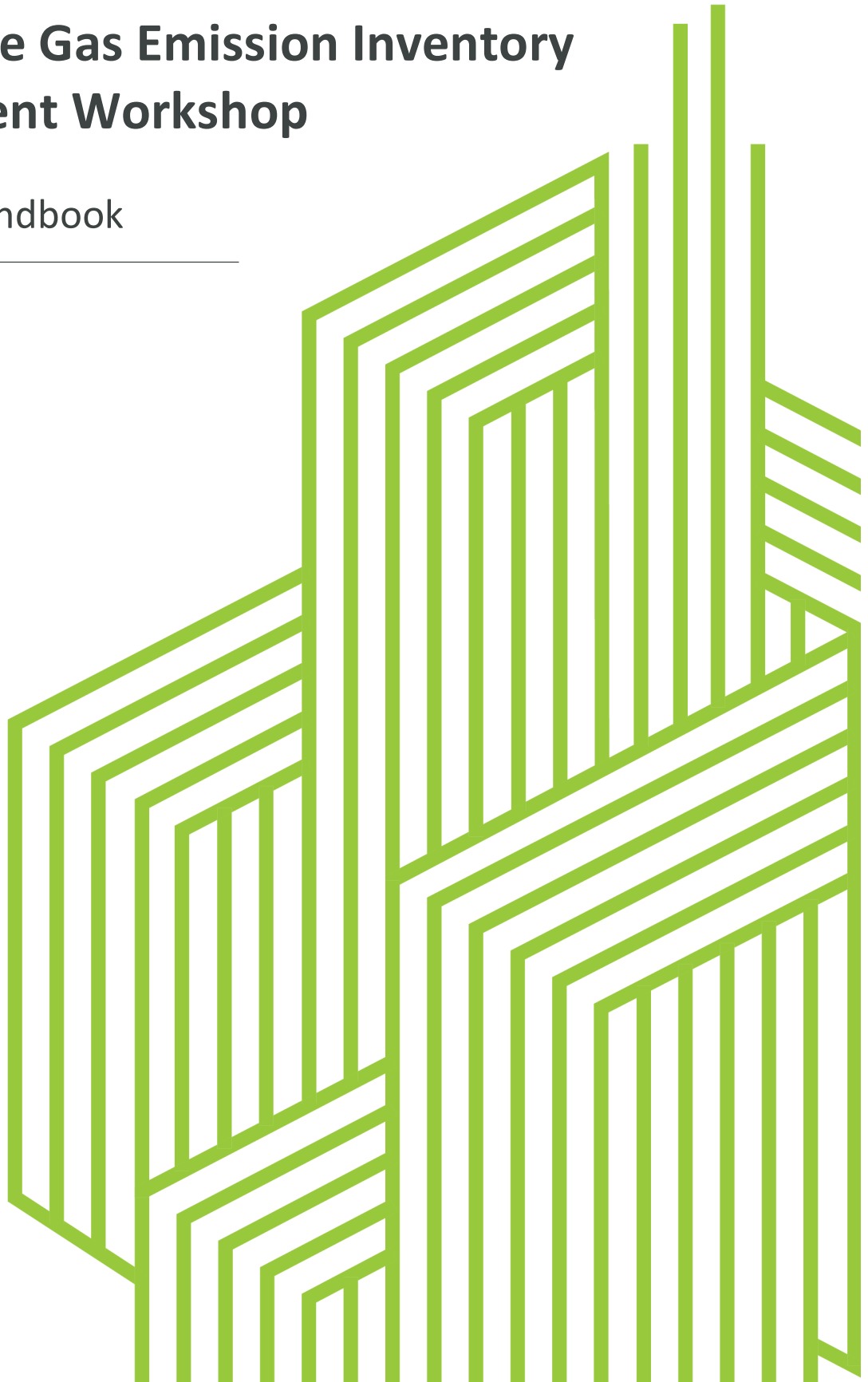




Greenhouse Gas Emission Inventory Development Workshop

Participant Handbook

Version 1.3



Introduction

This handbook is designed to accompany the Greenhouse Gas Inventory Development Workshop, delivered as part of the C40 Measurement and Planning Technical Assistance Programme.

It contains key information from the presentation as well as additional reference material to support the workshop and to act as a future reference source.

What is a greenhouse gas inventory?

A greenhouse gas inventory is an account of greenhouse gases (GHGs) emitted to or removed from the atmosphere.

An inventory lists, by source, the amount of GHGs emitted to the atmosphere during a given time period.

Why measure emissions at the city level?

Planning for climate action begins with developing a GHG inventory. Developing an inventory can help:

- understand the emissions contribution from different **sectors**
- establish an emissions **baseline** and **forecast** future emissions
- setting evidence-based GHG reduction **targets**
- **evidence base** to support development, implementation and **tracking** of policies and actions
- compare, learn from and share best practices with **other cities**
- build greater **confidence** for decision makers and investors
- lead to enhanced **reputation** enhancement and attract **investment**
- improve **communication** with residents and businesses
- achieve **compliance** with various initiatives and organisations

Add your own ideas here:

What is the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC)?

The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) is an accounting and reporting standard for cities.

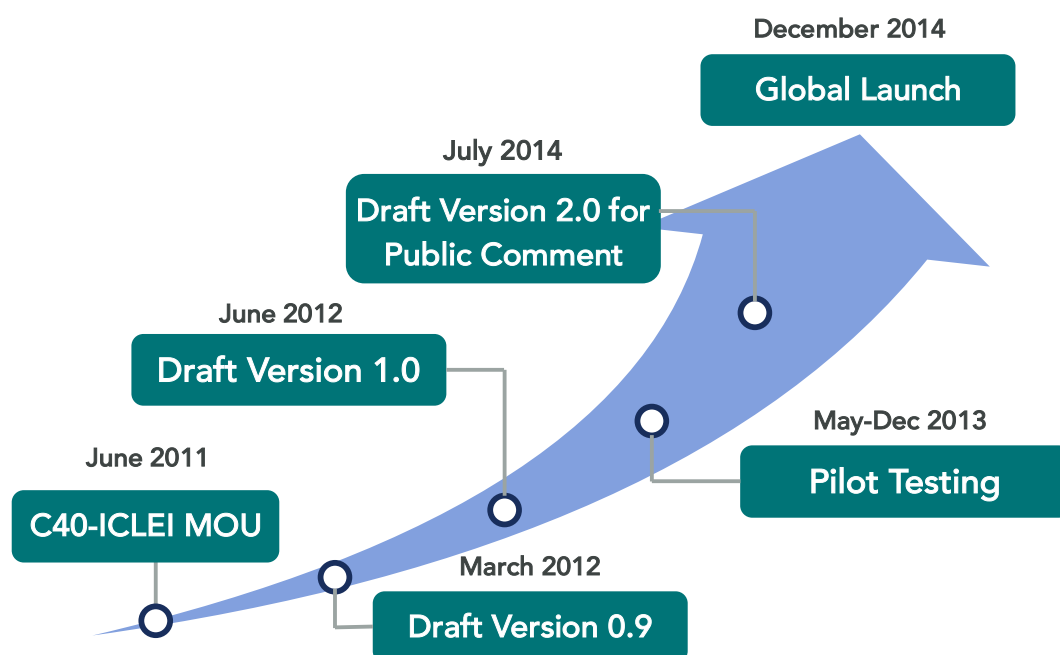
It offers cities a robust, transparent, consistent and globally-accepted framework to identify, calculate and report on city-wide GHG emissions.

Launched in December 2014 at the It has been developed in partnership with the World Resources Institute and ICLEI Local Governments for Sustainability and endorsed by The World Bank, UN HABITAT and UNEP. The development and pilot-testing of the GPC is summarised in Figure 1.

All C40 member cities are required to develop a city-wide GHG inventory using the GPC standard, as specified in the Participation Standards.

