GUIDANCE NOTE

Explanatory Note accompanying the
Global Covenant of Mayors
Common Reporting Framework

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Executive Summary

About the GCoM, the Common Reporting Framework (CRF) and this Guidance Note

The Global Covenant of Mayors for Climate & Energy (GCoM) is the world's largest coalition of cities and local governments[1] voluntarily committed to actively combatting climate change and with a shared long-term vision to moving to a low emission, climate resilient future. Local governments are committed to GCoM's pledge to implement policies and undertake measures to: (i) reduce/limit greenhouse gas emissions, (ii) prepare for the impacts of climate change, (iii) increase access to secure, affordable and sustainable energy and (iv) track progress toward these objectives.

To effectively reduce emissions, respond to current climate impacts and plan for the future, cities require data and information at the right geographical and temporal scales. The newly established GCoM Common Reporting Framework (CRF), formally endorsed by the GCoM Board in September 2018, introduces the first global reporting framework that will allow for cities across the world to use one standardised approach to sharing information on their climate activities. It guides GCoM cities in assessing their greenhouse gas emissions, climate change risks and vulnerabilities, as well as planning and reporting in an integrated and coherent way. This means the CRF is the reference document for GCoM signatories throughout all phases of engagement with the initiative. This will not only enable cities to identify and take the right actions in a timely manner, but it will also allow for better identification of shared challenges, greater cooperation and development of common responses to the impacts of climate change.

This Guidance Note accompanies the GCoM CRF with the purpose of explaining the framework and its applicability in more detail. It offers examples and references to help understand and correctly interpret all the requirements and recommendations laid out by the CRF. It aims to offer explanations and examples for cities, Regional Covenants and anyone who wants to interpret and apply the framework.

This Guidance Note is not a methodological guidebook and is understood as complementing the CRF, while not replacing available guidance materials which exist from various sources along all the steps of the GCoM initiative in the different regions. This document provides references to these extended resources and tools and explains how they can help cities in meeting the requirements of the CRF (please refer also to Annex 3 – Further guidance materials, tools and resources).

Regional Covenants are invited to translate this guidance note and adapt it to their regions, e.g., making references to regionally relevant frameworks and resources.

Guiding principle and reporting levels

The guiding principle embedded in the CRF and the GCoM initiative is that cities should strive as much as possible to report in a way that enables meaningful comparison and aggregation with their

[1] The terms "cities" and "local governments" are used throughout this document, understanding that the geo-political institutions of local governments may vary from country to country and terminology used may differ. In this document, a city refers to a geographical subnational jurisdiction ("territory") such as a community, a town or a city that is governed by a local government as the legal entity of public administration.

peers while ensuring robust monitoring of their progress at the local level. This also enables assessment of the collective impact of GCoM cities in the fight against climate change.

However, neither the CRF nor this Guidance Note prescribe specific templates, methodologies or tools. The CRF allows flexibility so it can be applied by cities and local governments in different regions and of all sizes, allowing to accommodate different local circumstances and needs.

The Common Reporting Framework defines three levels of reporting, reflecting the need for flexibility to meet specific local or regional circumstances while also allowing for global aggregation and comparison of data:

Level 1: Mandatory requirements
These provisions form the minimum set of requirements that a GCoM city has to meet under the three pillars of the initiative.[2]

Level 2: Recommendations
These provisions are considered good practice and therefore GCoM cities are strongly advised to follow these recommendations whenever possible.

Level 3: Additional options
These provisions refer to options that are acceptable under the initiative which a local government can decide to follow.

Main requirements and timelines outlined by the CRF

The CRF is designed for signatories of the GCoM in any region around the globe. It outlines the requirements and timeframes for each of the steps a city takes under the initiative, which are explained in more detail in this Guidance Note.

Error! Reference source not found. outlines which elements have to be covered by a **city-wide greenhouse gas (GHG) emissions inventory**. Signatories of the GCoM shall submit their city-wide GHG emissions inventory to GCoM **within two years** upon joining GCoM, using any of the formally recognized reporting platforms. Once the city has reached the monitoring phase, a more recent GHG emissions inventory shall be submitted **every two years** to GCoM.

The city-wide GHG emissions inventory **shall** report emissions occurring from different **sectors**, at minimum stationary energy, transportation and waste, as well as distinguish between direct and indirect emissions. At a minimum, the inventory shall quantify emissions of the following **gases**: carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O). The Guidance Note provides a detailed description of the sectors and guidance on how to calculate and report emissions from each sector and sub-sector.

To accommodate limitations in data availability and differences in emission sources between local governments, different **notation keys** may be used in absence of emissions data or if an emission

[2]Please note that the requirements for the 3rd pillar of the initiative – energy access – have not yet been defined. This Guidance Note will be updated with additional sections related to energy access once the reporting requirements on energy access have been formally endorsed as part of the Common Reporting Framework.

source category does not occur in the city. Where notation keys are used, an accompanying explanation shall be provided.

Error! Reference source not found. provides details on the aspects that have to be covered by a **city-wide Climate Risk and Vulnerability Assessment (CRVA)**. GCoM signatories shall prepare and submit a CRVA **within two years** after joining the initiative. The CRVA requires to identify the climate hazards faced by the local government, to estimate the future risk level (probability x consequence) and expected change in intensity and frequency due to climate change, and to assess what impacts can be expected from these hazards on all relevant sectors, assets or services.

Chapter 5 – Energy Access Assessment is under development.

Error! Reference source not found. explains which requirements must be met when setting **city-wide emissions reduction targets, adaptation/climate resilience goals and access to secure, affordable and sustainable energy goals**. Local governments shall submit their **city-wide greenhouse gas emissions reduction target(s)** to GCoM **within two years** upon joining GCoM. New targets should be reported when previously reported targets have expired or been revised. At a minimum, targets adopted by local governments shall be as ambitious as the unconditional components of the Nationally Determined Contribution (NDC). However, to demonstrate leadership, local governments are encouraged to set targets that are more ambitious. This Note provides further guidance on how to set a target boundary that is consistent with the boundary of the GHG emissions inventory, on setting the target timeframe and which of the four target types to choose when designing targets.

Adaptation goals should be formulated, equally **within two years**, based on the results of the climate risk and vulnerability assessment. The goal statement should include the baseline year as well as the delivery date.

Error! Reference source not found. summarizes which information has to be contained in **climate action plans**. Local governments that joined the GCoM are committed to taking concrete measures with long-term impact to tackle the interconnected challenges of climate change mitigation, adaptation and access to secure, affordable and sustainable energy. At the core of this commitment stands a formally adopted plan that captures the intentions and concrete policies and measures foreseen to (i) reduce/limit greenhouse gas emissions, (ii) prepare for the impacts of climate change and (iii) increase access to secure, affordable and sustainable energy in the community and within the boundaries of the local government. The local government can decide to adopt separate plans for each of the three pillars or to integrate the pillars into one plan. Alternatively, the three pillars can be mainstreamed into other plans developed and officially adopted by the local government, such as in the energy sector or in local development plans. GCoM signatories are required to present their plan(s) **within 3 years** from joining the initiative.

Next to the clearly stated mitigation target(s) and adaptation/climate resilience goal(s), including the baseline and delivery year(s), all actions of priority sectors must be included in the plan(s). For mitigation actions, an assessment of the expected energy savings, renewable energy production and GHG emissions reduction resulting from the implementation of each action, action area or sector must be provided.

Chapter 8 – GCoM monitoring and reporting provides an overview on what and how often cities have to **report** under the initiative. **Monitoring and progress reporting** are important cornerstones of the GCoM initiative. Once a GCoM signatory has completed the steps related to assessment, target/goal setting and planning, the city should regularly monitor progress in implementing the action plan(s) and toward achieving the targets and goals set. A robust monitoring system and timeline should be put in place from the beginning and be an integral part of the climate action plan(s) adopted by the city. While the monitoring of the implementation of the planned actions is done by each individual local government according to the locally applicable rules and the provisions included in the action plan(s), progress reporting to the GCoM is done **at least biannually** through one of the officially recognized reporting platforms.

Key city data under the GCoM, reported through any of the recognized reporting platforms, will be shared, consolidated and made publicly available through the GCoM website, and subsequently used for analysis and aggregation and shared with the UN's NAZCA platform.

Chapter 1 – Introduction

1.1 About the GCoM and the Common Reporting Framework

The Global Covenant of Mayors for Climate & Energy (GCoM) is the world's largest alliance of cities and local governments[3] voluntarily committed to actively combatting climate change and with a shared long-term vision of moving to a low emission, climate-resilient future. The GCoM has currently over 9260 signatories across 6 continents and more than 130 countries[4], representing more than 10% of the world's population. Local governments are committed to GCoM's pledge to implement policies and undertake measures to: (i) reduce/limit greenhouse gas emissions, (ii) prepare for the impacts of climate change, (iii) increase access to secure, affordable and sustainable energy and (iv) track progress toward these objectives.

GCoM cities are not only committed to taking bold local action but also to working side-by-side with peers around the world to share innovative solutions that enable mayors to do more, faster. GCoM cities connect and exchange knowledge and ideas, supported by relevant regional stakeholders.

To effectively reduce emissions and respond to current climate impacts and plan for the future, cities require data and information at the right geographical and temporal scales. The newly established Common Reporting Framework, will guide GCoM cities in assessing their greenhouse gas emissions, climate change risk and vulnerabilities, as well as planning and reporting in an integrated and coherent way. This will not only enable cities to identify and take the right actions in a timely manner, but it will also allow for better identification of shared challenges, greater cooperation and development of common responses to the impacts of climate change.

GCoM cities agree to make key data publicly available through the GCoM via regular reporting, which is needed to track overall progress in achieving the aims of the alliance. This information will make the case for accelerated support to cities by creating an evidence base for increased investment as well as unlocking access to financing necessary for low-carbon and climate-resilient urban and local development as well as for the energy transition. Showcasing climate and energy action leadership from cities is also instrumental in inspiring and driving stronger ambition at the national level.

Developed by multi-disciplinary experts among GCoM partners and in consultation with stakeholders, cities and local governments around the world, the CRF is the first global reporting framework that will allow for cities across the world to use a single, standardised approach to sharing information on climate activities. With this in mind, the framework accommodates current differences in measurement approaches and reporting practices and also ensures robust assessment, target setting, integrated climate action planning and monitoring, as well as streamlined reporting across all three pillars of the initiative – climate change mitigation, adaptation and access

[3] The terms "cities" and "local governments" are used throughout this document, understanding that the geo-political institutions of local governments may vary from country to country and terminology used may differ. In this document, a city refers to a geographical subnational jurisdiction ("territory") such as a community, a town or a city that is governed by a local government as the legal entity of public administration.
[4] As of January 2019

to secure, affordable and sustainable energy.[5] The CRF was formally endorsed by the GCoM Board in San Francisco in September 2018 and has been in effect since January 1, 2019. After a brief transition period, all official GCoM reporting platforms (see Chapter 8 for details) as well as procedures for validation and checking against GCoM minimum requirements[6] will align to this new framework.

