

Note

Amsterdam, Copenhagen, Helsinki, Oslo and Stockholm

Carbon Capture and Storage in City-Based Carbon Accounting.

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1 Foreword

This Carbon Capture and Storage in City-Based CO₂ Accounting note is a part of a project on Carbon Capture Storage and Utilization (CCSU) from a city perspective. The project is funded by the Carbon Neutral City Alliance (CNCA) and is carried out in collaboration between five leading climate action cities, all members of the network; Amsterdam, Copenhagen, Helsinki, Oslo and Stockholm.

CNCA is a collaboration of leading global cities working to cut greenhouse gas emissions by 80-100% by 2050 or sooner — the most aggressive GHG reduction targets undertaken anywhere by any city. The network enhances knowledge sharing and encourage member cities to test and implement radical, transformative changes to core systems.

NIRAS has contributed to the project with the development of this note and additional another note and a report. In total 10 notes, a technical report and a fact sheet have been produced throughout 2019.

2 General introduction to national and city-based GHG emissions inventories.

Cities are responsible for more than 70 percent of global energy-related CO₂ emissions and therefore cities represent the single greatest challenge and opportunity for tackling climate change.

One of the first steps will be to have a proper inventory and accounting system that aligns city accounting with national accounts as reported to United Nations Framework Convention on Climate Change (UNFCCC). This is the basis for identifying and prioritizing potential measures of CO₂ emission reductions and for following the development of the CO₂ emission levels in the cities.

2.1 National GHG inventories and accounting systems

Under the UNFCCC, all Parties (countries) are required to periodically develop and submit national inventories of anthropogenic emissions by sources, and removals by sinks, of all greenhouse gases (GHGs) not controlled by the Montreal Protocol.

The Montreal Protocol is a global agreement to protect the stratospheric ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS) such as chlorofluorocarbons (CFCs) and halons.

The UNFCCC reporting guidelines on annual inventories requires to the convention each party included in Annex I (industrialized country), by 15 April each year, to provide its annual GHG inventory covering emissions and removals of direct GHGs from five sectors (energy; industrial processes and product use; agriculture; land use, land-use change and forestry; and waste).

The reporting will cover the period from the base year and until 2 years before the submission of the inventory report. It means, if a inventory report is due 15 April 2020 it covers emissions and removals for all years from the base year to 2018.¹

¹ <https://unfccc.int/process-and-meetings/transparency-and-reporting/reporting-and-review-under-the-convention/greenhouse-gas-inventories-annex-i-parties/reporting-requirements>

Under the UNFCCC reporting guidelines on annual inventories for Annex I Parties, inventory submissions are in two parts:

- Common reporting format (CRF) tables – a series of standardized data tables containing mainly quantitative information;
- National Inventory Report (NIR) – a report containing transparent and detailed information on the inventory. It should include descriptions of the methodologies used in the estimations (including references and sources of information), the data sources, the institutional arrangements for the preparation of the inventory (including quality assurance and control procedures), and recalculations and changes compared with the previous inventory.

Countries have appointed a focal point to UNFCCC and the focal point must submit the national inventory to UNFCCC. Often national research institutes or universities will be involved in the overall preparation of the inventory and the cities will feed into this process.

2.2 City-based GHG inventories and accounting system

During the last decades the inventory and accounting methods that cities have been using have varied significantly. This inconsistency makes comparisons between cities difficult, raises questions about data quality, and limits the ability to aggregate local, subnational, and national government GHG emissions data.

To allow for more credible and meaningful reporting, greater consistency in GHG accounting is required. The Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) responds to this challenge and offers a robust framework that builds on existing methodologies for calculating and reporting city-wide GHG emissions.² The GPC is the most commonly used reporting system for cities, and all reporting is done on a voluntary basis.

World Resources Institute, C40 Cities Climate Leadership Group and Local Governments for Sustainability (ICLEI) have partnered and created the GPC.

When preparing the inventory, the GHG emissions from city activities shall be classified into six main sectors: 1) Stationary energy, 2) Transportation, 3) Waste, 4) Industrial processes and product use (IPPU), 5) Agriculture, forestry, and other land use (AFOLU) and 6) Any other emissions occurring outside the geographic boundary as a result of city activities.

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 among them, the abovementioned GPC emissions groups can be presented in three categories based on where they occur: scope 1, scope 2 or scope 3 emissions. See the table below made by GPC.

² <https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities>

Scope	Definition
Scope 1	GHG emissions from sources located within the city boundary
Scope 2	GHG emissions occurring as a consequence of the use of grid-supplied electricity, heat, steam and/or cooling within the city boundary
Scope 3	All other GHG emissions that occur outside the city boundary as a result of activities taking place within the city boundary

As no formal system is in place for city inventories, and city accounting is still being developed, the cities must give attention to avoiding potential double counting through a close cooperation between the cities and national administrations. This is supported by the cities if they are reporting all three scopes, especially scope 3, as it is outside the geographical area of the city.