The GPC can be downloaded from: www.c40.org/gpc

Figure 1: Development and pilot-testing of the GPC



GPC accounting principles

Accounting and reporting for city-wide GHG emissions is based on the following principles adapted from the GHG Protocol Corporate Standard¹ in order to represent a fair and true account of emissions:

Relevance: Prioritisation of activity data and reported emissions to the activities and priorities in the city

Completeness: Ensuring all sectors and sources are included, or explained if not

Consistency: Ensuring consistency in approach, boundaries, data sources, assumptions and methodologies, with the GPC, and within and between years

Transparency: Clear documentation and disclosure of data sources, assumptions, procedures and methodologies

Accuracy: Ensuring integrity of data, assumptions, and calculations, so results are neither under- or over-stated

Read more on this in Chapter 2 of GPC (pp 25 – 26).

¹ <http://www.ghgprotocol.org/standards/corporate-standard>

Categorising emissions

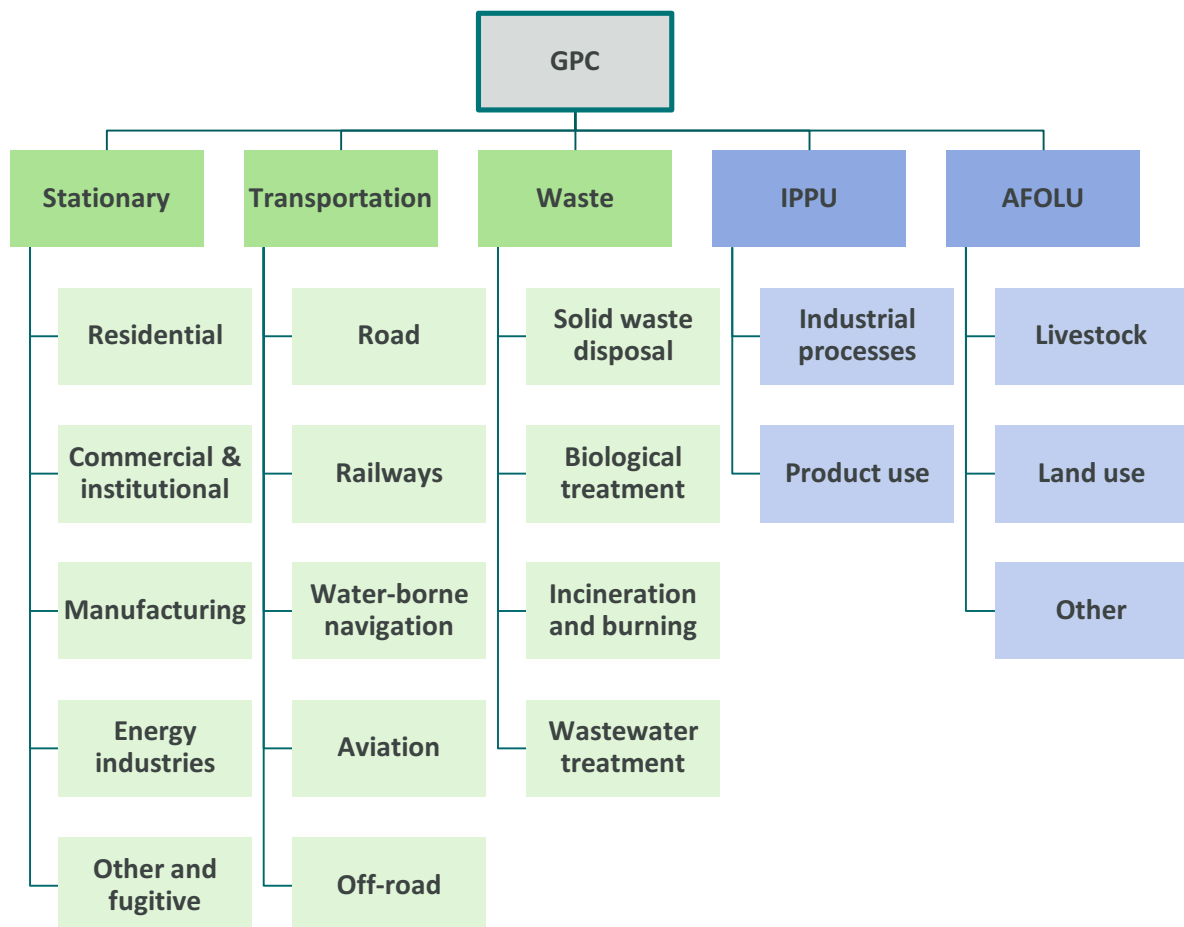
The GPC is a standard for organising and reporting city greenhouse gas emissions. It does not prescribe specific methodologies for calculating emissions but provides a standard framework for reporting information in a consistent and transparent way. The key accounting concepts within the GPC are set out in this section. These include:

- i) Organising emissions into sectors and sub-sectors.
- ii) The concept of scopes to differentiate between emissions occurring inside and outside the city boundary.
- iii) The different reporting levels.

Sector and sub-sector definitions

The GPC organises emissions sources into five sectors, each of which is broken down into a number of sub-sectors. Full definitions for each of the sectors and sub-sectors defined by the GPC are set out in the following section and summarised in Figure 2 below. In each sector the GPC reference number is listed.

Figure 2 Overview of GPC sectors and sub-sectors



STATIONARY ENERGY (I)



Stationary energy sources are one of the largest contributors to a city's GHG emissions. These emissions primarily come from fuel combustion to heat buildings and the use of grid-supplied electricity. Other sources include energy-related fugitive emissions (such as leaks from natural gas distribution systems).

Table 1: Definitions of stationary energy sub-sectors

Sub-sector	Definition
Emissions from stationary energy production and use	Emissions from the intentional oxidation of materials within a stationary apparatus that is designed to raise heat and provide it either as heat or as mechanical work to a process, or for use away from the apparatus
I.1 Residential buildings	All emissions from energy use in households
I.2 Commercial buildings and facilities	All emissions from energy use in commercial buildings and facilities
I.2 Institutional buildings and facilities	All emissions from energy use in public buildings such as schools, hospitals, government offices, highway street lighting, and other public facilities
I.3 Manufacturing industries & construction	All emissions from energy use in industrial facilities and construction activities, except those included in energy industries sub-sector. This also includes combustion for the generation of electricity and heat for own use in these industries.
I.4 Energy industries	All emissions from energy use in energy industries. Examples of energy industries include primary fuel production, fuel processing and conversion, and energy production supplied to a grid.
1.4.4 Energy generation supplied to the grid	All emissions from the use of primary energy sources for the generation of grid-distributed energy (e.g. electricity, steam, heat and cooling). For example, emissions from combustion of natural gas at electricity generation power plants inside the city.
I.5 Agriculture, forestry, and fishing activities	All emissions from energy use in agriculture, forestry, and fishing activities
I.6 Non-specified sources	All remaining emissions from facilities producing or consuming energy not specified elsewhere
Fugitive emissions from fuel	Includes the intentional and unintentional emissions from the extraction, processing, storage and transport of fuel to the point of use Note: some product uses may also give rise to emissions termed as 'fugitive', such as the release of refrigerants and fire-suppressants. These shall be reported in IPPU.
I.7 Fugitive emissions from mining, processing & transportation of coal	Includes the intentional and unintentional emissions from the extraction, processing, storage and transport of fuel in the city
I.8 Oil and natural gas systems	Fugitive emissions from all oil and natural gas activities occurring in the city. The primary sources of these emissions may include fugitive equipment leaks, evaporation losses, venting, flaring and accidental losses.

See Chapter 6 of the GPC for more guidance.

TRANSPORTATION (II)



Transportation sources are another large contributor to a city's GHG emissions. Transportation covers all journeys by road, rail, water and air, including inter-city and international travel. GHG emissions are produced directly by the combustion of fuel or indirectly by the use of grid-supplied electricity.