The CRF is designed for signatories of the GCoM in any region around the globe and serves as a reference document for GCoM signatories as they navigate through all milestones.[7] It outlines the requirements and timeframes for each of the steps a city takes under the initiative. It specifies:

1) which elements have to be covered by a **city-wide GHG emissions inventory** (see **Error! Reference source not found.** for further details)
2) which aspects have to be covered by a **city-wide Climate Risk and Vulnerability Assessment** (see **Error! Reference source not found.** for further details)
3) which requirements have to be met when setting **city-wide emissions reduction targets, adaptation/climate resilience goals and access to secure, affordable and sustainable energy goals** (see **Error! Reference source not found.** for further details)
4) which information has to be contained in **climate action plans** (covering the 3 GCoM pillars, i.e. mitigation, adaptation, energy access) adopted by GCoM cities (see **Error! Reference source not found.** for further details)
5) and what and how often cities have to **report** under the initiative (see Chapter 8 – GCoM monitoring and reporting for further details)

1.2 About this Guidance Note

This Guidance Note accompanies the GCoM Common Reporting Framework with the purpose of explaining the framework and its applicability in more detail. It offers examples and references to help understand and correctly interpret all the requirements and recommendations laid out by the CRF. It also provides explanations and examples for cities, regional covenants or anyone who wants to interpret and apply the framework.

This Guidance Note is not a methodological guidebook and is understood as complementing the CRF, while not replacing available guidance materials which exist from various sources along all the steps of the GCoM initiative in the different regions. This document provides reference to these extended resources and tools and how they can help cities in meeting the requirements of the CRF (please refer also to **Annex 3 – Further guidance materials, tools and resources**).

Regional Covenants are invited to translate this guidance note and adapt it to their regions, e.g., making reference to regionally relevant frameworks and resources.

[5]Please note that the energy access pillar of the Common Reporting Framework is currently being defined. The present guidance document will be complemented with supplementary information on energy access as soon as the updated framework has been endorsed.
[6] Further information on the GCoM validation process will follow later in 2019 and will be published separately.
[7] Together with other Regional Covenant guidance materials (as applicable).

1.3 About the Regional Covenants

Regional and National Covenants already exist or are being developed with the aim of supporting cities and local governments in different regions all around the world, operating under the shared vision of the GCoM and principles and methods that best suit each region.

A Regional/National Covenant consists of all relevant local, regional and national partners and city networks that support and contribute to the implementation of the mission and vision of the Global Covenant of Mayors for Climate & Energy in a given geographic area. Regional/National Covenants tailor the GCoM to regional realities, ensuring effective implementation in line with regional or national priorities.

The Common Reporting Framework was developed with the intention to be flexible in meeting specific local or regional circumstances while also allowing for global aggregation and comparison of data. It has been designed in consideration of local governments' needs and provides a step-wise approach to meeting GCoM commitments. The CRF is built upon already existing and broadly used frameworks for reporting on climate change, especially those developed under the former Compact of Mayors and Covenant of Mayors initiatives.

Chapter 2 – Definitions and General Principles

The terms “cities” and “local governments” are used throughout this document, understanding that the geo-political institutions of local governments may vary from country to country and terminology used may differ. In this document, a city refers to a geographical subnational jurisdiction (“territory”) such as a community, a town or a city that is governed by a local government as the legal entity of public administration. The term “city boundary” refers to a local government’s administration boundary.

The terminology and majority of definitions used in the CRF follow those used in the IPCC Fifth Assessment Report (AR5).[8]

The guiding principle embedded in the Common Reporting Framework (CRF) and the GCoM initiative is that cities should strive as much as possible to report in a way that enables meaningful comparison and aggregation with their peers while ensuring robust monitoring of their progress at the local level. This also enables assessing the collective impact of GCoM cities in the fight against climate change.

The Common Reporting Framework defines three levels of reporting:

Level 1: Mandatory requirements

These provisions form the minimum set of set of requirements that a GCoM city has to meet under the three pillars of the initiative.[9] In the CRF these requirements are introduced by the term “shall.”

Level 2: Recommendations

These provisions are considered good practice and therefore GCoM cities are strongly advised to follow these recommendations whenever possible. They are however not mandatory and a GCoM city is still considered as having met the requirements of the initiative even if not being able to follow these recommendations. In the CRF these recommendations are introduced by the term “should.”

Level 3: Additional options

These provisions refer to options that are acceptable under the initiative and that a local government can decide to follow. These options are introduced by the term “may.” In some cases, choosing these options can mean that a city needs to consent to GCoM making certain recalculations in order to ensure continued comparability and coherence of data reported under the global alliance.

These three reporting levels reflect the **need for flexibility** to meet specific local or regional circumstances while also allowing for global aggregation and comparison of data.

[8] https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_Glossary.pdf

[9] Please note that the requirements for the 3rd pillar of the initiative – energy access – have not yet been defined. This Guidance Note will be updated with additional sections related to energy access once the reporting requirements on energy access have been formally endorsed as part of the Common Reporting Framework.

The greenhouse gas emissions inventories and sectors covered, the identification of climate hazards, risks and the assessment of vulnerabilities should be relevant to the city, its geographic location, socio-economic and demographic profile, etc. Similarly, target(s) and goal(s) of the climate action plans should be relevant to the local and regional situation, reflecting the specific activities, capacity and regulatory context of the local government.

The Common Reporting Framework allows flexibility so it can be applied by cities and local governments in different regions and of all sizes, allowing to accommodate different local circumstances and needs, such as: (i) the use of different methodologies under the IPCC framework or as prescribed by national regulations or practices, (ii) varied access to necessary and quality data, (iii) different levels of capacity and available resources and (iv) differentiated relevance of recommended elements of the framework in different geographical locations.

Local governments can decide to develop either GHG emission inventories, climate risk and vulnerability assessments, targets and action plans (covering mitigation, adaptation or both), or all of the above jointly with neighbouring GCoM community(ies) (please see chapters 3, 6 and 7 for further details). In this context, it is important that each of the communities have formally endorsed joining the GCoM and it remains a requirement that the climate action plans are adopted by each municipal council individually, according to local government's formal procedure. The reporting platforms will be able to accommodate reporting from signatories that follow this joint/grouped approach.

Chapter 3 – Greenhouse Gas Emissions Inventories

A city-wide greenhouse gas (GHG) emissions inventory quantifies the amount of GHG emissions occurring due to activities in the community in a given year. It enables local governments to understand the emissions contribution of different activities, determine where to best direct mitigation efforts, create strategies to reduce GHG emissions and track their progress.[10]

Signatories of the GCoM **shall** submit their city-wide GHG emissions inventory to GCoM[11] within two years upon joining GCoM, using any of the formally recognized reporting platforms (please see chapter 8 for further details). Once the city has reached the monitoring phase (i.e. after having submitted the climate action plan(s)), every two years a more recent greenhouse gas emissions inventory **shall** be submitted to GCoM.[12]

The following GHG reporting guidance elaborates on the requirements that must be followed, as well as provides advice and recommendations for good practice.

3.1. GHG Emissions accounting principles

In addition to the general reporting principles mentioned in section 2.2 above, local governments **shall** follow the GHG emissions accounting principles outlined below:

- The inventory **shall** be relevant to the local and regional (where relevant) situation. This means it needs to reflect the specific activities and policy-making needs of the city and take into account the city's capacity and regulatory context.
- Local governments **shall** consider all categories of emission sources outlined in this guidance and report all emissions that are significant[13] and applicable in their local context. The exclusion of emission sources **shall** be disclosed and justified, using the appropriate notation keys set out in this guidance (see Section 3.4).
- Local governments **shall** compile GHG emissions inventories on a regular basis (at least every two years), to enable monitoring of the impact of climate actions, also to support continuous improvement in data quality and accuracy of the inventories.
- Local governments **shall** ensure sufficient accuracy to give local decision makers and the public reasonable assurance of the integrity of emissions reported. Efforts **shall** be made to reduce uncertainties and make improvements over time.
- To the extent possible, all relevant activity data[14], data sources, methodologies, assumptions, exclusions and deviations **shall** be documented and reported. Such transparency is important to

[10] In this guidance, the term "local government" is used to refer any geographically identifiable sub-national entity including a ward or borough, a combination of administrative divisions, town, city or metropolitan area.
[11] Inventory should be submitted to the GCoM secretariat where a Regional or National Covenant does not exist.
[12] Some cities may find that certain data sources used in the inventory are updated on a less frequent basis. In such circumstances, it is recommended that cities make best estimates possible from the available data.
[13] See Section 3.3 of the guidance for definition of insignificance.
[14] Activity data is a quantitative measure of a level of activity that results in GHG emissions taking place during a given period of time. See Section 3.5.1 of the guidance for more details.

allow for review, replication of good practice to support consistent inventories over time and tackling challenges identified.

The above principles are applicable throughout the inventory development and reporting process, from determining the inventory boundary and selecting calculation methods, to identifying data and preparing inventory reports. These principles are reflected throughout this guidance.

3.2. Defining the inventory boundary

Local governments **shall** define the inventory boundary and record this in the inventory documentation. This includes:

(1) Geographic boundary

This is the spatial dimension or physical perimeter of the local government's administrative boundary. Local governments **shall** provide a map that depicts the boundary and provide important context, including at least the population. It is recommended to report other useful city context such as GDP, type of climate, heating/cooling degree days, where available, to enable meaningful comparisons over time and between local governments.

(2) Inventory year

The inventory **shall** cover a consecutive period of 12 months, ideally aligning to either a calendar year, or a financial reporting year commonly used by the local government. This 12-month period is called the inventory year and **shall** be specified in the inventory.

(3) Types of greenhouse gases (GHGs)

At a minimum, the inventory **shall** quantify emissions of the following gases: carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).[15] All GHG emissions data **should** be reported as metric tonnes of each gas, and/or metric tonnes of CO_2 equivalent (CO_2e).[16]

In all cases, the Global Warming Potential (GWP) values that are used to convert GHGs other than CO_2 to CO_2e **shall** be clearly identified. Local governments **should** use the 100-year[17] GWP values provided in the IPCC Assessment Reports (AR).

