RAC equipment (kg) =

  Number of RAC units of type x •

  Original refrigerant charge in each unit (kg) •

  (1 – (Annual leakage rate for RAC equipment of type x • Time since last recharge (years)) •

  (1 – Recycling efficiency for RAC equipment of type x) – Amount of refrigerant i destroyed.

Appendix II (Table II.7) lists the default emission factors that are implemented in the tool. You must supply the time since the last discharge and the amount of refrigerant that has been sent for destruction.

3.4. Purchased Electricity

Purchased electricity is an indirect emissions source because the emissions from the generation of electricity occur at the energy plant, rather than at the reporting office. Nonetheless, these emissions should be included in the reporting office's inventory because they result from its activities. Moreover, they often contribute significantly to the inventories of office-based organizations.

The tool implements country-specific default emission factors for CO2. But CH4 and N2O emissions are not quantified for several reasons:

1. CH4 and N2O emissions vary with the size, efficiency and vintage of the combustion technology, as well as with the maintenance and operational practices. Because these variables vary significantly amongst electricity plants, they are not easily represented in simple, country-specific emission factors.
2. No current emission factors are available for CH4 and N2O. While CO2 emission factors are updated on an annual basis by the International Energy Agency (EIA), CH4 and N2O emission factors are not updated as regularly and are currently out of date.

The CO2 emissions from purchased electricity can be calculated in two ways:

Method 1: Based on metered electricity use

This method should be used by the reporting office when electricity bills or other data records are available that directly show how much electricity was consumed.

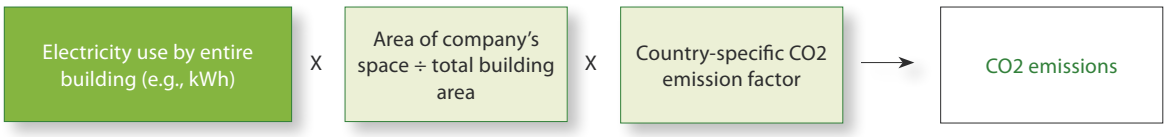
The CO2 emissions are calculated as:

Default emission factors are listed in Appendix II (Table II.8).

Method 2. Indirect method

Where the reporting office leases office space in a building owned by another organization, it may not have direct information about the amount of electricity it has consumed. In these cases, reporting offices should use Method 2, which requires data on the electricity consumed by the entire building and uses the proportion of the building that is occupied by the reporting office as a proxy for the proportion of the electricity use that the reporting office is responsible for. This method is potentially less accurate than Method 1 because of uncertainties in data on occupancy rates and floor areas, and also because it assumes that all occupants of the building have similar energy consumption habits. The electricity consumption data should be available from the building's property manager:

The CO2 emissions are calculated as:

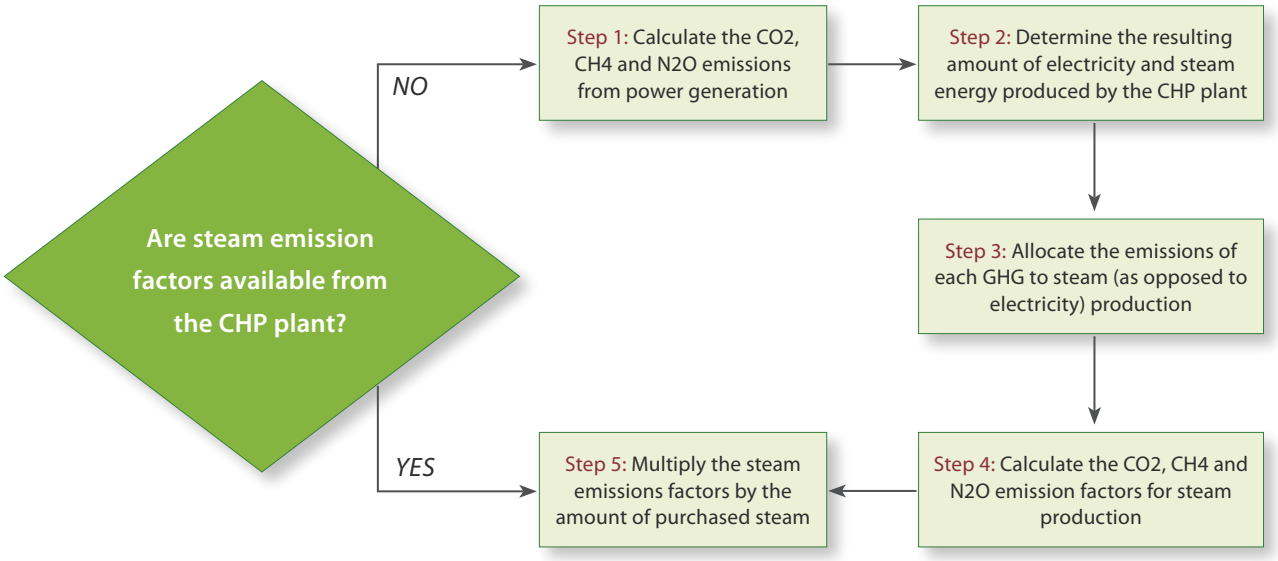


Default emission factors are listed in Appendix II (Table II.8).

3.5. Purchased Steam

Combined Heat and Power (CHP) plants generate both electricity and heat/steam. The emissions associated with the electricity should be calculated following the 2.4.1 Purchased electricity on page 19, assuming that the plant is grid-connected. The purchased steam spreadsheet should be used whenever reporting offices purchase a portion of the heat or steam outputs from an individual CHP plant.

The calculation of the indirect (scope 2) emissions from steam purchases requires information about the GHG emissions that stem from power generation at the CHP plant. This GHG information is used to calculate an emission factor for steam production, which is then multiplied by the amount of steam or heat purchased by the reporting office to quantify the scope 2 emissions from purchased steam. CHP plants may be able to supply emission factors for steam production. Otherwise, these factors have to be developed by the reporting office by using information about fuel consumption and energy production by the plant. The general process for developing steam emission factors and calculating the scope 2 emissions is summarized below:



If the energy provider is able to supply emission factors for steam production, proceed to step 5. Otherwise, calculate the emission factors following steps one - four below. Each step should be repeated for each of CO2, CH4 and N2O.

1. **Step one:** Calculate the emissions of a GHG from stationary combustion in the CHP system. The fuel consumption data will have to be supplied by the energy provider. For details, see 3.2 Power generation on page 30.

2. **Step two:** Determine the energy in the steam and electricity output streams generated by the CHP system. These values should be in the same units, for example, GJ or a similar SI unit. Again, the data will have to be supplied by the energy provider.

3. **Step three:** Determine the fraction of the total emissions of each GHG (CO2, CH4 and N2O) to allocate to steam production (as opposed to electricity production) using the following formula:

$$E_H = \frac{H / e_H}{H / e_H + P / e_P} \bullet E_T$$

Where:

E_H	=	emissions allocated to steam production
H	=	steam output (energy)
e_H	=	assumed efficiency of steam production
P	=	delivered electricity generation (energy)
e_P	=	assumed efficiency of electricity generation
E_T	=	total direct emissions of the CHP system

Default efficiency factors are provided in Appendix 3 of the Excel workbook.

4. **Step four:** Calculate the emission factor for steam production as follows:

$$\text{Emission factor for steam production} = \frac{E_H}{H}$$

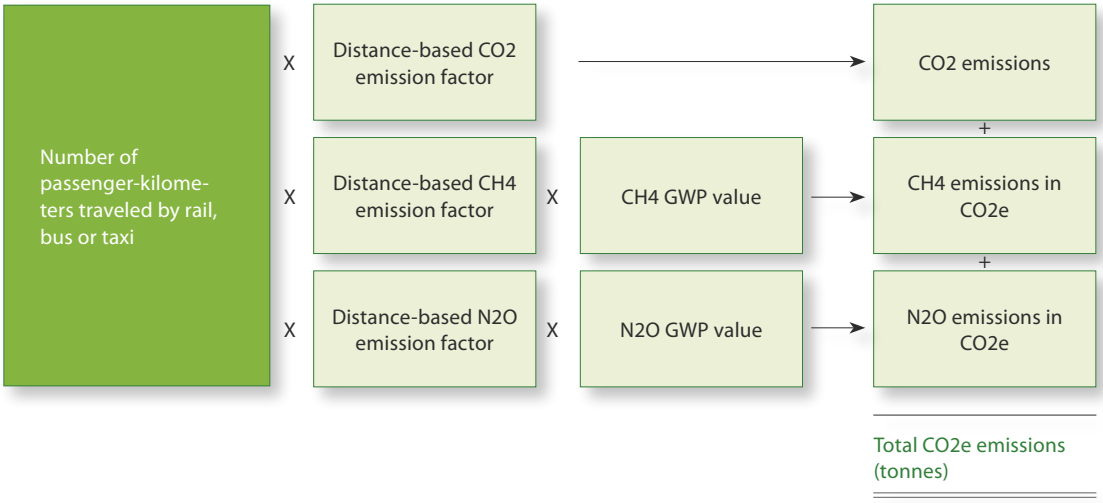
5. **Step five:** Estimate emissions from steam purchases as:

GHG emissions = Amount of steam purchased • Emission factor for steam production

3.6. Public Transport

The tool calculates the CO2, CH4 and N2O emissions from public transport, such as buses or rail, as well taxis. The tool assumes taxis are gasoline-powered passenger vehicles. Default emission factors are listed in Appendix II (Table II.10).

The emissions from each source are calculated based on distance data, as follows:



3.7. Optional Emissions

The Optional Emissions tab enables you to enter emissions data for sources that are not covered by the calculation methodologies in other parts of the calculator. Although the use of this tab is optional, you are encouraged to report this data so that a more complete understanding of the reporting office's climate impact can be obtained.

Emissions data should be entered directly into this tab for any of the Kyoto gases (CO2, CH4, N2O, HFCs, and PFCs) emitted by UN offices, as well as for any other greenhouse gases that are also ozone depleting substances, for example, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). These substances can be reported optionally because they are already subject to the Montreal Protocol, which specifically targets ozone depleting substances.

In using the Optional Emissions tab please input emissions data in kilogrammes. The tab then applies the appropriate GWP values to determine the GHG emissions on a tonne CO2e basis. For GWP values, see Appendix III.

Note: The CO2 emissions from biomass use, such as biofuel combustion, should be reported separately from the CO2 emissions from fossil fuel combustion.

Appendix I - DATA SOURCES

UN-Owned (or Leased) Vehicles

- Source of method: GHG Protocol tool 'CO2 emissions from transport or mobile sources'; Version 1.3. Also, US EPA Climate Leaders.
- Source of emission factors: US EPA Climate Leaders and 2006 IPPC Guidelines for National Greenhouse Gas Inventories, Volume 1, Chapter 1.

Power Generation

- Source of method and fuel density data: GHG Protocol Calculation Tool for Direct Emissions from Stationary Combustion, Version 3.1.
- Emission factors: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapters 1 and 2.

Refrigeration and Air-Conditioning Equipment

- Source of method: GHG Protocol tool 'Calculating HFC and PFC Emissions from the Manufacturing, Servicing, and/or Disposal of Refrigeration and Air-Conditioning Equipment'; Version 1.0.
- Emission factors: 2006 IPCC Guidelines for National greenhouse Gas Inventories; Volume 3, Chapter 3.

Consumption of Purchased Electricity

- Source of method: GHG Protocol tool 'Indirect CO2 emissions from Purchased Electricity, Heat, or Steam'
- Emission factors: International Energy Agency Data Services. 2006. "CO2 Emissions from Fuel Combustion (2006 Edition)".

Purchased Steam

- Source of method: GHG Protocol tool 'Allocation of GHG emissions from a combined heat and power (CHP) plant'; Version 1.
- Factors: The default factors for the assumed efficiency of electricity and steam production are sourced from the US EPA Climate Leaders programme.

Public Transport

- Source of method: GHG Protocol tool 'CO2 emissions from transport or mobile sources'; Version 1.3. Also, US EPA Climate Leaders.
- Source of emission factors: US EPA Climate Leaders.

Optional Emissions

- Source of CFC and HCFC emission Factors: IPCC (Intergovernmental Panel on Climate Change). Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons, Special Report of the Intergovernmental Panel on Climate Change, Cambridge, England, 2005.

Other References

- EMG: A Strategy for a Climate Neutral UN. www.unemg.org/climateneturalun.
- UNEP/GRID- Arendal: Kick the Habit – a UN guide to climate neutrality. A United Nations Environment Programme Publication 2008.
- WRI/WBCSD: The Greenhouse Gas Protocol – A corporate accounting and reporting standard.

Appendix II - DEFAULT EMISSION FACTORS

UN-owned (or leased) Vehicles

Table II.1. Fuel-specific CO2 emission factors for use with Methods 1-3.