Table 2: Definitions of transportation sub-sectors

Sub-sector	Definition
II.1 On-road transportation	Vehicles travelling on roads including electric and fuel powered cars, taxis, buses, etc. On-road vehicles are designed for transporting people, property or material on common or public roads, or highways.
II.2 Railways	Vehicles travelling by rail including trams, urban railway subway systems, regional (inter-city) commuter rail transport, national rail system, and international rail, etc.
II.3 Water-borne transportation	Marine vessels including sightseeing ferries, domestic inter-city vehicles, or international water-borne vehicles.
II.4 Aviation	Emissions produced by aircraft including helicopters, domestic inter-city flights, and international flights, etc.
II.5 Off-road transportation	Off-road vehicle and mobile machinery within transportation facility premises such as airports, harbours, bus terminals, and train stations. Snowmobiles, etc.

Further clarification on reporting emissions from the off-road sector is set out in Table 3.

Table 3 Guidance on reporting off-road transportation emissions

Type of off-road activity	Reporting guidance
Off-road vehicle and mobile machinery within industrial premises and construction sites	Report as a Stationary Energy source under manufacturing industries and construction sub-sector or energy industries subsector
Off-road vehicle and mobile machinery within agriculture farms, forests, and aquaculture farms	Report as a Stationary Energy source under agriculture, forestry, and fishing activities sub-sector
Off-road vehicle and mobile machinery within the transportation facility premises such as airports, harbours, bus terminals, and train stations	Report as a Transportation source under off-road transportation sub-sector
Off-road vehicle and mobile machinery within military premises	Report as a Stationary Energy source under unidentified activities sub-sector

See Chapter 7 of the GPC for more guidance.

WASTE (III)



Cities produce solid waste and wastewater (referred to collectively as “waste”) that may be disposed of and/or treated at facilities inside the city boundary, or transported to other areas for treatment. Waste disposal and treatment produces GHG emissions through aerobic or anaerobic decomposition, or combustion.

Table 4: Definitions of waste sub-sectors

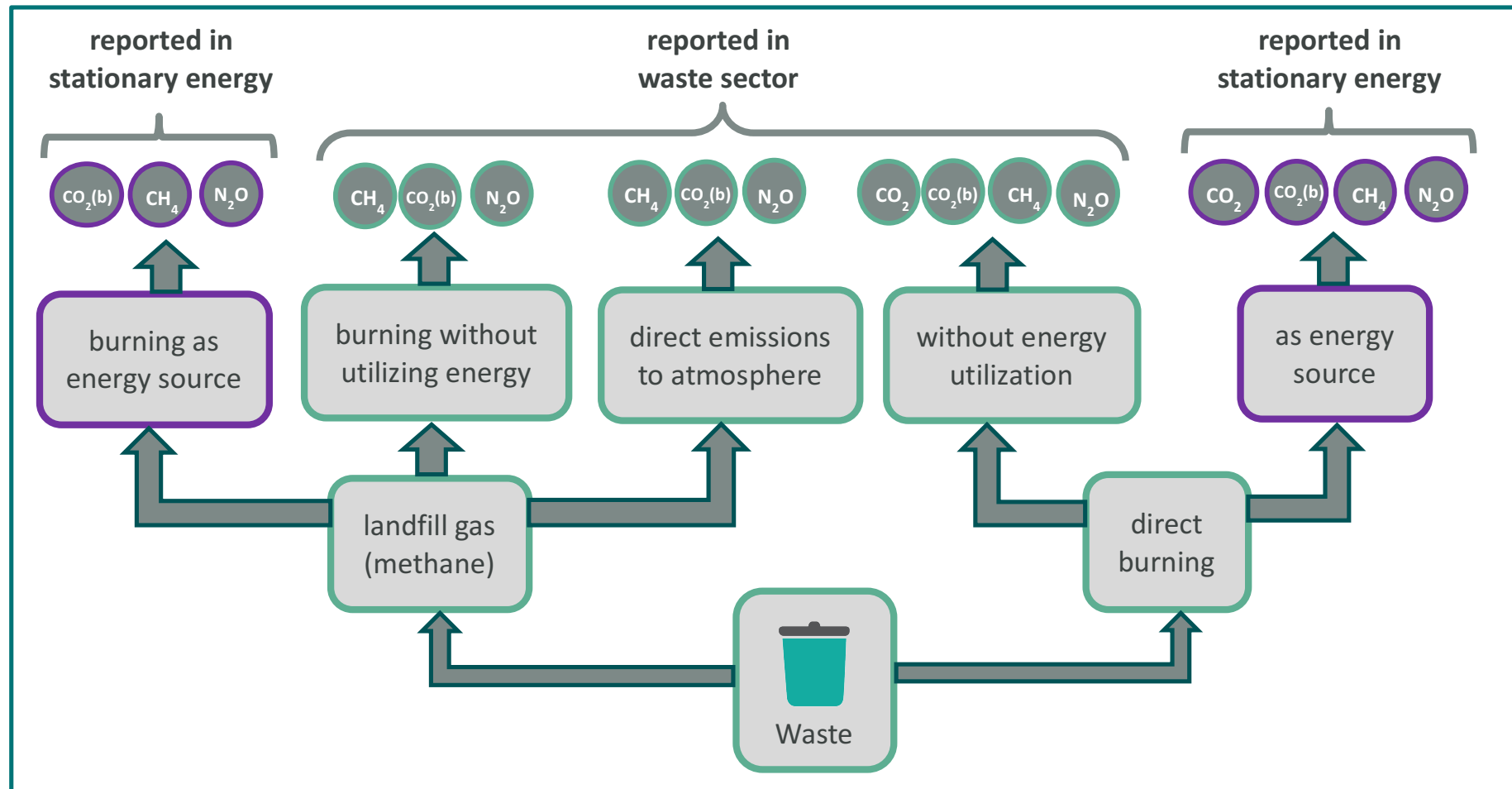
Sub-sector	Definition
III.1 Solid waste disposal	<p>Emissions from solid waste disposed in landfills or dump sites, including disposal in an unmanaged site, disposal in a managed dump or disposal in a sanitary landfill. Note it is important to distinguish between the following:</p> <ul style="list-style-type: none"> - Solid waste that is generated <i>within</i> the city and disposed of <i>within</i> the city (III.1.1) and <i>outside</i> the city (III.1.2). - Solid waste generated <i>outside</i> the city and disposed in landfills or open dumps <i>within</i> the city (III.1.3)
III.2 Biological treatment of waste	<p>Emissions from waste that is treated biologically. This refers to composting and anaerobic digestion of organic waste, such as food waste, garden and park waste, sludge, and other organic waste sources. Note it is important to distinguish between the following:</p> <ul style="list-style-type: none"> - Waste that is generated <i>within</i> the city and treated biologically <i>within</i> the city (III.2.1) and <i>outside</i> the city (III.2.2). - Waste generated <i>outside</i> the city and treated biologically <i>within</i> the city (III.2.3)
III.3 Incineration and open burning	<p>Waste that is incinerated or burned in the open. Note it is important to distinguish between the following:</p> <ul style="list-style-type: none"> - Waste that is generated <i>within</i> the city and incinerated or burned in the open <i>within</i> the city (III.3.1) and <i>outside</i> the city (III.3.2). - Waste generated <i>outside</i> the city and incinerated or burned in the open <i>within</i> the city (III.3.3)
III.4 Wastewater treatment and discharge	<p>Emissions associated with the treatment and discharge of wastewater. Note it is important to distinguish between the following:</p> <ul style="list-style-type: none"> - Wastewater that is generated <i>within</i> the city and treated <i>within</i> the city (III.4.1) and <i>outside</i> the city (III.4.2). - Wastewater generated <i>outside</i> the city and treated <i>within</i> the city (III.4.3)

See Chapter 8 of the GPC for more guidance.

Waste used to generate energy (biogas from landfill, waste-to-energy plants) shall be reported in the Energy sector (specifically under sector I.4.4 Energy Generation, if the electricity or heat generated is distributed on a city-wide grid) (see Figure 3).

Figure 3: Waste or energy

Read more on this in page 64 of the GPC



INDUSTRIAL PROCESSES AND PRODUCT USE – IPPU (IV)



The IPPU sector includes non-energy related emissions from industrial activities and product uses, including non-energy uses of fossil fuels, within the city boundary. These are summarised in Table 5 below.