Local governments **should** also use GWPs from the latest version of the IPCC AR or the version used in the country's reporting to the UNFCCC. Where values from other versions of AR are used, this **should** be justified.

Each GHG **should** be reported individually where possible but may be reported in aggregated form (as Total CO_2e) if it is not possible to disaggregate.

[15] When reporting emissions from the IPPU sector, the inventory should also include hydro fluoro carbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3).

[16] CO_2 equivalent (CO_2e) can be determined by multiplying each gas by its respective global warming potential (GWP). The IPCC Assessment Report used for the GWP factors should be clearly referenced (i.e. FAR; SAR; TAR; AR4; AR5).

[17] Cities who wish to use other GWP values of other timeframes for their own reporting may produce a separate inventory which does not need to be reported to GCoM. In such case, cities are recommended to disclose the discrepancy between the results of the two inventories in their own reporting to avoid confusion.

Local governments **may** report CO_2 emissions from biogenic carbon[18], as long as they are categorised separately and not counted in emissions totals. Where an activity produces both biogenic and non-biogenic CO_2 emissions, the two **shall** be reported separately. For example, biogenic CO_2 emissions released from combustion of gasoline blended with ethanol should be calculated on basis of the ethanol content in the blend fuel and reported separately from non-biogenic CO_2 emissions calculated based on the gasoline content.

3.3 Identifying emission sources

The city-wide GHG emissions inventory **shall** report emissions occurring from different sectors as well as distinguish between direct and indirect emissions. This is aligned with the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, as well as some other commonly used GHG accounting and reporting frameworks (see Annex 1 for comparison of emission sources categories between these and the GCoM framework).

(1) Sector and sub-sectors

Local governments **shall** distinguish emissions from different sectors and sub-sectors as categorised in

[18]Biogenic carbon emissions are those that result from the combustion of biomass material such as wood, bio-waste, biofuels, etc.

Table , in order to identify the most significant opportunity areas for mitigating emissions. The following labels are used in the table to indicate whether a sector/sub-sector shall be included in the inventory:

- Required **shall** be reported, unless not applicable or considered insignificant in the city (in which case notation keys can be used – see section 3.4 for more details). These are coloured in green in the table.
- Optional: **may** be reported and is highly recommended to be reported if it is significant (see Box 1 for how to determine if emissions are insignificant). These are coloured in blue in the table.

Detailed description of the sub-sectors and guidance on how to calculate and report emissions from each sector and sub-sector are provided in Section 25.

It is good practice to further disaggregate emissions in a sub-sector into more specific categories. For example, identifying emissions associated with specific types of buildings, facilities, industries, vehicles, etc. Detailed, disaggregated data helps local governments identify emissions hotspots more precisely and design more specific mitigation actions.

Box 1. Insignificant emission sources – definition and reporting requirements

An emission source can be considered insignificant if the size of emissions is smaller than any other sub-sector that shall be reported.

In addition, the combined emissions from all sources that are considered insignificant **should** not exceed 5% of total emissions that shall be reported. For example, if all the emissions sources that shall be reported amount to one million tonnes of CO2e, the total emissions of all insignificant sources cannot exceed 5% of that, i.e. 50,000 tonnes of CO2e.

Local governments need to make a crude estimate of such emissions in order to determine if it is insignificant. For example, if the only waterborne activities that start and end within the city boundary are sightseeing cruises, to make a crude estimate of emissions from fuel oil used by the ferries, the local government may calculate the number of trips made per year based on the cruise timetable and estimate the average fuel consumption per trip.

(2) Direct and indirect emissions

To avoid double counting between local governments within the same region, the inventory **shall** distinguish and report the following types of emissions based on where they physically occur:

- **Direct emissions** due to fuel combustion in the buildings, equipment/facilities and transportation sectors within the city boundary. These emissions physically occur inside the city boundary.[19]
- **Other direct emissions** that are not related to fuel combustion, including: fugitive emissions from disposal and treatment of waste (including wastewater) generated within the city

[19]These are often referred to as Scope 1 emissions in some other commonly used GHG inventory standards.

boundary, which may occur inside or outside the city boundary[20], and; fugitive emissions from natural gas distribution systems (such as equipment or pipeline leaks).

- **Indirect emissions** due to consumption of grid-supplied energy (electricity, heat or cold) within the geographic boundary.[21] Depending on where energy is generated, these emissions may physically occur inside or outside the city boundary.

Cities **shall** quantify emissions in the three categories above for all the sectors and sub-sectors that are marked as "Yes" as highlighted in green cells in

[20] Emissions occurring outside the city boundary as a result of city activities, such as emissions from waste generated by the city but treated outside the city boundary, are often referred to as Scope 3 emissions in some other commonly used GHG inventory standards.
[21] These are often referred to as Scope 2 emissions in some other commonly used GHG inventory standards.

Table . This is referred to as the **mandatory reporting level** in this guidance.

Separately, cities **shall** also report emissions from the generation of grid-supplied energy that occurs inside the city's boundary, or outside the city boundary but from facilities that are fully or partially owned by the local government. However, as these emissions will have already been accounted for through the emission factor for grid-supplied energy that is reported under indirect emissions, they shall be excluded from direct emissions and not accounted for in the total emissions. See section 3.7 for further guidance on reporting emissions from generation of grid-supplied energy.

In addition, local governments **may** also report other emissions that occur outside the boundary as a result of activities taking place inside the boundary. Examples include transmission and distribution (T&D) losses of grid-supplied energy consumed within the boundary[22], out of boundary proportion of transboundary transport activities, upstream activities in the production process of fuel and products consumed within the boundary. These emissions, if reported, **shall** be clearly described and do not form part of the GHG emissions inventory total at the mandatory reporting level.

3.4 Using notation keys

To accommodate limitations in data availability and differences in emission sources between local governments, the following notation keys **may** be used in the GHG emissions inventories in absence of emissions data or if an emission source category does not occur in the city. Where notation keys are used, an accompanying explanation **shall** be provided.

- **"NO"** (not occurring): An activity or process does not occur or exist within the city. This notation key may also be used for insignificant sources (see Box 1 for definition).

  For example, NO may be used for the Aviation sub-sector if there are no aviation activities that both start and end within the city boundary. This reason should be stated in the inventory as an explanation for the use of the notation key.

  Another example of the use of NO, is a city that determines that emissions from waterborne transportation within the city boundary are insignificant. The notation key NO can be used, as long as it is explained why it is considered insignificant.

- **"IE"** (included elsewhere): GHG emissions for this activity are estimated and presented in another category in the same inventory, stating what that category is. This notation key may be used where it is difficult to disaggregate data into multiple sub-sectors.

  This notation key can also be used when waste is used for generating energy. In these circumstances IE can be used in the relevant waste sub-sector (See section 3.6.3 for more details).

- **"C"** (confidential): GHG emissions which could lead to the disclosure of confidential information, and as such are not reported publicly. For instance, certain military operations or industrial facilities may not permit public data disclosure where this impacts security.

[22] In some cases, the electricity grid emission factors already include the T&D losses. If it is not possible to disaggregate, cities may report T&D losses as part of the emissions associated with grid electricity consumption, and clearly describe this.

- **“NE”** (not estimated): GHG emissions occur but have not been estimated or reported, with a justification why. NE cannot be used for emission sources that are required by the mandatory reporting level (see Table 1). Use of NE **should** also be minimised for non-mandatory emission sources by exploring methodologies and data sources to make best estimates.

Notation keys can be applied at the sub-sector level (i.e. for an entire emission source category), or at activity/facility level (i.e. for a specific emission source).

Cities **should** make efforts to obtain/estimate and report data where possible, and only use notation keys as a last resort. For example, it might be possible to obtain confidential data through confidentiality agreements with providers, and such data may be reported in an aggregated form with other emission sources, or cities may report emissions without disclosing information on the type or level of activities.

Table 1. GCoM categorisation of emission sources

Sectors and sub-sectors	Included?		Note	IPCC ref. no.
	Direct emissions	Indirect emissions		
Stationary energy				
Residential buildings	Required	Required	This covers emissions from fuel combustion and use of grid-supplied energy by buildings, equipment and facilities within city boundary (including transportation and waste facilities), as well as fugitive emissions from production, transformation and distribution of fuels. Emissions from sources covered by a regional or national emissions trading system **should** be identified and described. See section 3.6.1 for detailed guidance and requirements.	1A4b
Commercial building and facilities	Required	Required		1A4a
Institutional buildings and facilities	Required	Required		1A4a
Industrial buildings and facilities	Required	Required		1A1, 1A2
Agriculture	Required	Required		1A4c
Fugitive emissions	Required			1B1, 1B2
Transportation				
On-road	Required	Required	This covers emissions from fuel combustion and use of grid-supplied energy for all modes of transportation activities within city boundary (for waterborne and aviation, cities only need to report journeys fully confined within the city boundary). On-road and rail travel **should** additionally be disaggregated by municipal fleet, public transport, private and commercial transport. See section 3.6.2 for detailed guidance and requirements.	1A3b
Rail	Required	Required		1A3c
Waterborne navigation	Required	Required		1A3d
Aviation	Required	Required		1A3a
Off-road	Required	Required		1A3e
Waste				
Solid waste disposal	Required		This covers non-energy related emissions from disposal and treatment of waste (incl. wastewater) generated within the city boundary, as a result of aerobic or anaerobic decomposition of waste, or incineration. Emissions from waste-to-energy, where waste/wastewater material is used directly as fuel or converted into a fuel, should captured under the Stationary Energy sector. See section 3.6.3 for detailed guidance and requirements.	4A
Biological treatment	Required			4B
Incineration and open burning	Required			4C
Wastewater treatment and discharge	Required			4D
Industrial Process and Product Use (IPPU)				
Industrial Process	Optional		This covers non-energy related emissions from industrial processes, the use of certain products and non-energy use of fossil fuels. See section 3.6.4 for detailed guidance and requirements.	2A, 2B, 2C, 2E
Product Use	Optional			2D, 2F, 2G, 2H

Agriculture, Forestry and Other Land Use (AFOLU)				
Livestock	Optional		This covers non-energy related emissions produced in the digestive processes of livestock and emissions/removals as a result of land use and management. See section 3.6.5 for detailed guidance and requirements.	3A
Land use	Optional			3B
Other AFOLU	Optional			3C, 3D
Energy Generation				
Electricity-only generation	Required		This means disclosure of information on activity and emissions specifically related to energy generation within the city boundary or outside the boundary but can be controlled or influenced by the city. It is for information only and not added to the total emissions.	1A1
CHP generation	Required			
Heat/cold generation	Required			
Local renewable generation	Optional	Optional		

3.5 Calculating and reporting emissions – overview

For some activities, local governments may be able to use direct measurements of GHG emissions (e.g., through use of continuous emissions monitoring systems at power stations). However, for most emission sources, local governments will need to estimate GHG emissions by multiplying activity data by an appropriate emission factor:

GHG emissions = Activity data x Emission factor

Activity data is a quantitative measure of a level of activity that results in GHG emissions taking place during the inventory year. Examples of activity data are:

- amount of natural gas used for space heating in residential buildings, measured in MWh
- distance travelled by private car journeys, measured in vehicle kilometres travelled (VKM)
- amount of waste sent to landfill, measured in tonnes

Emission factors are coefficients which quantify the emissions associated with each unit of activity, for example:

- amount of CO_2 emitted per litre of petrol combusted
- amount of CH_4 emitted per tonne of waste sent to landfill

Emission reductions can be achieved by reducing activity level, increasing fuel efficiency, switching fuels or a combination of above. Therefore, to better inform mitigation strategies and track impacts of actions, local governments **shall** also report activity data and emission factors, disaggregated by activity and/or fuel type, in addition to GHG emissions data.