The GPC requires cities to report their emissions by gas, scope, sector and subsector, and to add up emissions using two distinct but complementary approaches:

- *Scopes framework*: This totals all emissions by scope 1, 2 and 3. Scope 1 allows for the separate accounting of all GHG emissions produced within the geographic boundary of the city, consistent with national-level GHG reporting.
- *City-induced framework*: This totals GHG emissions attributable to activities taking place within the geographic boundary of the city. It covers selected scope 1, 2 and 3 emission sources representing the key emitting sources occurring in almost all cities, and for which standardized methods are generally available.

The two approaches combined will contribute to the high quality of city inventory and accounting.

The city induced framework gives cities the option of selecting between two reporting levels: BASIC or BASIC+. The BASIC level covers scope 1 and scope 2 emissions from stationary energy and transportation, as well as scope 1 and scope 3 emissions from waste. BASIC+ involves data collection, calculation processes, and additionally includes emissions from IPPU and AFOLU and transboundary transportation. Therefore, where these sources are significant and relevant for a city. The sources covered in BASIC+ also align with sources required for national reporting in IPCC guidelines.

The GPC does not require that cities verify their inventory results, but recommends that cities choose the level and type of verification that meets their needs

and capacity. In case verification shall be done it should focus on completeness and accuracy.

3 Accounting principles and guidance in the GPC

3.1 Principles

Accounting and reporting for city-wide GHG emissions are based on five principles adapted from the GHG Protocol Corporate Standard³. The five principles are relevance, completeness, consistency, transparency and accuracy.

Relevance: The reported GHG emissions shall appropriately reflect emissions occurring as a result of activities and consumption patterns of the city.

Completeness: Cities shall account for all required emissions sources within the inventory boundary. Any exclusion of emission sources shall be justified and clearly explained.

Consistency: Emissions calculations shall be consistent in approach, boundary, and methodology. Using consistent methodologies for calculating GHG emissions enables meaningful documentation of emission changes over time, trend analysis, and comparisons between cities.⁴

Transparency: Activity data, emission sources, emission factors, and accounting methodologies require adequate documentation and disclosure to enable verification.

Accuracy: The calculation of GHG emissions shall not systematically overstate or understate actual GHG emissions. Accuracy should be sufficient enough to give decision makers and the public reasonable assurance of the integrity of the reported information.

The GPC is in line with the Paris Agreement where it is stated that countries shall when reporting promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting.

3.2 Guidance

Within the requirements of the GPC, a city will need to make important decisions in terms of setting the inventory boundary, choosing calculation methods, deciding whether to include additional scope 3 sources, etc. Tradeoffs between the five principles above may be required based on the objectives or needs of the city.

Tradeoffs between the five principles above may be required based on the possibilities, objectives or needs of the city. An illustrative example could be that a city is lacking data for instance in the transport sector and therefore the city will need to

³ GHG Protocol Corporate Standard, 2004

⁴ <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

finalise the inventory knowing this. The city can improve this in the following inventory reports. With this example both the accuracy and completeness of the GHG data will increase over time and thereby the tradeoffs between these accounting principles will likely diminish.

In all city the limitations in data availability will be an issue. Therefore, GPC requires the use of notation keys, as recommended in IPCC Guidelines. Where notation keys are used, cities shall provide an accompanying explanation to justify exclusions or partial accounting of GHG emission source categories. The most used notation keys are Included Elsewhere (IE), Not Estimated (NE), Not Occurring (NO) and confidential (C). This guidance helps a transparent reporting.

GPC does not require specific methodologies to be used to produce emissions data. Instead the focus has been to set-up data collection as presented below.

Data collection principles

Establish collection processes that lead to continuous improvement of the data sets used in the inventory (resource prioritization, planning, implementation, documentation, etc.)

Prioritize improvements on the collection of data needed to improve estimates of key categories which are the largest, have the greatest potential to change, or have the greatest uncertainty

Review data collection activities and methodological needs on a regular basis to guide progressive, and efficient, inventory improvement

Work with data suppliers to support consistent and continuing information flows

Cities should select or develop methodologies for estimating emissions that accurately represent the characteristics of their source categories. The GPC provides many default methods and calculation tools to help with this effort.

To manage inventory quality over time, cities should establish a management plan for the inventory process. The design of an inventory management plan should provide for the selection, application, and updating of inventory methodologies as new research becomes available, or the importance of inventory reporting is elevated.