Reporting IPPU emissions is not a requirement of a BASIC inventory; however, for a BASIC+ inventory, a city must report all sources of IPPU emissions.

Table 5: Examples of IPPU sub-sectors

Sub-sector	Examples
IV.1 Industrial processes	<p>The main emission sources from industrial processes are those that chemically or physically transform materials; for example, the blast furnace in the iron and steel industry, and ammonia and other chemical products manufactured from fossil fuels used as chemical feedstock). During these processes, many different GHGs are emitted including CO₂, CH₄, N₂O and F gases.</p> <ul style="list-style-type: none"> • Production of mineral products such as cement production, lime production, and glass production • Production of chemicals such as ammonia, nitric acid and adipic acid • Production of metals such as iron steel and metallurgical coke, ferroalloy, aluminum, magnesium, lead and zinc. <p><i>See section 9.3 in Chapter 9 of the GPC for more guidance.</i></p>
IV.2 Product use	<p>The use of certain products can result in emissions of a range of greenhouse gases. Examples include:</p> <ul style="list-style-type: none"> • Lubricants and paraffin waxes used in non-energy products • FC gases used in electronics production • Fluorinated gases used as substitutes for Ozone depleting substances <p><i>See section 9.4 in Chapter 9 of the GPC for more guidance.</i></p>

AGRICULTURE, FORESTRY AND OTHER LAND USE – AFOLU (V)



The AFOLU sector covers emissions associated with agriculture, forestry and other land use. This covers methane produced in the digestive processes of livestock (sub-sector V.1 Livestock), GHG emissions from activities including land-use changes (sub-sector V.2 Land), as well as other land-use related emissions (sub-sector V.3 Aggregate Sources). These are summarised in Figure 4.

Reporting AFOLU emissions is not a requirement of a BASIC inventory; however, for a BASIC+ inventory, a city must report all sources of AFOLU emissions. It should be noted that many cities will have very small, or no AFOLU emissions.

Figure 4: Emissions sources in the AFOLU sector

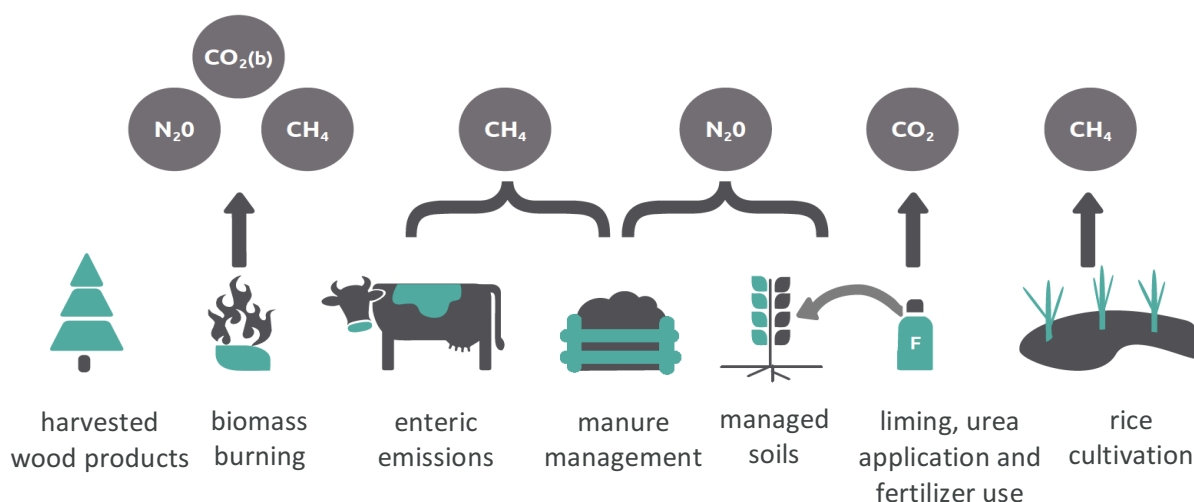


Table 6: Definitions of AFOLU sub-sectors

Sub-sector	Examples
V.1 Livestock	Livestock production emits CH_4 through enteric fermentation, and both CH_4 and N_2O through management of their manure.
V.2 Land	Emissions and removals are based on changes in stocks of Carbon and are estimated for six categories used by the IPCC and the GPC: forest land, cropland, grassland, wetlands, settlements, and other. This includes both land remaining in a land-use category as well as land converted to another use. Carbon stocks consist of above-ground and below-ground biomass, dead organic matter, and soil organic matter.
V.3 Aggregate sources	This includes a range of other land use related emissions sources such as rice cultivation, fertilizer use, liming, and urea application as well as the burning of biomass without energy recovery.

See Chapter 10 of the GPC for more guidance.

Scopes

Activities taking place within a city can generate GHG emissions that occur inside the city boundary as well as outside the city boundary. To distinguish between these, the GPC groups emissions into three categories based on where they occur: scope 1, scope 2 or scope 3 emissions.

These are summarised in Figure 5 and described in Table 7. Note the grey box in Figure 5 represents the geographical boundary of the city.

Figure 5: Overview of all emissions sources in scope 1, 2 and 3.

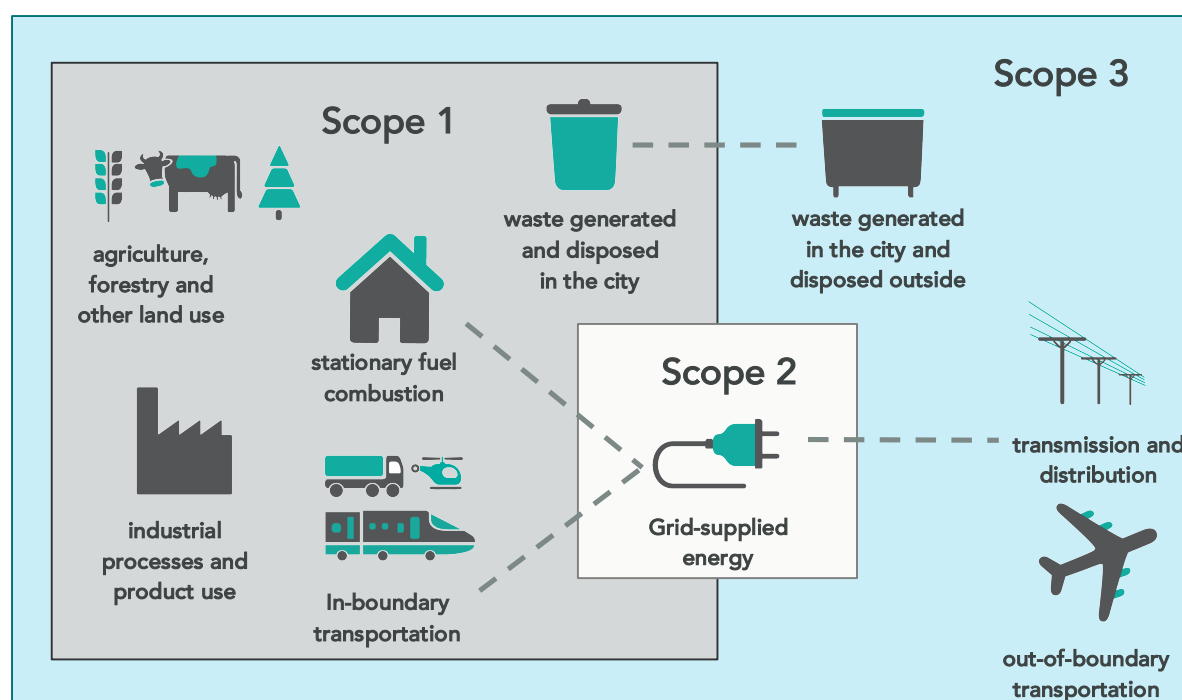


Table 7: Definitions of scope 1, 2 and 3

Scope	Definition	Examples
Scope 1	GHG emissions from sources located within the city boundary.	<ul style="list-style-type: none"> Fuel consumed within the city boundary Waste generated and disposed of within the boundary
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling	<ul style="list-style-type: none"> Residential consumption of grid-supplied electricity
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary.	<ul style="list-style-type: none"> Waste generated in the city but disposed in a landfill outside of the city Transmission and distribution losses from grid-supplied electricity

See section 6.1, 7.1, 8.1, 9.1 and 10.1 of the GPC for more guidance.