3.5.1 Sourcing data

It is good practice to start data collection activities with an initial screening of available data sources. This will be an iterative process to improve the quality of data used and should be driven by two primary considerations:

- Data should be from reliable and robust sources
- Data should be time- and geographically-specific to the inventory boundary, and technology-specific to the activity being measured. In general, local specific data should be sought and used before considering using national or international data.

Data can be gathered from a variety of sources, including government departments and statistics agencies, utility companies and service providers, a country's national GHG inventory report, universities and research institutes, scientific and technical articles in environmental books, journals and reports and sector experts/stakeholder organisations. Sometimes it may be necessary to generate new data if the required data does not exist or cannot be estimated from existing sources. This could involve physical measurement, sampling activities or surveys.

(1) Activity data

Local governments should aim to obtain the following types of data, categorised by the approaches in which data are generated (listed from most preferred to least preferred). Examples are provided for the stationary energy and waste sectors, but the principles apply to other sectors:

- **Real activity data disaggregated by sub-sector.** For example, the amount of energy consumption monitored at the point of use or sale, or amount of waste at the point of disposal or treatment. This should ideally be obtained from utility or fuel providers.
- **A representative sample set of real activity data from surveys.** For example, surveying buildings for fuel consumption.
- **Modelled data.** For example, determine energy intensity, by building and/or facility type, expressed as energy used per square meter (e.g., GJ/m2/year) or per unit of output, in order to calculate energy consumption of the relevant sub-sector.
- **Incomplete or aggregate real activity data:** For example, if fuel consumption data by sub-sector are unavailable, but data are available for total emissions from stationary sources within the city, apportion by total built space for each sub-sector or building type. If data are only available for a few of the total number of fuel suppliers, determine the population (or other indicators such as industrial output, floor space, etc.) served by real data to scale-up the partial data for total city-wide energy consumption.
- **Regional or national fuel consumption data scaled down using population or other indicators.** Where the best available data do not align with the geographical boundary or time period of the inventory, the data can be adapted to meet the inventory boundary by adjusting for changes in activity using a scaling factor. The scaling factor represents the ratio between the available data and the required inventory data and should reflect a high degree of correlation to variations in the data. For example, population is a commonly used scaling factor for household waste data, as expressed in the equation below:

$$Activity\ data\ = \frac{City\ population}{National\ population} * Activity\ data\ at\ national\ level$$

  When scaling regional or national data, cities should consider whether it represents an appropriate estimate of the local situation and make local adjustment where necessary. For example, the amount of waste generated per capita in a city may be higher than that at national level.

(2) Emission factors

When reporting emission factors, local governments **shall** also disclose which of the following two types of emission factors are used in their inventories:

- Activity-based emission factors, also referred to as IPCC emission factors.[23] They are based on the carbon content of relevant fuel and account for emissions resulting from the final

[23]Note this is different from default emission factors from IPCC. Activity-based emission factors developed at the local/regional/national level can also be called IPCC emission factors, and they should be used instead of default emission factors from IPCC.

combustion of the fuel. This is the recommended type of emission factors that local governments **should** use.

- Life-Cycle Analysis (LCA)-based emission factors, which not only include the emissions of the final combustion, but also all emissions resulting from all stages of the supply chain such as extraction, transport and processing of the fuel. Local governments **may** use LCA emission factors where it is required for reporting at the national level or allowed in reporting tools recognised by national governments; in this case, they **shall** also consent to GCoM recalculating and reporting their inventory using standard activity-based emission factors to enable comparison and aggregation across local governments.

Special notes on emission factors for grid-supplied electricity:

Like other data in the inventory, the grid emission factors **should** be time-specific to the inventory year, and geographically-specific to the inventory boundary.

Local governments **shall** use electricity grid emission factors that are based on a location-based approach, i.e. the average electricity generation emission factors that represent the electricity produced in the defined location (e.g., the area covered by a local, regional, national or supranational grid). Furthermore, local governments **shall** specify whether the grid emission factor is locally estimated and accounts for local production of renewable electricity, or whether it covers a regional, national or supranational grid.

Local governments that are part of the European Covenant of Mayors and following the European Covenant of Mayors reporting framework **may** use emission factors based on the EU Covenant methodology for accounting indirect emissions, which takes into account location and market-based methods, as well as tracking instruments, like guarantees of origins, renewable energy certificates by city customers.[24] Further guidance for calculating local emission factors for electricity is available in the Emission Inventory Guidance from the European Covenant of Mayors.[25] Where local governments choose to use the European Covenant methodology for determining grid emission factors, they **shall** also report the location-based (national or regional) grid emission factor and report the associated energy-related emissions.

3.5.2 Reporting data sources and methodologies

Local governments **shall** document and adequately report the methodologies used to calculate or measure emissions, including key assumptions and information on tools used. This also includes reporting the sources of all activity data, emission factors and emissions data that are reported, including full references. Web links should be provided if available.

[24] In some cities, energy suppliers or utilities can provide consumers with emission factors for either their standard portfolio or for any low-carbon or renewable energy consumer labels, tariffs or other programs. The market-based method reflects contractual relationships between energy suppliers and customers, but not necessarily the carbon intensity of the actual grid serving the customers. See more information about location-based vs. market-based methods in the GHG Protocol Scope 2 Guidance at https://ghgprotocol.org/scope_2_guidance

[25] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC112986/jrc112986_kj-nb-29412-en-n.pdf pg. 53-55

3.6 Calculating and reporting emissions – by source

This section provides more detailed guidance on how to collect data and calculate emissions for each sector, including further definitions and reporting guidance.

3.6.1 Stationary energy

This sector refers to energy used in buildings and facilities. It is one of the largest contributors to GHG emissions in cities. Emissions **shall** be disaggregated by different types of buildings and facilities, as per the sub-sectors defined in the table below. Emissions can be estimated by multiplying energy consumption (activity data) by the corresponding emission factors for each energy type, by gas and by sub-sector.

Table 2. Definitions for sub-sectors under the Stationary Energy sector

Sub-sectors	Description
Residential buildings	Emissions from energy use (i.e. fuel combustion and use of grid-supplied energy) in buildings that are primarily used as residential buildings. Energy uses include cooking, heating/cooling, lighting, appliances, etc. Cities **may** further categorise this sub-sector by different types of buildings (by tenure or age, for example). Informal residential settlements and social housing are included in this sub-sector.
Commercial buildings and facilities	Emissions from energy use in buildings that are primarily used as commercial buildings (e.g., commercial offices, banks, shops, hotels, private schools or clinics, other privately owned facilities, etc). Cities **may** further categorise this sector by different types and/or sizes of buildings.
Institutional buildings and facilities	Emissions from energy use in public buildings such as schools, hospitals, government offices, publicly-owned water/waste/wastewater facilities, other facilities, etc. Public lighting is also included in this sub-sector.
Industrial buildings and facilities	Emissions from energy use in manufacturing and industrial facilities, construction activities and energy industries. Due to the complex nature of this sub-sector, local governments are recommended to further disaggregate emissions by these categories. Note: this sub-sector does not include emissions from the generation of grid-distributed energy.
Agriculture, forestry and fishing facilities	Emissions from energy use in agriculture, forestry and fishing activities, including energy use associated with plant and animal cultivation, afforestation, reforestation and fishery activities. This could include, for example, the on-site operation of farm vehicles and machinery, generators to power lighting, pumps and heaters.
Fugitive emissions	All fugitive emissions from the extraction, transformation and transportation of primary fossil fuels within the city boundary, including: 1) Fugitive emission occurring during mining, processing, storage and transportation of coal 2) Fugitive emissions from oil and natural gas systems, such as equipment or pipeline leaks, evaporation and flashing losses, venting, flaring, incineration, accidental releases, etc. This is usually a small emission source in a city. Emissions data may be directly measured at facility level, or cities can estimate emissions using default emission

	factors from national inventories or the IPCC[26].

There are some particular scenarios that may occur and complicate classification of sectors or sub-sectors, such as mixed-use buildings and energy used in transportation and waste facilities etc. Further guidance on how to report those emissions are provided in **Error! Reference source not found.**, with the general principle being to avoid double counting.

For the Stationary Energy sector, emissions from sources covered by a regional or national emissions trading system (ETS) **should** be identified and described, i.e. the names and/or registration number of relevant facilities and the trading scheme are specified.

Box 2. How to report emissions that may cover multiple sectors

- Mixed-use buildings

Where buildings or facilities are used for multiple purposes, such as residential units in commercial complex, or offices in an industrial facility, inventory developers can either i) subdivide such mixed-use buildings based on the floor area (square meters) of a building dedicated to different uses (and allocate the activity data and resulting emissions accordingly), or ii) categorise the entire building under one of the sub-categories and provide justification.

- Manufacture of transport equipment

GHG emissions from the manufacture of motor vehicles, ships, boats, railway and tramway locomotives, aircraft and spacecraft, etc. are attributable to the relevant industrial buildings and facilities and thus **shall** be reported under the Stationary Energy sector rather than the Transportation sector (see section 3.6.2 for further guidance).

- Transport premises

On-site energy use in transport premises (e.g., airports, train stations, bus terminals, harbours, etc.) and associated GHG emissions **shall** be reported in Stationary Energy sector, not Transportation.

- Waste and wastewater treatment and disposal facilities

GHG emissions resulting from on-site energy use within these facilities (e.g., electricity used for pumping, natural gas for heating, etc.) **shall** be reported in the Stationary Energy sector.