4 Carbon Capture and Storage in the GPC accounting guidance

According to the GPC guidance the GHG emissions shall be reported for each sector and sub-sector. Emissions sequestered by carbon capture and storage (CCS) systems shall be excluded from emission totals for applicable sectors. However, cities may report these separately.

The guidance doesn't indicate how the separate reporting shall be done. The reporting of CCS is important in the inventory and accounting as it supports the 5 principles which the GPC is built on, especially completeness and accuracy.

CCS would show up in a GHG inventory as a reduction in CO₂ emissions. It means for instance if there previously were scope 1 emissions from facilities and these facilities are within the scope 1 boundary and with CCS these CO₂ emissions would be reduced. In this example there is no CO₂ removals and the storage of CO₂ should be reported separately.

The GHG Protocol has started preparing guidance on reporting requirements for CO₂ storage and it is recommended that the guidance should be used by GPC and the cities when it is finalised.

Through the UNFCCC it is possible to have CCS methodologies for instance under the UN approved carbon market, CDM, but it will require a specific methodology for CCS to be developed and approved.

In the GPC there are no requirements to specific methodologies to be used and therefore dependent on the type of CCS a methodology for calculation of stored CO₂ can be developed. It is recommended to follow UNFCCC guidance of how to develop methodologies.

The CCS is often on larger scale and can involve several cities and therefore attention should be given to a potential risk for double counting.

5 Biomass Energy with Carbon Capture and Storage (BECCS) in the GPC accounting

Bio-energy with carbon capture and storage (BECCS) is the process of extracting energy from biomass and capturing and storing the CO₂, thus removing it from the atmosphere. The main appeal and advantage of BECCS is in its ability to result in negative emissions of CO₂. The capture of carbon dioxide from bioenergy sources effectively removes CO₂ from the atmosphere.

According to the 2006 IPCC Guidelines for National Greenhouse Gases Inventories it is allowed to recognise the negative emissions from the BECCS.

Through both the "Australian Greenhouse and Energy Reporting Act (NGER)" and the Canada GHG Reporting Programme (Canada GHGRP) it is possible to report negative emission from the BECCS.

Through the UNFCCC it is possible to have BECCS methodologies for instance under the UN approved carbon market, CDM, but it will require a specific methodology for BECCS to be developed and approved.

Bioenergy will be reported differently in the GPC dependent on the activity and use. See the following table

Activity	Purpose	CO ₂	CH ₄ and N ₂ O
Landfill gas combustion	As part of waste disposal process	Report biogenic CO ₂ emissions under Waste sector (separately from any fossil CO ₂ emissions)	Report emissions under Waste sector
	Energy generation	Report biogenic CO ₂ under Stationary Energy sector (separately from any fossil CO ₂ emissions)	Report emissions under Stationary Energy sector
Waste incineration	Waste disposal (no energy recovery)	Report CO ₂ emissions under Waste sector (with biogenic CO ₂ reported separately from any fossil CO ₂ emissions)	Report emissions as Waste sector
	Energy generation	Report CO ₂ emissions under Stationary Energy sector (with biogenic CO ₂ reported separately from any fossil CO ₂ emissions)	Report emissions under Stationary Energy sector
Biomass incineration	Waste disposal	Report biogenic CO ₂ emissions under Waste sector (separately from any fossil CO ₂ emissions)	Report emissions under Waste sector
	Energy generation	Report biogenic CO ₂ emissions under Stationary Energy sector (separately from any fossil CO ₂ emissions)	Report emissions under Stationary Energy sector

Furthermore, having BECCS in the accounting will be in line with the five principles in the accounting – especially completeness and accuracy.

The reporting of BECCS would be similar to CCS, except that there would also be removals associated with it. Both CO₂ from removals and storage should be separately reported.

GHG Protocol has attention to BECCS and will in a forthcoming guidance elaborate on reporting requirements for carbon removals as well as storage. It is recommended that the guidance should be used by GPC and the cities.

6 Conclusion

The advantage of GPC is that many cities have already used the manuals and guidelines in the reporting and city reporting can also feed into the national reporting.

The GPC will have an inventory and reporting at the same high standard as under the Paris Agreement.

Both CCS and BECCS will contribute to GHG emission reductions and all reporting will support a more accurate and complete reporting which is in line with the GPC principles.

For CCS the CO₂ sequestered should be reported separately.

For BECCS the CO₂ from removals and storage should be separately reported.

GHG Protocol will soon be developing guidance and also standards on how companies/organizations should account for CO₂ removals and storage in GHG inventories, which will address CCS and BECCS. It is expected and recommended that GPC and cities can use the same new guidelines and standards.