Reporting levels

The GPC gives cities the option of selecting between two reporting levels: BASIC or BASIC+. The BASIC level covers emission sources that occur in almost all cities (Stationary Energy, in-boundary transportation and waste). This allows all cities using the GPC to be compared.

BASIC+ includes emissions from IPPU and AFOLU and transboundary transportation which generally involve more challenging data collection and calculation processes. Therefore, where these sources are significant and relevant for a city, the city should aim to report according to BASIC+. See Figure 6 and Figure 7 for a summary of sources under each level. Note the grey box in Figure 5 represents the geographical boundary of the city.

Figure 6: Emissions sources to be reported under BASIC level reporting

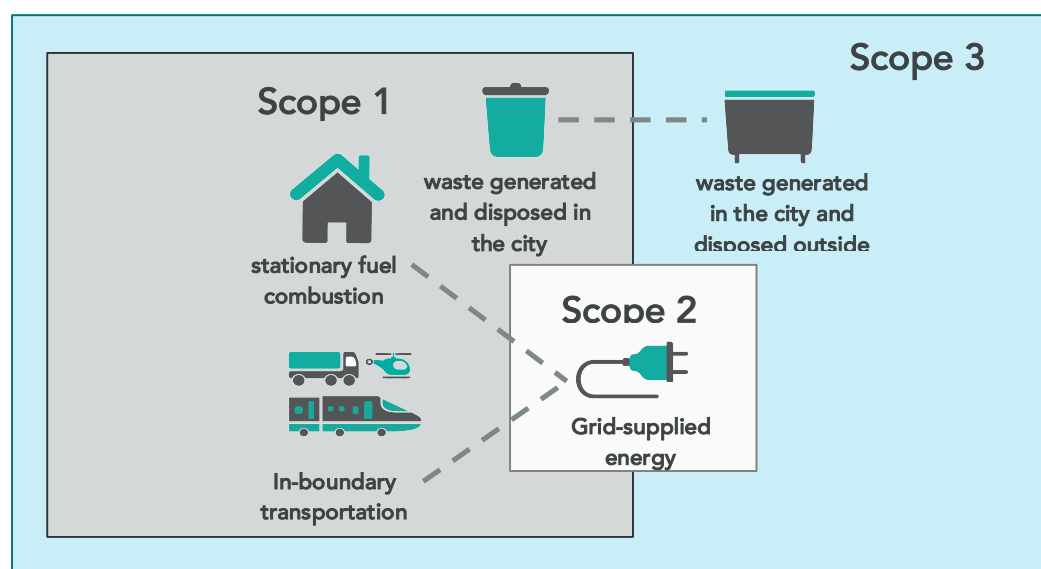
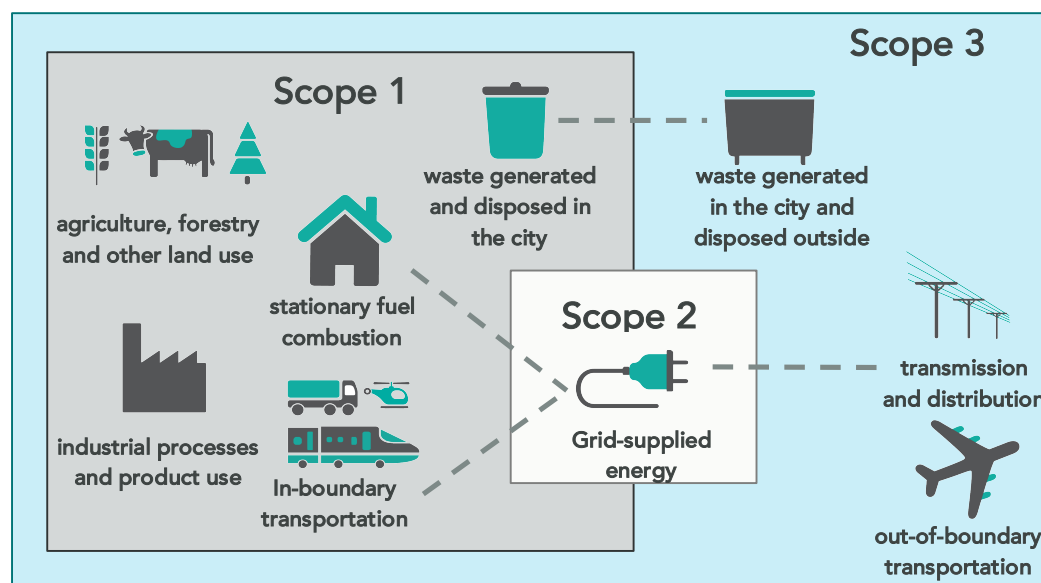


Figure 7: Emissions sources to be reported under BASIC+ level reporting



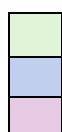
Summary of concepts

Table 8 summarises the key emission sources by sectors and sub-sectors. It also presents the emissions sources to be reported by scope and reporting level (BASIC and BASIC+).

Table 8: Summary of sources and scopes

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tonnes CO ₂ e)		
		Scope 1	Scope 2	Scope 3
I	STATIONARY ENERGY			
I.1	Residential buildings	✓	✓	✓
I.2	Commercial and institutional buildings and facilities	✓	✓	✓
I.3	Manufacturing industries and construction	✓	✓	✓
I.4.1/2/3	Energy industries	✓	✓	✓
I.4.4	Energy generation supplied to the grid	✓		
I.5	Agriculture, forestry and fishing activities	✓	✓	✓
I.6	Non-specified sources	✓	✓	✓
I.7	Fugitive emissions - coal	✓		
I.8	Fugitive emissions from oil and natural gas systems	✓		
II	TRANSPORTATION			
II.1	On-road transportation	✓	✓	✓
II.2	Railways	✓	✓	✓
II.3	Waterborne navigation	✓	✓	✓
II.4	Aviation	✓	✓	✓
II.5	Off-road transportation	✓	✓	
III	WASTE			
III.1.1/2	Solid waste generated in the city	✓		✓
III.2.1/2	Biological waste generated in the city	✓		✓
III.3.1/2	Incinerated and burned waste generated in the city	✓		✓
III.4.1/2	Wastewater generated in the city	✓		✓
III.1.3	Solid waste generated outside the city	✓		
III.2.3	Biological waste generated outside the city	✓		
III.3.3	Incinerated and burned waste generated outside city	✓		
III.4.3	Wastewater generated outside the city	✓		
IV	INDUSTRIAL PROCESSES and PRODUCT USES			
IV.1	Emissions from industrial processes occurring in the city	✓		
IV.2	Emissions from product use occurring within the city	✓		
V	AGRICULTURE, FORESTRY and OTHER LAND USE			
V.1	Emissions from livestock	✓		
V.2	Emissions from land	✓		
V.3	Aggregate sources and non-CO2 emissions from land	✓		
VI	OTHER SCOPE 3			
VI.1	Other Scope 3			

✓ sources covered by GPC



sources required for BASIC reporting

+ sources required for BASIC+ reporting

additional scope 1 sources required for territorial reporting



other scope 3 sources

non-applicable emission sources

Global warming potential

A fixed amount of one greenhouse gas emitted to the atmosphere will have a greater or lesser warming impact on the planet than another greenhouse gas; this varying impact is known as its global warming potential (GWP). A GWP value is used to convert quantities of different greenhouse gases to a shared unit (carbon dioxide equivalent, CO₂e) that can then be directly compared, as expressed in the equation below. The GPC requires that all emissions are reported in tonnes of CO₂e.

$$\text{CO}_2\text{e} = \text{GHG} \times \text{GWP}$$

There are several different sets of GWP values, derived from different ‘Assessment Reports’ published by the Intergovernmental Panel on Climate Change (IPCC). For example, the “4AR” values are taken from the 4th Assessment Report, published in 2007. Over time, these values change to reflect the latest understanding of the science of climate change.