Emissions as a result of energy used for transporting waste to and from these facilities (e.g., diesel used in waste collection vehicles) **shall** be reported in the Transportation sector. The exception to this is the emissions associated with off-road vehicles operating within the facilities (e.g., forklift trucks on landfill sites), which shall be reported in the Stationary Energy sector.

Fugitive emissions from the decay of solid waste and the anaerobic degradation of wastewater in these facilities are non-energy related and **shall** be reported in the Waste sector (see section 3.6.3 for further guidance).

Where waste (including by-products of waste disposal and treatment, such as landfill gas, biogas, sludge, etc.) is used to generate energy using waste, this is considered to be energy related, so they shall be captured under the Stationary Energy sector. If the energy generated is not grid-connected but used on-site, this should be reported as direct emissions, similar to fuel combustion. If energy generated is supplied to the grid, this should be reported as indirect emissions. Additionally, the emissions should be disclosed in the Energy Generation section of the inventory. See section 3.6.3 for more details.

- Farms, aquaculture sites, forests

[26] www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_4_Ch4_Fugitive_Emissions.pdf

Energy used in buildings (e.g., sheds, offices, lodges) and by equipment (such as off-road vehicles and machineries) on these sites should be reported as a Stationary Energy emission source under the Agriculture, forestry and fishing facilities sub-sector.

On-road transportation to and from these sites, such as trucks and fishing boats, should be reported under the Transportation sector.

Emissions from enteric fermentation of livestock, manure management and burning of agricultural residues should be reported under the AFOLU sector (see section 3.6.5 for further details).

3.6.2 Transportation

This sector is often referred to as mobile energy. Vehicles produce GHG emissions directly by combusting fuel or indirectly by consuming grid-supplied electricity. All emissions **shall** be reported and disaggregated by transportation mode as per the sub-sectors defined in the table below. Emissions can be calculated by multiplying energy consumption (activity data) by the corresponding emission factors for each energy type, by gas and by sub-sector.

Table 3. Definitions for sub-sectors required under Transportation sector

Sub-sectors	Description
On-road	Emissions from energy use for on-road transportation of people or goods. Cities only need to report emissions from journeys occurring inside the city boundary. Cities **should** further categorise this sub-sector by municipal fleet, public transport, private and commercial transport, and **may** breakdown further by mode such as cars, taxis, buses, motorbikes, etc.
Rail	Emissions from energy used for rail transportation of people or goods, such as trams, urban railway subway systems, regional (inter-city) commuter rail transport, national and international rail system, etc. Cities only need to report emissions from journeys occurring inside the city boundary.
Waterborne navigation	Emissions from energy use for water transportation of people or goods, such as ferries, domestic inter-city vehicles, international water–borne vehicles, etc. Cities only need to consider emissions from journeys that are fully confined within the city boundary (i.e. both start and end inside the city, such as sightseeing cruises). Reporting of this sub-sector is only required if considered significant (see Box 1 for definition of insignificant emission sources).
Aviation	Emissions from energy use for air transportation of people or goods, including civil and military aviation. Cities only need to report emissions from journeys that are fully confined within the city boundary (i.e. both start and end inside the city, such as sightseeing or emergency helicopters and other local aviation). Reporting of this sub-sector is only required if considered significant.
Off-road	Emissions from energy use by off-road vehicles and mobile machinery within the city boundary. Reporting of this sub-sector is only required if considered significant.

Reporting of the in-boundary components of regional or international waterborne or airborne journeys, such as the landing and taking-off (LTO) components of regional or international flights, is optional. Cities may use the notation key "Included Elsewhere" to identify such activities without reporting emissions. If emissions are reported, cities **should** distinguish between LTO emissions and emissions from journeys fully confined within the boundary.

Local governments **may** also separately report emissions from the portion of trans-boundary journeys occurring outside the boundary.

Depending on data and resource availability, local governments **may** choose from the following two approaches to calculate the energy consumed for transportation activities within the city boundary:

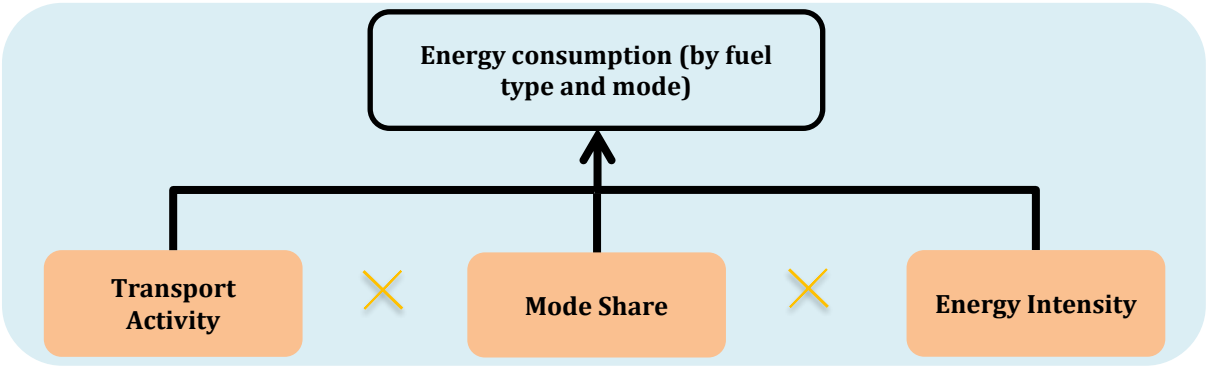
(1) Fuel sales approach

This approach treats the quantity of transport fuels sold as a proxy for transportation activities. Cities may assume that all fuels sold within the boundary are used for journeys within the boundary. It is also possible to use surveys or other methods to determine the portion of fuels sold that are attributable to journeys within the boundary. Fuel sales data can be obtained from fuel dispensing facilities and/or distributors, or from fuel sales tax receipts.

This approach is consistent with national inventory practices and is suitable for cities that have limited resources, technical capacity or time. However, it does not capture all transportation activities within a city boundary (for example, vehicles may be fuelled outside the boundary but driven inside), nor does it disaggregate the reasons for travel emissions (such as origins, destinations, modes, vehicle types and efficiency). Therefore, it does not comprehensively demonstrate mitigation potential.

(2) Model-based approach

This approach estimates fuel consumption from detailed activity data on the basis of the following parameters:



- Transport activity

This is a measure of traffic flow reflecting the number and lengths of trips, usually expressed as VKM (vehicle kilometres travelled). The VKM is determined by multiplying the number of vehicles on a given road or traffic network by the average length of their trips measured in kilometres (or miles). It can be measured as passenger-kilometre (a unit of measurement = 1

passenger transported a distance of 1 kilometre) and tonne-kilometre (a unit of measurement = 1 tonne transported a distance of 1 kilometre).

The VKM may be available from the local or regional transport department who collect such data for transport planning purposes, or from sample surveys (i.e. traffic counts), household transport surveys, etc.

- Mode share

This represents the portion of trips taken by different modes (e.g., walking, biking, public transport, private transport, etc.) and vehicle types (e.g., cars, taxis, buses, motorbikes, trucks, etc.).

The mode share can be estimated from traffic counts and surveys, vehicle registration, local/regional/national statistics, etc.

- Energy intensity

This is the energy consumption per km travelled by each vehicle type. This is determined by the type of energy used, the make, model and age of vehicles, the road condition, the driving cycle and a number of other factors. Cities may estimate the average fuel consumption of vehicles driving on the street network based on polls, information from inspection agencies or vehicle registration information.

The model-based approach can produce detailed and more actionable data for mitigation planning and integrates better with existing transport models and planning processes in some cities. However, it can be expensive and time consuming to establish. Where possible, cities should use both fuel sales and model-based approaches to validate results and improve reliability.

Under the model-based approach, cities can choose one of the following methods to identify transport activities attributable to the city:

a) **Geographic or territorial**: This method quantifies travel activity occurring solely within the city boundary, often based on surveys at the physical boundary and regardless of the origin or destination of the journeys. Some European traffic demand models already collect such data for local air pollution estimates and traffic pricing.

b) **Resident activity**: This method quantifies travel activity undertaken by residents within the city boundary only, often based on resident VKT, from vehicle registration records and surveys on resident travels. While such information may be more manageable and cost-effective than traffic models, their limitation to resident activity overlooks the impact of non-residents such as commuters, tourists, logistics providers and other travellers.

c) **Induced activity**: This method seeks to quantify travel activity induced by the community, including trips that begin, end or are fully contained within the city boundary (usually excluding pass-through trips). It relies on models or surveys to assess the number and length of all on-road trips occurring - both transboundary and in-boundary only. These models are more common in US cities.

Please refer to the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories or the "Sustainable Energy and Climate Action Plan" Guidebooks for further details on the methodological approaches above.

3.6.3 Waste

Waste (including solid waste and wastewater) disposal and treatment produces GHG emissions through aerobic or anaerobic decomposition, or incineration. All GHG emissions from disposal and treatment of waste generated within the city boundary **shall** be reported and disaggregated by the following sub-sectors. Further definitions and guidance on sub-sectors are provided below.

Table 4. Definitions for sub-sectors required under the Waste sector

Sub-sectors	Description
Solid waste disposal	All emissions from solid waste that are disposed of at managed sites (e.g., sanitary landfill and managed dumps) and unmanaged sites (e.g., open dumps, including above-ground piles, holes in the ground and dumping into natural features such as ravines).
Biological treatment	All emissions from biological treatment of waste, including composting and anaerobic digestion of organic waste.
Incineration and open burning	All emissions from waste that are burned either in a controlled, industrial process or in an uncontrolled, often illicit, process. The former is often referred to as incineration, and the latter as open burning. Note that this excludes emissions from waste incineration for the purposes of energy generation, also known as energy recovery. See Box 2 for more details.
Wastewater treatment and discharge	All emissions from the treatment process of wastewater, either aerobically or anaerobically, and direct discharge of wastewater into an open body of water.

Note that this sector excludes emissions resulted from the waste to energy process inside or outside the city boundary (e.g., energy recovery from waste incineration, energy generation using landfill/biogas/sludge produced by waste facilities, etc.). Where the energy generated from waste is connected to a grid, the resulting GHG emissions will have been included under the indirect emissions within the Stationary Energy sector. Additionally, these sources **shall** be disclosed in the Energy Generation section of the inventory. If the energy generated is not connected to the grid but used on-site, then the associated emissions **should** be reported as direct emissions under the Stationary Energy sector. In both cases, the notation key IE **should** be used in the relevant waste sector where the waste is used to generate energy (see Section 3.4 for more details on notation keys).