Fuel	Emission factor	
	Value	Units
Gasoline	2.271	kg CO2 / litre
Diesel	2.676	kg CO2 / litre
Ethanol	1.469	kg CO2 / litre
Biodiesel	2.499	kg CO2 / litre
LNG	1.178	kg CO2 / litre
CNG	1.885	kg CO2 / m3
LPG	1.612	kg CO2 / litre

Table II.2. Fuel economy factors used in Method 2.

Vehicle type	Fuel economy factor (km / litre)
Passenger car	3.694
Motorcycle	8.208
Vans Pickuptrucks SUVs	2.6660
Buses	
Diesel	0.607
CNG	0.394
LNG	0.296
Heavy duty vehicles	1.445
Light duty vehicles	0.969

Table II.3. Distance-based emission factors for CH4 and N2O. Used in Methods 2 and 3.

Vehicle type	Fuel	Emission factor (kg / vehicle km)	
		CH_4	N_2O
Gasoline Passenger Car*		9.00988E-06	5.15738E-06
Gasoline Vans, Pickup trucks, SUVs*		9.44484E-06	8.2021E-06
Gasoline Heavy-duty vehicles*		2.11888E-05	1.77091E-05
Diesel Passenger Car*		3.10686E-07	6.21371E-07
Diesel Vans, Pickup trucks, SUVs*		6.21371E-07	9.32057E-07
Diesel Heavy-duty vehicles*		3.16899E-06	2.98258E-06
Motorcycle		4.3496E-05	4.3496E-06
Alternatively fueled vehicles			
Buses	CNG	0.001222	0.000109
	Ethanol	0.000122	0.000109
Heavy duty vehicles	CNG	0.001222	0.000109
	Ethanol	0.000122	0.000109
	LPG	0.000041	0.000109
	LNG	0.001222	0.000109
Light duty vehicles	CNG	0.000458	0.000031
	Ethanol	0.000034	0.000042
	LPG	0.000023	0.000042

Power Generation

Table II.4. Fuel-specific CO2 emission factors

Fuel		Energy basis kg/GJ	Mass basis kg/tonne	Liquid basis kg/ litre	Gas basis kg/m³
Oil products	Crude oil	73.3	3100.59	2.48	
	Orimulsion	77	2117.5		
	Natural Gas Liquids	64.2	2837.64		
	Other kerosene	71.9	3149.22	2.52	
	Gas/Diesel oil	74.1	3186.3	2.68	
	Residual fuel oil	77.4	3126.96	2.94	
	Liquified Petroleum Gases	63.1	2984.63	1.61	
	Lubricants	73.3	2946.66	2.95	
	Petroleum coke	97.5	3168.75		
	Other petroleum products	73.3	2946.66		
Coal products	Anthracite	98.3	2624.61		
	Coking coal	94.6	2667.72		
	Other bituminous coal	94.6	2440.68		
	Sub bituminous coal	96.1	1816.29		
	Lignite	101	1201.9		
	Oil shale and tar sands	107	952.3		
	Brown coal briquettes	97.5	2018.25		
	Patent fuel	97.5	2018.25		
	Coke oven coke	107	3017.4		
	Lignite coke	107	3017.4		
Natural gas	Natural gas	56.1	2692.8		1.88
Other wastes	Municipal waste (Non biomass fraction)	91.7	917		
	Waste oils	73.3	2946.66		
Biomass	Wood or Wood waste	112	1747.2		
	Other primary solid biomass fuels	100	1160		
	Charcoal	112	3304		
	Biogasoline	70.8	1911.6		
	Biodiesels	70.8	1911.6		
	Other liquid biofuels	79.6	2181.04		
	Landfill gas	54.6	2751.84		2.48
	Sludge gas	54.6	2751.84		
	Other biogas	54.6	2751.84		
	Municipal wastes (Biomass fraction)	100	1160		
	Peat	106	1034.56		