The GPC requires that cities use the most recent GWP values when converting their emissions to CO₂e. Earlier versions are permissible to use where the city’s inventory is required to be consistent with the National inventory, which may use an earlier set of GWP values. The GWP values from the different Assessment Reports are shown in Table 9.

Table 9: Global Warming Potential (GWP) values from the IPCC Assessment Reports

Greenhouse gas		IPCC Assessment Report			
Formula	Name	5AR	4AR	3AR	2AR
CO ₂	Carbon Dioxide	1	1	1	1
CH ₄	Methane	28	25	23	21
N ₂ O	Nitrous Oxide	265	298	296	310
SF ₆	Sulphur hexafluoride	23,500	22,800	22,200	23,900
CF ₄	Carbon tetrafluoride	6,630	7,390	5,700	6,500
C ₂ F ₆	Hexafluoroethane	11,100	12,200	11,900	9,200
CHF ₃	HFC-2	12,400	14,800	12,000	11,700
CH ₂ F ₂	HFC-32	677	675	550	650
CH ₃ F	HFC-41	116	92	97	150
C ₂ H ₅ F	HFC-125	3,170	3,500	3,400	2,800
C ₂ H ₂ F ₄	HFC-134	1,120	1,100	1,100	1,000
CH ₂ FCF ₃	HFC-134	1,300	1,430	1,300	1,300
C ₂ H ₃ F ₃	HFC-14	328	353	330	300
C ₂ H ₄ F ₃	HFC-143a	4,800	4,470	4,300	3,800
C ₂ H ₄ F ₂	HFC-152a	138	124	120	140
C ₃ HF ₇	HFC-227ea	3,350	3,220	3,500	2,900
C ₃ H ₂ F ₆	HFC-236fa	8,060	9,810	9,400	6,300
C ₃ H ₃ F ₅	HFC-245ca	716	1,030	950	560
NF ₃	Nitrogen trifluoride	16,100	17,200		

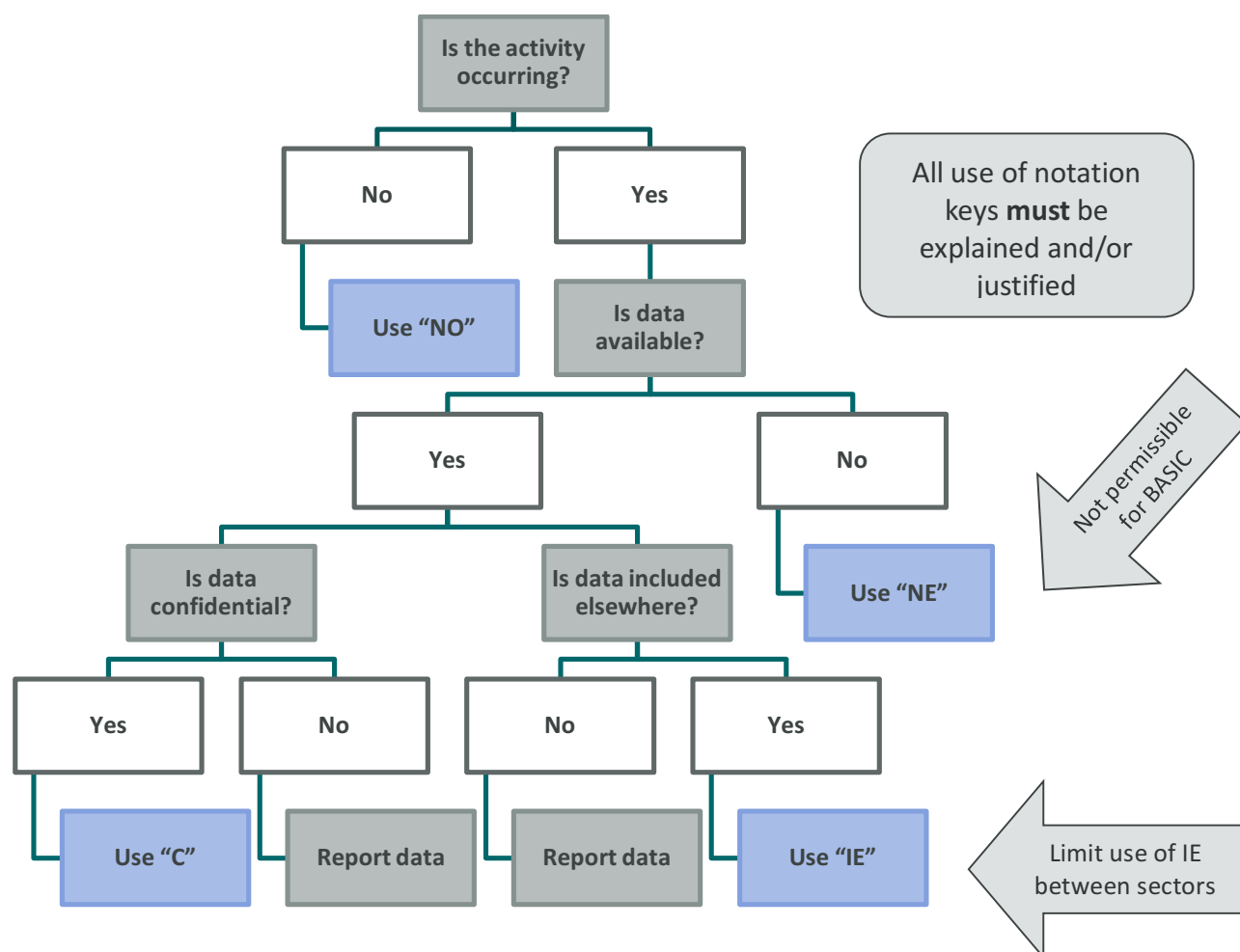
Notation keys

To accommodate limitations in data availability and differences in the presence or relevance of emission sources between cities, the GPC describes a set of notation keys, as recommended in IPCC Guidelines, to clearly communicate these situations. Where notation keys are used, cities shall provide an accompanying explanation to justify the use of the notation key. The notation keys are listed in Table 10. A decision tree to support their use is presented in Figure 8.

Table 10: Notation keys

Notation key	Definition	Description	Exemple explanatory note
NO	Not Occurring	An activity or process does not occur or exist within the city.	I.7.1 does not occur. No coal-related activities within the city boundary.
IE	Included Elsewhere	GHG emissions for this activity are estimated and presented in another category of the inventory. That category shall be noted in the explanation.	II.5.1 is reported in II.1.1. Fuel sales approach does not allow for disaggregation.
NE	Not Estimated	Emissions occur but have not been estimated or reported; justification for exclusion shall be noted in the explanation	III.4.3 has not been estimated. Activity not required for BASIC inventory.
C	Confidential	GHG emissions which could lead to the disclosure of confidential information and can therefore not be reported.	II.5.1 is confidential. Military base within city boundary.

Figure 8: Notation key decision tree



See section 2.2 in Chapter 2 of the GPC for city examples.