Box 3

The inventory **should** quantify emissions released during the inventory year. In certain cases, the available or nationally consistent methodologies may also estimate the future emissions that result from activities conducted within the inventory year. For instance, as it can take many years for waste to decompose, when reporting emissions from landfill sites, local governments may choose to report emissions released during the inventory year as a result of waste disposed during that year and previous years. Alternatively, they can report emissions that may be released during the inventory year

and in future years as a result of the actual quantity of waste deposited during the inventory year. See *footnote 27* for further details about the two methods for calculating emissions from waste landfill.

For example, a hypothetical landfill site captures 80% of the landfill gas produced, which is then combusted to generate electricity that is supplied to the grid. The city **should** report the amount of landfill gas captured and combusted for energy generation (i.e. 80% of total landfill produced), as well as the associated emissions, in the Energy Generation section of the inventory. Then in the Waste sector, the city **should** report the landfill gas that is not combusted (i.e. the remaining 20%) as direct emissions released to the atmosphere, and also use notation key IE in a separate line to indicate the landfill gas that is used as energy source without reporting the relevant emissions.

Generally speaking, the quantification of GHG emissions from disposal and treatment of waste should include the following steps:

(1) Identify the quantity of waste generated, and how and where it is treated

This is the activity data. Local governments should identify the quantity of waste generated in the inventory year[27], categorised by different types of generation and treatment pathways where possible. How waste is generated affects the composition of waste, which determines the emission factors that need to be used (further elaborated below). How waste is treated determines what GHGs are emitted as well as the emission factors.

Activity data on quantities of waste generated and disposed/treated at managed sites can be calculated based on records from waste collection services, such as weigh-ins at the landfill sites. Waste disposed at unmanaged sites (e.g., solid waste sent to open dumps, wastewater discharged to open water) can be estimated by subtracting the amount of waste disposed/treated at managed sites from the total waste generated. Total waste generated can be calculated from the per capita waste generation rate and the population. More guidance on collecting this information is available in IPCC Guidelines.

(2) Determine the emission factor

This is dependent on how waste is treated and the composition of the waste.

Disposal of solid waste produces significant amounts of CH_4, which contributes approximately 3 to 4 percent to the annual global anthropogenic GHG emissions.[28] In addition, solid waste disposal sites (SWDS) also produce biogenic CO_2 and smaller amounts of N_2O as well as other non-methane volatile organic compounds, nitrogen oxides and carbon monoxide. As a minimum, local governments **should** quantify the CH_4 emissions. According to IPCC Guidelines, the emission factor of CH_4 from SWDS is illustrated as methane generation potential, which is a function of degradable

[27]For solid waste disposal, methane emissions continue several decades (or sometimes even centuries) after waste disposal. In line with the IPCC Guidelines, local governments may choose to either estimate emissions that physically occur during the inventory year, which is contributed by waste disposed in that year and previous years, or estimate emissions based on waste disposed in the inventory year. The former is often referred to as the First Order of Decay method, the latter as Methane Commitment method. If local governments choose the former, waste disposed in the landfill site from previous years should also be quantified.

[28]www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/5_Volume5/V5_3_Ch3_SWDS.pdf

organic content (DOC). DOC varies between different types of waste and is therefore dependent on the waste composition.

Similarly, anaerobic digestion of organic waste also produces CH_4, biogenic CO_2 and trace of N_2O. In cases where waste is composted, the DOC in the waste material is converted into CO_2 which is of biogenic origin. CH_4 is also formed in anaerobic sections of the compost but is oxidised to a large extent in the aerobic sections of the compost. Composting can also produce a small amount of N_2O emissions.

Like other types of combustion, incineration and open burning of waste emit CO_2, CH_4 and N_2O. Local governments **should** distinguish non-biogenic CO_2 emissions from biogenic CO_2 by identifying the fossil carbon contained in the waste.

Wastewater can be a source of CH_4 when treated or disposed anaerobically, and the emission factor is largely dependent on the organic content and the methane generation capacity of the wastewater, as well as the amount of organic component removed as sludge and the amount of CH_4 recovered. Wastewater treatment produces trace amounts of N_2O emissions through the nitrification and denitrification of sewage nitrogen, which can be considered negligible. N_2O emissions can also occur during disposal of wastewater effluent into waterways, which local governments should quantify where possible.

Further guidance for calculating emission factors from different waste disposal and treatment pathways, including equations and default data that local governments may use in absence of local or regional/national data, is available within the IPCC Guidelines and the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

3.6.4 Industrial Processes and Product Use (IPPU)

Reporting GHG emissions from the IPPU sector is optional but it is recommended where such emissions are considered relevant or significant (see Box 1 for guidance on how to determine if an emission source is significant). Cities should consider emissions from two sub-sectors:

(1) Industrial processes

GHG emissions are produced from a wide variety of industrial activities and processes that chemically or physically transform materials, including:

- Mineral industry, such as production of cement, lime, glass, etc., where notable CO_2 emissions can be released from the calcination of carbonate compounds.
- Chemical industry, such as production of ammonia, nitric acid, adipic acid, caprolactam, glyoxal, glyoxylic acid, carbide, titanium dioxide, soda ash, etc. Depending on the process and technology, major GHG emissions could include CO_2, N_2O and CH_4.
- Metal industry, such as the production of iron steel and metallurgical coke, ferroalloy, aluminium, magnesium, lead, zinc, etc. Major GHG emissions could include CO_2, CH_4 and in some cases (such as in magnesium production), SF_6, HFC and other GHG emissions.

(2) The use of products

GHGs are often used or contained in products such as refrigerators, foams or aerosol cans. For example, HFCs and PFCs are used as alternatives to ozone depleting substances (ODS) in various types of product applications. Several advanced electronics manufacturing processes also utilise fluorinated compounds (FC) for plasma etching intricate patterns, cleaning reactor chambers, and temperature control, all of which emit GHGs.

This sub-sector also includes GHG emissions from non-energy uses of fossil fuels as a product. Typical examples include: lubricants used in transportation and industry; paraffin waxes used in candle making, paper coating, adhesives, food production, packaging, etc.; road oil and other petroleum diluents used in asphalt production for road paving; and white spirit, kerosene and some aromatics used as solvent (e.g., for paint and dry cleaning).

Where fossil fuels are combusted to provide heat or mechanical work, or used to produce secondary energy or another fuel, the associated emissions shall be reported in the Stationary Energy sector.

GHG emissions from IPPU are usually less significant than other sectors but can be notable for some local governments, in which case emissions should be quantified.

To estimate GHG emissions from this sector, local governments **should** first identify major industries or product use within the city boundaries that release GHG emissions. Unless emissions are monitored or measured on site, local governments **should** then also identify:

- Activity data – this includes the amount of production output and raw material consumption of the identified industrial process and the amount of identified product use in the inventory year.
- Emission factors of raw material/product in the identified industrial process and emission factors of the identified product use. If factory-specific or local-specific data is not available, local governments may refer to national GHG inventories or IPCC Guidelines for default factors.

Further guidance on calculation methods, including equations, and default emission factors that local governments may use in absence of local or regional/national data, are available in the IPCC Guidelines and the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

3.6.5 Agriculture, Forestry and Other Land Use (AFOLU)

Reporting GHG emissions from the AFOLU sector is optional but it is recommended where such emissions are considered relevant or significant. In line with the IPCC Guidelines, cities should consider emissions from three sub-sectors:

(1) Livestock

Livestock production emits CH_4 through enteric fermentation and the amount of CH_4 emitted by enteric fermentation is driven primarily by the number of animals, type of animals/digestive system and the type and amount of feed consumed.

Manure management produces CH_4 from the decomposition of manure under anaerobic conditions, during storage and treatment. The amount of CH_4 emissions produced depends on the amount of manure produced (determined by the number of animals and the rate of waste production) and the

portion of the manure that decomposes anaerobically, which is affected by how the manure is managed.

Manure management also releases N_2O emissions via combined nitrification and denitrification of nitrogen contained in the manure. The amount of N_2O emissions is also dependent on the nitrogen and carbon content of manure and how it is managed.

Respired CO_2 emissions from livestock can be considered as biogenic. Emissions associated with the burning of manure shall be reported under the Stationary Energy sector or under the Waste sector if burned without energy recovery.

(2) Land use

The IPCC divides land use into six categories: forest land, cropland, grassland, wetlands, settlements and other. Emissions and removals of CO_2 are based on changes in the ecosystem Carbon (C) stocks as a result of land use and change in land use. C stocks consist of above-ground and below-ground biomass, dead organic matter (dead wood and litter) and soil organic matter.

Detailed definition of land use and calculation guidance is available in the IPCC Guidelines. Cities may adopt a simplified approach that consists of multiplying net annual C stock change for different land-use (and land-use change) categories by surface area. All changes in carbon stock are summed across all categories and multiplied by 44/12 to covert to CO_2 emissions.

- Land-use categorization by surface area

  Such data can be obtained from national agencies or local government using land zoning or remote sensing data. Lands with multiple uses can be assigned into a single land-use category using the following ranking: Settlements > Cropland > Forest land > Grassland > Wetlands > Other land.

  In addition to the current land use, any land-use changes within the last 20 years will need to be determined. Large quantities of GHG emissions can result as a consequence of a change in land use. When the land use is changed, such as from urban farms or parks to residential development, soil carbon and carbon stock in vegetation can be lost as emissions of CO_2. Examples include change of use from agriculture (e.g., urban farms) or parks, to another use (e.g., industrial development). Lands stay in the same category if a land-use change has not occurred in the last 20 years.

- Net annual C stock change for different land use and land-use change categories

  Default data can be obtained from the relevant country's national inventory reporting body, the United Nations Framework Convention on Climate Change (UNFCCC)-reported GHG emissions for countries, IPCC and other peer-reviewed sources. Alternatively, annual carbon stock changes can be determined for different land-use categories by subtracting estimated carbon stocks in a previous year from estimated carbon stocks in the inventory year, divided by the total area of land in the inventory year. Default data on annual carbon stock changes can be obtained from the above listed sources.