Table II. 5. Fuel-specific CH4 emission factors

Fuel		Energy basis kg/GJ	Mass basis kg/tonne	Liquid basis kg/ litre	Gas basis kg/m³
Oil products	Crude oil	0.01	0.423	0.0003	
	Orimulsion	0.01	0.275		
	Natural Gas Liquids	0.01	0.442		
	Other kerosene	0.01	0.438	0.0004	
	Gas/Diesel oil	0.01	0.43	0.0004	
	Residual fuel oil	0.01	0.404	0.0004	
	Ethane	0.005	0.232		0.0003
	Lubricants	0.01	0.402	0.0004	
	Petroleum coke	0.01	0.325		
	Other petroleum products	0.01	0.402		
Coal products	Anthracite	0.01	0.267		
	Coking coal	0.01	0.282		
	Other bituminous coal	0.01	0.258		
	Sub bituminous coal	0.01	0.189		
	Lignite	0.01	0.119		
	Oil shale and tar sands	0.01	0.089		
	Brown coal briquettes	0.01	0.207		
	Patent fuel	0.01	0.207		
	Coke oven coke	0.01	0.282		
	Lignite coke	0.01	0.282		
Natural gas	Natural gas	0.005	0.24		0.0002
Other wastes	Municipal waste (Non biomass fraction)	0.3	3		
	Waste oils	0.3	12.06		
Biomass	Wood or Wood waste	0.3	4.68		
	Other primary solid biomass fuels	0.3	3.48		
	Charcoal	0.2	5.9		
	Biogasoline	0.01	0.27		
	Biodiesels	0.01	0.27		
	Other liquid biofuels	0.01	0.274		
	Landfill gas	0.005	0.252		0.0002
	Sludge gas	0.005	0.252		
	Other biogas	0.005	0.252		
	Municipal wastes (Biomass fraction)	0.3	3.48		
	Peat	0.01	0.0976		

Table II. 6. Fuel-specific N2O emission factors

Fuel		Energy basis kg/GJ	Mass basis kg/tonne	Liquid basis kg/ litre	Gas basis kg/m3
Oil products	Crude oil	0.0006	0.0254	0.00002	
	Orimulsion	0.0006	0.0165		
	Natural Gas Liquids	0.0006	0.0265		
	Other kerosene	0.0006	0.0263	0.00002	
	Gas/Diesel oil	0.0006	0.0258	0.00002	
	Residual fuel oil	0.0006	0.0242	0.00002	
	Liquified Petroleum Gases	0.0001	0.0047	2.5542E-06	
	Lubricants	0.0006	0.0241	0.00002	
	Petroleum coke	0.0006	0.0200		
	Other petroleum products	0.0006	0.0241		
Coal products	Anthracite	0.0015	0.0401		
	Coking coal	0.0015	0.0423		
	Other bituminous coal	0.0015	0.0387		
	Sub bituminous coal	0.0015	0.0284		
	Lignite	0.0015	0.0179		
	Oil shale and tar sands	0.0015	0.0136		
	Brown coal briquettes	0.0015	0.0311		
	Patent fuel	0.0015	0.0311		
	Coke oven coke	0.0015	0.0423		
	Lignite coke	0.0015	0.0423		
Natural gas	Natural gas	0.0001	0.0048		0.000003
Other wastes	Municipal waste (Non biomass fraction)	0.004	0.04		
	Waste oils	0.004	0.1608		
Biomass	Wood or Wood waste	0.004	0.0624		
	Other primary solid biomass fuels	0.004	0.0464		
	Charcoal	0.001	0.0295		
	Biogasoline	0.0006	0.0162		
	Biodiesels	0.0006	0.0162		
	Other liquid biofuels	0.0006	0.0164		
	Landfill gas	0.0001	0.0050		0.000005
	Sludge gas	0.0001	0.0050		
	Other biogas	0.0001	0.0050		
	Municipal wastes (Biomass fraction)	0.004	0.0464		
	Peat	1.4	0.0137		

Refrigeration and Air-Conditioning Equipment

Table II.7. Emission factors implemented in Method 3. The tool assumes the mid point of the ranges in parentheses.

Application	Average Charge (kg)	Average Lifetime (years	Average Assembly	Average Annual Leakage Rate	Average Recycling Efficiency
Domestic refrigeration	0.28 (0.05 - 0.5)	16.00 (12 - 20)	0.60% (0.2 -1%)	0.30% (0.1 - 0.5%)	70%
Stand-alone commercial applications	2.90 (0.2 - 6)	12.50 (10 - 15)	1.75% (0.5 - 3%)	7.50% (1 - 15%)	75% (10 - 80%)
Medium and large commercial refrigeration	1025.00 (50 - 2,000)	8.50 (7 - 10)	1.75% (0.5 -3%)	22.50% (10 - 35%)	85% (80 - 90%)
Transport refrigeration	5.50 (3.0 - 8.0)	7.50 (6 - 9)	0.6 (0.2 - 1%)	32.50% (15 - 50%)	75% (70 - 80%)
Industrial refrigeration including food processing and cold storage	4995.00 (10 - 10,000)	22.50 (15 - 30)	1.75 (0.5 - 3%)	16% (7 - 25%)	85% (80 - 90%)
Chillers	995.00 (10 - 2,000)	22.50 (15 - 30)	0.6 (0.2 - 1%)	8.50% (2 - 15%)	87.50% (80 - 95%)
Residential and commercial A/C, including heat pumps	49.75 (0.5 - 100)	15.00 (10 - 20)	0.6 (0.2 - 1)	3% (1 - 5%)	75% (70 - 80%)
Mobile air conditioners	1.00 (0.5 - 1.5)	12.50 (9 - 16)	0.35% (0.2 - 0.5)	15% (10 - 20%)	0%