GHG Management System

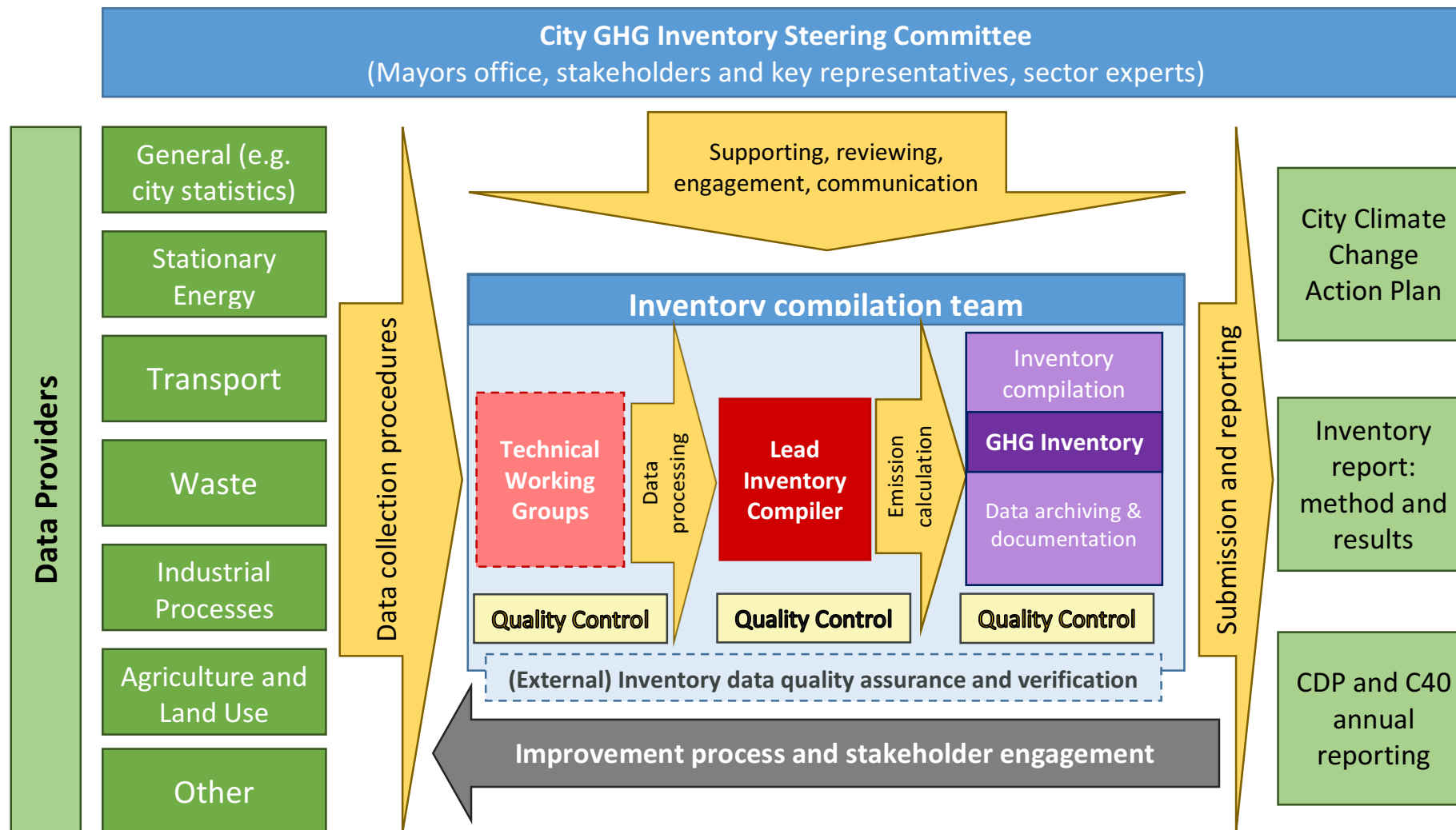
A management system can support the inventory process in at least the following ways:

- Providing a clearer understanding of roles and responsibilities and thus reducing confusion
- Having central storage, documentation and clear procedures and thus avoiding lost data
- Enabling easier tracking of inventory compilation process and improvements undertaken
- Enabling easier engagement, communication and reporting with management and other stakeholders
- Increase credibility of information

A comprehensive GHG management system is illustrated in Figure 9. It does not have to be this complex. Much of it is common sense and often already occurring and just needs to be clearly defined.

Use Figure 9 to understand your roles better and consider how it can be adapted for your city.

Figure 9. Illustration of a comprehensive city GHG management system



City Climate Planner Programme



The World Bank and global partners developed the City Climate Planner (CCP) Certificate Program; a training and professional certificate programme that aims to increase the global talent base of climate planning professionals. The first certificate is focused on GHG emission inventories.

The certificate is for individuals who help cities or communities develop and track GHG emissions at the local scale. The GPC is at the core of this certificate.

The CCP programme provides online training and support. Participants will need to take an exam that consists of 80 multiple choice questions to obtain the certificate. The certificate exam is the core component of the City Climate Planner Certificate Program. The exam was written and developed by experts in GHG emissions inventory accounting and is meant to rigorously test the knowledge of exam takers. Successful completion of the exam demonstrates expertise of the GHG inventory building process and its connection to city climate planning.

For more information, please email the team at cityclimateplanner@worldbank.org or visit the World Bank website at: www.worldbank.org/en/topic/climatechange/brief/city-climate-planner-certificate-program

Key links and further reading

Title	Description and link
GPC	More information about the GPC as well as the full GPC guidance document can be downloaded from the following links: www.c40.org/gpc www.ghgprotocol.org/city-accounting
City Inventory Reporting and Information System (CIRIS)	The City Inventory Reporting and Information System (CIRIS) is an accessible, easy-to-use and flexible Excel-based tool for managing and reporting city greenhouse gas inventory data. Based on the GPC, the tool facilitates transparent calculation and reporting of emissions for all sectors. CIRIS is free to download and use, and can be directly uploaded to public reporting platforms CDP and Carbons. www.c40.org/programmes/ciris
World Bank City Climate Planner Programme	www.worldbank.org/en/topic/climatechange/brief/city-climate-planner-certificate-program

Appendix - Exercises

This part of the workbook contains the activities and exercises that are included in the workshop to help you understand the GPC better, as listed below, and blank sheets to record your own notes if needed:

- *Activity:* Mapping city energy and waste systems
- *Activity:* Why compiling an emission inventory?
- *Exercise:* Sectors and sub-sectors
- *Exercise:* Scopes
- *Exercise:* Reporting level
- *Exercise:* Reporting framework
- *Exercise:* Notation keys
- *Exercise:* Data quality assessment
- *Exercise:* Reporting
- *Exercise:* Transportation methodologies
- *Exercise:* Waste or Energy?
- *Exercise:* GWP
- *Exercise:* Scaling factors

Activity: Mapping city energy and waste systems

Use the space below to record your notes (such as main emissions sources) from the activity

Activity: Why compile an emission inventory?

In small groups, design a 2 minute proposal to convince your Mayor to develop or update a GHG inventory using the GPC

City A	City B	City C
Will host large international climate conference next year	No GHG inventory and no emission reduction target	Most recent GHG inventory for 2010, not GPC compliant
Has not updated GHG inventory since 2008	Mayor has committed to the Compact of Mayors	Inventory showed much higher per capita emissions than neighbouring cities
Target to reduce emissions by 80% in 2050 from 2000 levels	Very vulnerable to climate change	Big tourist destination all year round
Does not have a climate action plan	Suffers from air pollution	Important industrial area

Exercise: Sectors and sub-sectors

Identify the correct sector for each of the emission sources in the table below

Emission source	Sector
Diesel used by buses	
Electricity used for street lighting	
Electricity consumption in schools	
Methane gas release from landfill	
Methane gas release from gas distribution network	
Kerosene used by helicopter ambulances	
Composting of organic waste	
Gas used for home cooking	

Exercise: Scopes

Identify the correct scope for each of the emission sources in the table below

Emission source	Scope
Diesel used by buses within the city	
Electricity used for street lighting within the city	
Electricity consumption in schools within the city	
Methane gas release from landfill outside the city	
Methane gas release from gas distribution network inside city	
Kerosene used by city helicopter ambulances outside the city	
Composting of organic waste within the city	
Gas used for home cooking within the city	

Exercise: Reporting level

Identify the correct reporting level (BASIC, BASIC+) for each of the emission sources in the table below

Emission source	Reporting level
Industrial processes in the city	
Wastewater generated inside city and treated outside city	
Scope 1 emissions from residential buildings in the city	
Scope 3 emissions from aviation serving the city	
Scope 3 emissions from disposal of solid waste	
Enteric fermentation by cows in the city	
Fugitive emissions from natural gas systems in the city	
Electric trains operating within the city	

Exercise: Reporting framework

Identify the correct reporting framework (city-induced, territorial, or both) for each emission source in the table below

Emission source	Reporting framework
Natural gas combustion for heating (scope 1) in residential buildings inside city	
Wastewater generated outside the city and treated inside city	
Electricity consumption in commercial buildings inside city	
Scope 3 emissions from aviation serving the city	
Solid waste generated inside city but treated outside city (Scope 3)	
Grid-connected electricity generation plants in the city	
Fugitive emissions from natural gas distribution systems in the city	
Electric trains operating within the city	

Exercise: Notation keys

Which notation key should be used for each of the examples in the table below?