(3) Other AFOLU

This sub-sector intends to capture the following emissions sources:

- Biomass burning without energy recovery, such as periodic burning of land or accidental wildfires. Note that emissions associated with biomass burned for energy should be reported under the Stationary Energy sector instead.
- Liming: Adding carbonates in the form of lime (e.g., calcic limestone or dolomite) to reduce soil acidity and improve plant growth of managed lands, particularly agricultural lands and managed forests, can lead to CO_2 emissions as the carbonates dissolve and release bicarbonate which then evolves into CO_2 and water.
- Urea application: The use of urea as fertilizer leads to emissions of CO_2 that were fixed during the industrial production process. Urea in the presence of water and urease enzymes are converted into ammonium, hydroxyl ion and bicarbonate which then evolves into CO_2 and water.
- Direct and indirect N_2O from managed soils: Agricultural emissions of N_2O result directly from the soils to which N is added/released, such as through the application of synthetic or organic fertiliser, crop residue and mineralization of organic carbon in mineral soils due to land-use change or management; and indirectly through the volatilization of N, biomass burning, leaching and runoff of N additions to managed lands.
- Indirect N_2O from manure management as a result of volatile nitrogen losses that occur primarily in the forms of NH_3 and NO_x.
- Rice cultivation: CH_4 can be released through anaerobic decomposition of organic material in flooded rice fields.
- Harvested wood products (HWP): HWP include all wood material that leaves harvest sites and constitutes a carbon reservoir. The time carbon is held in products will vary depending on the product and its uses. For example, fuel wood may be burned in the year of harvest, whilst wood used for panels in buildings may be held for decades to over 100 years. Due to this storage in products, the oxidation of HWP in a given year could be less, or potentially more, than the total amount of wood harvested in that year, resulting in emissions or removals of CO_2 from the atmosphere.

GHG emissions from AFOLU are usually less significant than other sectors but can be notable for some local government areas, in which case emissions should be quantified. Further guidance on calculation methods, including equations, and default emission factors that local governments may use in absence of local or regional/national data, are available in the IPCC Guidelines as well as the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories.

3.7 Reporting on energy generation sector

Local governments **shall** report all activity data and GHG emissions from the generation of grid-supplied energy by facilities within the city boundary, as well as by facilities owned (full or partial) by the local government outside the boundary. The reporting of such information is important to indicate the influence that the local government has over power generation and the decarbonisation of the energy grid in the region.

As the energy generated by such facilities is supplied to the grid, the resulting emissions will have already been captured as the indirect emissions from consumption of grid-supplied energy, under the Stationary Energy sector of the inventories for the local authority where the facilities are located and other local authorities that share the same grid. As such, emissions reported in the Energy Generation sector will not be included in the emissions total of the local government in order to avoid double counting.

Where possible, local governments **should** further disaggregate this sector by electricity-only generation, heat/cold-only generation and combined Heat and Power (CHP) generation (including combined cooling, heat and power - CCHP), as defined in Table 5 below.

Emissions from sources covered by a regional or national emissions trading system (ETS) **should** be identified and described, i.e. the names and/or registration number of relevant facilities and the trading scheme are specified.

In addition, local governments **should** report all activity data for distributed local renewable energy generation, as an important indicator of their investment in local generation. Local governments **may** report zero emissions associated with this generation.

Table 5. Definitions for sub-sectors under Energy Generation

	Sub-sector	**Description**
Generation of grid-supplied energy	Electricity-only generation	All activity data and GHG emissions from energy (both renewable and non-renewable[29]) consumption for the purpose of generating grid-supplied electricity in power plants that solely generate electricity.
	CHP generation	All activity data and GHG emissions from energy consumption (both renewable and non-renewable) for the purpose of generating electricity and thermal energy in Combined Heat and Power (CHP) plants (including combined cooling, heat and power plants). Where possible, data should be further disaggregated between generation of power and thermal energy.
	District heating/cooling	All activity data and GHG emissions from energy (both renewable and non-renewable) consumption for the purpose of generating thermal energy only in district heating/cooling plants.
Generation of distributed energy	Distributed local renewable energy generation	All activity data and GHG emissions from local energy generation (electricity, heat, etc.) facilities that are not grid-connected.

3.8 Disclosing information on emissions credits

Local governments **should** clearly identify GHG emissions from sources covered by a regional or national emissions trading system (ETS), and where possible, also provide the names and/or registration number of relevant facilities and the trading system or programme. This is particularly

[29]No emissions need to be reported for electricity generation from renewable energy such as wind, solar thermal, solar photovoltaic, geothermal energy, ambient heat or hydropower. Cities may apply LCA emission factors related to renewable energy sources, by doing which they also consent to GCoM recalculating and reporting the emissions as zero. CO_2 emissions from combustible renewables (such as biofuels, bioliquids, biogas and solid biofuels) are considered biogenic and do not need to be reported either.

relevant to the Stationary Energy and Energy Generation sectors. Emissions covered by regional/national trading systems will still be accounted for in gross GHG emissions inventory total, except those reported in the Energy Generation sector.

Separately, local governments are recommended to report any offset credits generated in the city boundary and sold, or any offset credits purchased from outside the boundary, as well as any green energy purchased by consumers in the city boundary. These credits are not to be "netted" or deducted from gross GHG emissions inventory total.

3.9 Recalculating and re-submitting inventories

In order to track emissions over time and demonstrate progress toward targets, local governments **shall** develop inventories consistently through the years. This means that as far as possible, the inventories **should** be calculated using the same boundary definitions, emission sources, data sources and methodologies over the years.

Examples of scenarios where recalculation is needed are listed in Table 6 below. GCoM has adopted a threshold of significance of impacts on the total emissions as +/-10%, to determine whether recalculation and re-submission of inventory is needed. That means, if the methodological changes result in total emissions of an historic inventory to change by more than 5%, that inventory should be recalculated and resubmitted to GCoM.

Note that this should not undermine the requirement for local governments to make continuous efforts to improve data quality and methodologies to more accurately reflect the level of emissions.

Table 6. Triggers for re-calculating inventories

Type of changes	Examples	Recalculation needed?
Changes in inventory boundary	A community is included in or removed from a local government's administrative boundary	Yes (if significant)
	Inclusion of AFOLU or IPPU sectors that are not previously included, or reporting additional types of GHGs	Yes (if significant)
	Shut down of a power plant or construction of a new factory	No
Changes in calculation methodology or improvements in data accuracy	Change in transportation calculation method from Fuel Sales to Induced Activity, or change in landfill emissions calculation method from Methane Commitment method to First Order Decay	Yes (if significant)
	Adopt more accurate activity data (or localised emission factors) instead of scaling down national data (or using national emission factors)	Yes (if significant)
	Change in electricity emission factor due to cleaner grid	No
	Change in the Global Warming Potentials used	Yes
Discovery of errors	Discovery of mistake in unit conversion for emissions calculation	Yes (if significant)

3.10 Summary of reporting output

Local governments may use existing GHG emissions inventory reporting tools available from GCoM partners (some examples listed below) or other bespoke tools, as long as all the information outlined in Table 7. are provided. Please note that the format of the output table may vary (incl. from one reporting platform/tool to another).

- City Inventory Reporting and Information System (CIRIS)
- ClearPath GHG Inventory tool - ICLEI
- 'Sustainable Energy and Climate Action Plan Template' - Covenant of Mayors

A mapping of emission source categories with other commonly used guidance can be found in Annex 1.

Table 7. GHG emissions inventory reporting output summary

Colour coding: green cells – required for mandatory reporting, blue cells – optional

A. City Information

		Data source
Official name of local government		N/A
Country		N/A
Region		N/A
Inventory year (specify months covered)		N/A
Description of boundary and map		
Resident population		
GDP		
Heating / cooling degree days		

B. Inventory Setup

GWP (IPCC AR version used)	
Types of emissions factors (IPCC or LCA)	

These columns are not included in the final output table submitted to GCoM reporting platform, but they should be included in the inventory files that cities need to submit to GCOM (variation of format is allowed).
For these columns, cities should report multiple rows in each sub-sector for different types of energy or activities.

C. Emission Sources and Emissions

Sector	Sub-sector	Direct (fuel combustion) or Indirect (grid energy) or Other *(in separate rows)*	Total tC2Oe or Notation Key	ETS or non-ETS *(in separate rows)*	Sub-category	Type of energy	Description of activity /facility	Activity data			Emission factors (Disaggregated by gases or as total CO2e)			Emissions (Disaggregated by gases or as total tCO2e)				Notation keys (if no data to report)	
								Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source	Method	Notation key	Explanation
Stationary Energy	Residential																		
	Commercial																		
	Institutional																		
	Industry																		
	Agriculture																		
	Fugitive																		
Transportation	On-road																		
	Rail																		
	Waterborne																		

	Aviation																		
	Off-road																		
Waste	Solid waste disposal			N/A		N/A													
	Biological treatment			N/A		N/A													
	Incineration and open burning			N/A		N/A													
	Wastewater			N/A		N/A													
IPPU	Industrial process			N/A		N/A													
	Product use			N/A		N/A													
AFOLU	Livestock			N/A		N/A													
	Land use			N/A		N/A													
	Other AFOLU			N/A		N/A													

D. Energy Generation

Category	Inside or outside city boundary *(in separate rows)*	Total tC2Oe	ETS or non-ETS *(in separate rows)*	Sub-category	Description of activity	Type of (primary) energy	ETS or non-ETS	Activity data			Emission factors (Disaggregated by gases or as total tCO2e)			Emissions (Disaggregated by gases or as total tCO2e)		
								Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source
Electricity-only generation																
CHP generation																
Heat/cold generation																
Local renewable energy generation	N/A															