Consumption of Purchased Electricity

Table II. 8. Country-specific CO2 emission factors

Country	Emission factor (kg CO2/ kWh of Electricity)
Albania	0.0344395
Algeria	0.6709448
Angola	0.3427467
Argentina	0.3064495
Armenia	0.138329
Australia	0.87331
Austria	0.22487
Azerbaijan	0.5048522
Bahrain	0.8901022
Bangladesh	0.5568777
Belarus	0.298834
Belgium	0.267959
Benin	0.7099346
Bolivia	0.481352
Bosnia-Herzegovina	0.6186506
Botswana	1.8476941
Brazil	0.0842192
Brunei Darussalam	0.7888284
Bulgaria	0.4480035
Cambodia	1.2059307
Cameroon	0.0390982
Canada	0.198664
Chile	0.3574757
People's Republic of China	0.7878678
China (including Hong Kong)	0.7881334
Taipei	0.6316822
Colombia	0.1631909
Congo	No data
Democratic Republic of Congo	0.0029579
Costa Rica	0.0268938
Côte d'Ivoire	0.5181223
Croatia	0.3113264
Cuba	0.9874434

Country	Emission factor (kg CO2/ kWh of Electricity)
Cyprus	0.7923237
Czech Republic	0.515573
Denmark	0.283582
Dominican Republic	0.5739929
Ecuador	0.3690944
Egypt	0.4714438
El Salvador	0.2634097
Eritrea	0.6961661
Estonia	0.6649089
Ethiopia	0.0066382
Finland	0.193551
France	0.090859
Gabon	0.3683352
Georgia	0.0892311
Germany	0.349232
Ghana	0.2037662
Gibraltar	0.7430897
Greece	0.776493
Guatemala	0.3837588
Haiti	0.3073561
Honduras	0.4107127
Hong Kong, China	0.8097809
Hungary	0.338703
Iceland	0.000619
India	0.9433615
Indonesia	0.770737
Islamic Republic of Iran	0.5337664
Iraq	0.7007056
Ireland	0.584173
Israel	0.7674805
Italy	0.405393
Jamaica	0.7133488
Japan	0.42854
Jordan	0.6598882
Kazakhstan	1.1368468
Kenya	0.3067699
Dem. People's Republic of Korea	0.5209546
Korea	0.418188

Country	Emission factor (kg CO2/ kWh of Electricity)
Kuwait	0.8074868
Kyrgyzstan	0.0816262
Latvia	0.1620338
Lebanon	0.6673417
Libya	0.8993748
Lithuania	0.1296019
Luxembourg	0.327756
FYR of Macedonia	0.6447905
Malaysia	0.5570099
Malta	0.8918929
Mexico	0.51547
Republic of Moldova	0.5157233
Mongolia	0.5332154
Morocco	0.7775021
Mozambique	0.0013384
Myanmar	0.3648027
Namibia	0.026364
Nepal	0.0014075
Netherlands	0.386667
Netherlands Antilles	0.7178293
New Zealand	0.275422
Nicaragua	0.5387694
Nigeria	0.402963
Norway	0.005502
Oman	0.8545383
Pakistan	0.3795676
Panama	0.2768361
Paraguay	No data
Peru	0.1978384
Philippines	0.4951494
Poland	0.658899
Portugal	0.498223
Qatar	0.6179696
Romania	0.3941358
Russia	0.3379606
Saudi Arabia	0.7476115
Senegal	0.6341252
Serbia and Montenegro	0.7479229