Example		Notation key
III.1	None of the city's waste is sent to landfill	
II.2.2	The number of electric vehicles is very low	
V.1	Emissions from land are too difficult to calculate	
I.8	Fugitive emissions are too difficult to calculate	
I.2.2	Electricity use in commercial buildings cannot be disaggregated from data for residential buildings	
II.4.1	The only airport in the city is a military airport. They do not allow their activity data to be disclosed.	
II.5.1	Off-road transportation is included in on-road data	

Exercise: Data quality assessment

Assess the quality of each of the data sources in the table below as either High, Medium or Low

Data source	Data quality
National average fuel use per household	
Quantity of solid waste weighed at a transfer station	
Methane recovered from landfill based on system design	
National average solid waste generated per person	
National statistics agency data on electricity generation in city	
Number of buses based on published travel schedule	
Number of buses based on traffic count over two days	
Metered office energy use, disaggregated by tariff	

Exercise: Reporting

City A has submitted a BASIC inventory. You have been asked to review the inventory to make sure that it meets the requirements of the GPC.

Review the inventory report for City A. It contains ten mistakes. Identify them all, thinking about the following:

- Is all the required information reported?
- Has the inventory boundary been properly defined?
- Are all BASIC sources included?
- Have notation keys been used correctly?
- Does the information look accurate?

Exercise: Reporting (continued) - Inventory Report for City A

City Information

A. INVENTORY BOUNDARY (GPC table 4.1 page 40)

Boundary	Information	Map
Name of city	Pangea	
Country	Tethys	
Inventory year (if not calendar year, please specify the full 12-month period, e.g. 01 April 2014 - 31 March 2015)	01 January 2014 - 31 October 2014	
Geographic boundary (select from list of values)	Administrative boundary of a local government	
Land area (km ²) within city boundary	2455	
Resident population within city boundary	3837414	
GDP (US\$) of economic activity within city boundary	17454000000	

B. INVENTORY INFORMATION

Inventory	Information
GPC reporting level (select from list)	BASIC
Greenhouse gases included in inventory (select from list)	CO ₂ , CH ₄ , N ₂ O
Global Warming Potential (select relevant IPCC AR from list)	IPCC Second Assessment Report (1995) and IPCC Fourth Assessment Report (2007)
Description of overall methodology and tools used	Methodologies follow the IPCC 2006 Guidelines, Global Protocol for Community-scale GHG emission inventories and EMEP/EEA Emissions Inventory Guidebook

Exercise: Reporting (continued) - Inventory Report for City A

GPC GHG Summary Table

GPC ref No.	GHG Emissions Source (By Sector and Sub-sector)	Total GHGs (metric tonnes CO ₂ e)				
		Scope 1	Scope 2	Scope 3	BASIC	BASIC+
I	STATIONARY ENERGY					
I.1	Residential buildings	153,682	4,420,214	178,594	4,573,896	4,752,490
I.2	Commercial and institutional buildings and facilities	69,968	5,652,332	228,377	5,722,300	5,950,677
I.3	Manufacturing industries and construction	663,784	150,433,450	57,917	151,097,235	151,155,152
I.4.1/2/3	Energy industries	IE (I.3)	IE (I.3)	IE (I.3)		
I.4.4	Energy generation supplied to the grid	729,084			729,084	
I.5	Agriculture, forestry and fishing activities	23	209,157	8,451	209,179	217,630
I.6	Non-specified sources	NO	1,042,806	42,134	1,042,806	1,084,940
I.7	Fugitive emissions from mining/processing/storage/transportation of coal	NO				
I.8	Fugitive emissions from oil and natural gas systems	NE				
SUB-TOTAL	(city induced framework only)	887,457	161,757,959	515,473	163,374,500	14,160,889
II	TRANSPORTATION					
II.1	On-road transportation	5,743,301	NO	NE	5,743,301	5,743,301
II.2	Railways	459,154	I.E	4,127	459,154	463,281
II.3	Waterborne navigation	NO	NO	531,666		31,666
II.4	Aviation	NO	NO	740,102	740,102	740,102
II.5	Off-road transportation		NO	NO		
SUB-TOTAL	(city induced framework only)	6,202,455		1,275,895	6,942,557	7,478,350
III	WASTE					
III.1.1/2	Solid waste disposal of waste generated in the city	2,286,195		NO	2,286,195	2,286,195
III.2.1/2	Biological treatment of waste generated in the city	NO		NO		
III.3.1/2	Incinerated and burned waste generated in the city	NO		NO		
III.4.1/2	Wastewater generated in the city	NO		NO		
III.1.3	Solid waste generated outside the city	508,673				
III.2.3	Biological waste generated outside the city	NO				
III.3.3	Incinerated and burned waste generated outside city	NO				
III.4.3	Wastewater generated outside the city	NO				
SUB-TOTAL	(city induced framework only)	2,286,195			2,286,195	2,286,195
IV	INDUSTRIAL PROCESSES and PRODUCT USES					
IV.1	Emissions from industrial processes occurring in the city boundary	1,456,287				1,456,287
IV.2	Emissions from product use occurring within the city boundary	NE				
SUB-TOTAL	(city induced framework only)	1,456,287				1,456,287
V	AGRICULTURE, FORESTRY and OTHER LAND USE					
V.1	Emissions from livestock	NE				
V.2	Emissions from land	NE				
V.3	Emissions from aggregate sources and non-CO2 emission sources on land	NE				
SUB-TOTAL	(city induced framework only)					
VI	OTHER SCOPE 3					
VI.1	Other Scope 3			NE		
TOTAL	(city induced framework only)	10,832,394	161,757,959	1,791,368	172,603,252	25,381,722

Exercise: Transportation methodologies

Match the description to the correct transportation methodology

Description
Transport activities only by those who live in the city
All traffic occurring within the city boundary
Volume of fuel purchased within the city
All trips within the city and half of the trips that either start or end in the city

Transportation methodology
Fuel sales
City-induced activity
Geographic
Resident activity

Exercise: Waste or Energy?

Where should emissions from the following activities be reported?

Activity	Sector
Landfill gas used to generate electricity	
Open burning of waste	
Atmospheric releases of landfill gas	
Biogas from anaerobic digestion of waste used in vehicle fleet	
Flaring of landfill gas	
Incineration of waste with energy recovery	
Biomass used for cooking	

Exercise: GWP

Estimate emissions in CO₂e for the activities in the table below, using GWP values in the IPCC Assessment report indicated

Activity	GWP	CO ₂ e
100,000 tonnes of CH ₄	2AR	
100,000 tonnes of CH ₄	5AR	
40 tonnes of CH ₄ and 10 tonnes of N ₂ O	4AR	
10 tonnes of CH ₄ and 40 tonnes of N ₂ O	3AR	
1,000,000 tonnes of CO ₂	3AR	
2 tonnes of SF ₆	4AR	

Exercise: Scaling factors

Identify the most suitable proxy data for the following emission sources

Activity data
Emission from commercial air conditioning
Emissions from domestic refrigeration
Emissions from on-road transportation
Emissions steel production

Proxy data
Number of vehicles
GDP
Population
Floor area by building type