Country	Emission factor (kg CO2/ kWh of Electricity)
Singapore	0.5439296
Slovak Republic	0.232063
Slovenia	0.3282908
South Africa	0.8483575
Spain	0.394298
Sri Lanka	0.3976328
Sudan	0.8480347
Sweden	0.044537
Switzerland	0.026231
Syria	0.5874982
Tajikistan	0.027412
United Republic of Tanzania	0.6065632
Thailand	0.5313397
Togo	0.4740695
Trinidad and Tobago	0.7090296
Tunisia	0.4815921
Turkey	0.432842
Turkmenistan	0.7951234
Ukraine	0.314316
United Arab Emirates	0.8436165
United Kingdom	0.472514
United States	0.572934
Uruguay	0.1027396
Uzbekistan	0.4430373
Venezuela	0.2252232
Vietnam	0.4055964
Yemen	0.8454729
Zambia	0.0068391
Zimbabwe	0.5723375
For other countries, please use the following:	
Other Africa	0.4201425
Other Latin America	0.5182661
Other Asia	0.3608507
Memo: European Union - 27	0.340861
Memo: Former Yugoslavia	0.5765181
OECD Europe	0.325559
Africa	0.6427366
Non-OECD Europe	0.4785902

Purchased Steam

Table II.9. Efficiency factors for steam and power production.

eH Assumed efficiency of typical power production	eP Assumed efficiency of typical steam production
0.8	0.35

Public Transport

Table II.10.

Public transport	Emission Factor (Kg GHG/ passenger km)		
	CO2	CH4	N2O
Intercity/National	0.115	1.24E-06	6.21E-07
Commuter/light rail	0.107	1.24E-06	6.21E-07
Transit rail (trams, subways)	0.101	2.49E-06	1.24E-06
Passenger Bus (Default)	0.066	3.73E-07	3.11E-07
Local Bus	0.1073	3.73E-07	3.11E-07
Coach	0.029	3.73E-07	3.11E-07
Passenger Car (Taxi)	0.12915374	0.0000124274	0.0000130488

Appendix III - GWP VALUES

Table III.1. GWP values for individual greenhouse gases.

Gas			GWP
Formula	Common name	Chemical name	
CO2	Carbon dioxide		1
CH4	Methane		21
N2O	Nitrous oxide		310
SF6	Sulfur hexafluoride		23,900
Hydrofluorocarbons (HFCs)			
CHF3	HFC-23	trifluoromethane	11,700
CH2F2	HFC-32	difluoromethane	650
CH3F	HFC-41	fluoromethane	150*
C5H2F10	HFC-43-10mee	1,1,1,2,3,4,4,5,5,5-decafluoropentane	1300*
C2HF5	HFC-125	pentafluoroethane	2,800
C2H2F4	HFC-134	1,1,2,2-tetrafluoroethane	1,000
C2H2F4	HFC-134a	1,1,1,2-tetrafluoroethane	1,300
C2H3F3	HFC-143	1,1,2-trifluoroethane	300
C2H3F3	HFC-143a	1,1,1-trifluoroethane	3,800
C2H4F2	HFC-152	1,2-difluoroethane	43*
C2H4F2	HFC-152a	1,1-difluoroethane	140
C2H5F	HFC-161	fluoroethane	12*
C3HF7	HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane	2,900
C3H2F6	HFC-236cb	1,1,1,2,2,3-hexafluoropropane	1,300*
C3H2F6	HFC-236ea	1,1,1,2,3,3-hexafluoropropane	1,200*
C3H2F6	HFC-236fa	1,1,1,3,3,3-hexafluoropropane	6,300
C3H3F5	HFC-245ca	1,1,2,2,3-pentafluoropropane	560
C3H3F5	HFC-245fa	1,1,1,3,3-pentafluoropropane	950*
C4H5F5	HFC-365mfc	1,1,1,3,3-pentafluorobutane	890*
Perfluorocarbons (PFCs)			
CF4	PFC-14 (Perfluoromethane)	tetrafluoromethane	6,500
C2F6	PFC-116 (Perfluoroethane)	hexafluoroethane	9,200
(C3F8)	PFC-218 Perfluoropropane	octafluoropropane	7,000
C4F10	Perfluorobutane	decafluorobutane	7,000
c-C4F8	Perfluorocyclobutane	octafluorocyclobutane	8,700
C5F12	Perfluoropentane	dodecafluoropentane	7,500
C6F14	Perfluorohexane	tetradecafluorohexane	7,400

Source:

The GWP values are from the IPCC Second Assessment Report (1995), unless indicated otherwise (*), in which case they are from the IPCC Third Assessment Report (2001). Third Assessment Report values have only been included for greenhouse gases that were not originally covered by the Second Assessment Report.

Note: All GWP values were calculated assuming a 100 year time horizon.

Table III.2 GWP values for refrigerant blends.

Chemical blend	GWP
R-401A	18
R-401B	15
R-401C	21
R-402A	1,680
R-402B	1,064
R-403A	1,400
R-403B	2,730
R-404A	3,260
R-406A	0
R-407A	1,770
R-407B	2,285
R-407C	1,526
R-407D	1,428
R-407E	1,363
R-408A	1,944
R-409A	0
R-409B	0
R-410A	1,725
R-410B	1,833
R-411A	15
R-411B	4
R-412A	350
R-413A	1,774
R-414A	0
R-414B	0
R-415A	25

Chemical blend	GWP
R-415B	105
R-416A	767
R-417A	1,955
R-418A	4
R-419A	2,403
R-420A	1,144
R-500	37
R-501	0
R-502	0
R-503	4,692
R-504	313
R-505	0
R-506	0
R-507 or R-507A	3,300
R-508A	10,175
R-508B	10,350
R-509 or R-509A	3,920

Note: The GWPs of blends are based only on the GWPs of their HFC and PFC constituents. Other constituents are considered to have a GWP of zero, even though they may have significant climate impacts, because these gases are not recognized under the Kyoto Protocol. The HFC and PFC contents of these blends have been obtained from ASHRAE Standard 34.

Table III.3 GWPs of ozone depleting substances

Ozone Depleting Substance	GWP*
CFC-11 (CCl3F) Trichlorofluoromethane	4680
CFC-12 (CCl2F2) Dichlorodifluoromethane	10720
CFC-113 (C2F3Cl3) 1,1,2-Trichlorotrifluoroethane	6030
CFC-114 (C2F4Cl2) Dichlorotetrafluoroethane	9880
CFC-115 (C2F5Cl) Monochloropentafluoroethane	7250
Halon 1211 (CF2ClBr) Bromochlorodifluoromethane	1860
Halon 1301 (CF3Br) Bromotrifluoromethane	7030
Halon 2402 (C2F4Br2) Dibromotetrafluoroethane	1620
CFC-13 (CF3Cl) Chlorotrifluoromethane	14190
CCl4 Carbon tetrachloride	1380

Ozone Depleting Substance	GWP*
Methyl Chloroform (C2H3Cl3) 1,1,1-trichloroethane	144
Methyl Bromide (CH3Br)	5
HCFC-22 (CHF2Cl) Monochlorodifluoromethane	1780
HCFC-123 (C2HF3Cl2) Dichlorotrifluoroethane	76
HCFC-124 (C2HF4Cl) Monochlorotetrafluoroethane	599
HCFC-141b (C2H3FCl2) Dichlorofluoroethane	713
HCFC-142b (C2H3F2Cl) Monochlorodifluoroethane	2270
HCFC-225ca (C3HF5Cl2) Dichloropentafluoropropane	120
HCFC-225cb (C3HF5Cl2) Dichloropentafluoropropane	586

*All GWPs are based on a 100 year time horizon.

Appendix IV - MINIMUM REQUIRED ACTIVITY DATA FOR THE UN GREENHOUSE GAS CALCULATOR

Reference Data

- Number of personnel
- Surface area of building (m^2)

UN Vehicles

- Type of vehicle
- Type of fuel used
- Distance travelled (km)
- Quantity of fuel consumed (litre)

Public transport

- Type of vehicle
- Distance travelled (km)

Purchased electricity

- Electricity consumed (kWh)

Purchased steam/heat

- Quantity of steam/heat purchased (kWh)

  AND:

- CO2, CH4, N2O emission factors

  OR:

- Type of fuel used by supplier
- Total quantity of fuel consumed by supplier (litre)
- Total steam/heat production by supplier (kWh)
- Total amount of electricity produced by supplier (kWh)

Power generation

- Type of fuel
- Quantity of fuel consumed

Refrigeration and Air-Conditioning

- Type of refrigerant

  AND:
- Inventory change (kg)
- Transferred amount (kg)
- Change in capacity (kg)

  OR:
- New equipment charge (kg)
- New equipment capacity (kg)
- Existing equipment recharge (kg)
- Disposed equipment capacity (kg)

  OR:
- Type of equipment
- Number of equipment