E. Emission Credits

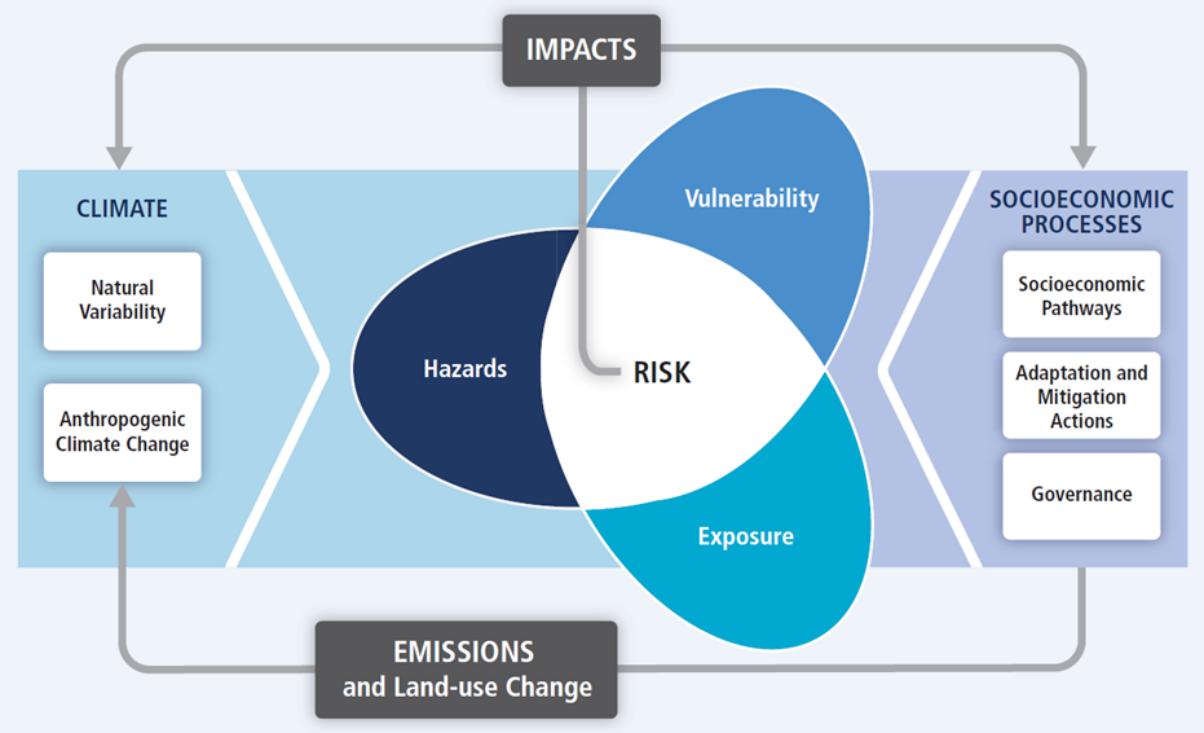
Category	Sold or purchased	Total tC2Oe or Notation Key	Allocation to sector	Sub-category	Description of activity	Date of sale/ purchase	Activity data			Emission factors (Disaggregated by gases or as total tCO2e)			Emissions (Disaggregated by gases or as total tCO2e)		
							Amount	Unit	Data source	Amount	Unit	Data source	Amount	Unit	Data source
Offset credits generated in the city	*Sold*														
Credits purchased from outside	*Purchased*														
Purchase of certified green electricity	*Purchased*														

Chapter 4 – Climate Risk and Vulnerability Assessment

This chapter explains in more detail the GCoM requirements and recommendations for undertaking a Climate Risk and Vulnerability Assessment (CRVA)[30] – one of the initial steps for developing climate change adaptation plans. GCoM signatories **shall** prepare and submit a CRVA within **two years** after joining the initiative.

A climate change-related disaster occurs when a combination of factors come together at the same time in the same place. For example, a ***climate hazard*** (e.g., a heat wave) might occur in a municipality, but it becomes a ***climate risk*** only when inhabitants and/or assets are ***exposed*** to this particular hazard and if those exposed inhabitants or assets are ***vulnerable*** to it (such as the elderly, persons with chronic diseases, children, homeless, etc.). These factors are not static, but rather conditional to the impacts of climate change on climate hazards, and to the local government's adaptation actions to improve ***resilience*** and ***adaptive capacity*** to climate-related shocks and stresses. Cities' climate change adaptation and resilience efforts have the potential to reduce/mitigate the exposure and/or vulnerability factors and increase the long-term adaptive capacity. For a visualization of climate risk, see Figure 1, while core concepts used in this paragraph are defined in Annex 2 – Chapter 4: Core definitions for the climate risk and vulnerability assessment.

Figure 1. Visualizing climate risk



Source: IPCC, 2012[31]

[30] Please note that the term Climate Risk and Vulnerability Assessment (CRVA) was introduced to be as concise as possible, while it is understood that CRVA is equal to the often-used term and abbreviation Risk and Vulnerability Assessment (RVA).

[31] IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 3-21.

The understanding of climate risks, i.e. the combination of hazards, exposure and vulnerability in a specific territory is the main goal of a CRVA. In the following sections, each of these elements are presented in detail to support cities and local governments in the process of understanding and correctly reporting their climate risks using the Common Reporting Framework.

4.1. Climate Risk and Vulnerability Assessment – Initial steps

The local government **shall** prepare and submit a CRVA within **two years** after committing to the GCoM including the following:

- **Leading/coordinating team in the city**. A lead municipal team **should** be identified to collect data and deal with reporting. The creation of an Advisory Group of relevant experts from academia, non-governmental organizations, citizens, city government and the private sector could help to construct sound and policy-relevant indicators and select the best scale of analysis (e.g., neighbourhood).[32]
- **Boundary of assessment**. It **shall** be equal to or smaller/greater than the city boundary (i.e. local government's administrative boundary) or partially cover the city boundary and adjoining areas.
- **Data sources**. The main sources of information – such as city agencies, civil protection, utility companies and universities, among others – **should** be mapped. The contact point at the local authority **should** be entrusted to facilitate the communication between the parties and foster data sharing.
- **A glossary of key terms and definitions**. For the purposes of reporting to the CRF, cities **shall** use the Intergovernmental Panel on Climate Change (IPCC) terms and definitions given in the last Assessment Report (AR5), or any relevant version preceding or update following the AR5, as well as key terminology contained in official literature sources (see Annex 2 for a glossary of key terms and definitions), since these are the most updated internationally-recognized concepts.

It is further recommended to include information on the foreseen update and revision process of the CRVA.

4.2. Step 1: Identification of climate risks and their impacts (at different timescales)

In a first step of the CRVA, the signatory **shall** identify the climate hazards faced by the local government. Thereby, the local government is taking a close look at hazards that occurred in the past and the impact these hazards had in their jurisdiction. Once current hazards are identified, the local government assesses how these hazards are expected to change in the future and what impacts can be expected from these hazards.

4.2.1 Identifying past climate hazards and their impacts

With regards to past climate hazards, the local government **shall** report the following information about major hazards that occurred in the past years:

[32]Weber, S., Sadoff, N., Zell, E., Sherbinin, A., 2015. Policy relevant indicators for mapping the vulnerability of urban populations to extreme heat events: a case study of Philadelphia. Applied geography 63, pp. 231-243.

- **Type of climate hazard that occurred in the past and the current risk level (probability x consequence).** Climate risk levels estimated by multiplying probability and consequence of occurring hazard (see "heat map" representation in Box 4 below).
- Local governments are asked to report the ***probability*** (likelihood of occurrence) and ***consequence*** (outcome/impact/gravity) of identified hazards. Climate hazards reported by local governments as having "***high probability***" and "***high consequence***" of bearing an impact are considered "***high risk***" (see Box 4). This means that such hazards are expected to result in serious impacts and catastrophic disruptions to the city. On the contrary, climate hazards with a low probability of occurrence and low consequence are considered ***"low risk,"*** low priority hazards (see example in Box 5).
- **Intensity and frequency of past hazards**. Both the intensity (how strong they were) and frequency (how many events occurred) could have increased, decreased, suffered no change or not be known.
- **Description of the impacts experienced in the past.** Local governments shall report on the past impacts as a result of the identified climate risks, including loss of human lives, economic and non-economic losses (direct and indirect, if possible), environmental and other impacts. Direct losses might refer, for example, to losses in crop yield, or direct damage to infrastructure from flooding. Indirect losses, on the other hand, usually manifest through markets, for example, how an impacted economic sector would affect others.[33] This includes all relevant sectors, assets, or services most impacted by the identified hazards and the magnitude of the impact for each of them. The sectors potentially affected might be energy, water supply & sanitation, transport, waste management, information & communications technology, food & agriculture, environment, industrial, commercial, residential, education, public health, community & culture, law & order, emergency management and others.

If this information is readily available, local governments **may** also report on vulnerable population groups (see Section 4.3) potentially affected by the identified climate hazards. Such information is relevant to identify trends in socio-economic, environmental, physical and other vulnerabilities that may exist in the city.

Box 4 Guidance on probability and consequence of hazards[34]

Local governments are asked to indicate the *likelihood* of each reported climate hazard. The response should ideally be based on the outcome of a conducted CRVA, but qualitative descriptors are also used for the purposes of reporting, i.e. local governments are asked to select the response that most appropriately represents the probability and consequence of each climate hazard from the following list of values:

[33] J.C. Ciscar, D. Ibarreta, A. Soria, A. Dosio, A.Toreti, A. Ceglar, D. Fumagalli, F. Dentener, R. Lecerf, A. Zucchini, L. Panarello, S. Niemeyer, I. Pérez-Domínguez, T. Fellmann, A. Kitous, J. Després, A. Christodoulou, H. Demirel, L. Alfieri, F. Dottori, M.I. Vousdoukas, L. Mentaschi, E. Voukouvalas, C. Cammalleri, P. Barbosa, F. Micale, J.V. Vogt, J.I. Barredo, G. Caudullo, A. Mauri, D. de Rigo, G. Libertà, T. Houston Durrant, T. Artés Vivancos, J. San-Miguel-Ayanz, S.N. Gosling, J. Zaherpour, A. De Roo, B. Bisselink, J. Bernhard, L., Bianchi, M. Rozsai, W. Szewczyk, I. Mongelli and L. Feyen, Climate impacts in Europe: Final report of the JRC PESETA III project, EUR 29427 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-97218-8, doi:10.2760/93257, JRC112769.

[34] CDP, CDP Cities 2018 Reporting Guidance, Hazards and Adaptation: https://guidance.cdp.net/en/guidance?cid=4&ctype=theme&idtype=ThemeID&incchild=1&microsite=0&otype=Guidance&tags=TAG-637%2CTAG-638.

[Probability of climate hazard]

- **High** – Extremely likely that the hazard occurs (e.g., greater than 1 in 20 chance of occurrence).
- **Moderate** – Likely that the hazard occurs (e.g., between 1 in 20 and 1 in 200 chance of occurrence).
- **Low** – Unlikely that the hazard occurs (e.g., between 1 in 200 and 1 in 2,000 chance of occurrence).
- **Do not know** – City has not experienced or observed climate hazards in the past or has no ways of accurately reporting this information based on evidence or data.

[Consequence of climate risk]

- **High** – The hazard represents a high (or the highest) level of potential concern for your jurisdiction. When it occurs, the hazard results in (extremely) serious impacts to the jurisdiction and (catastrophic) interruptions to day-to-day life.
- **Moderate** – The hazard represents a moderate level of potential concern for your jurisdiction. When it occurs, the hazard results in impacts to your jurisdiction, but these are moderately significant to day-to-day life.
- **Low** – The hazard represents a lower (the lowest) level of potential concern for your jurisdiction. When it occurs, the hazard results in impacts to your jurisdiction, but these are deemed less significant (or insignificant) to day-to-day life.
- **Do not know** – City has not experienced or observed climate hazards in the past or has no ways of accurately reporting this information based on evidence or data.

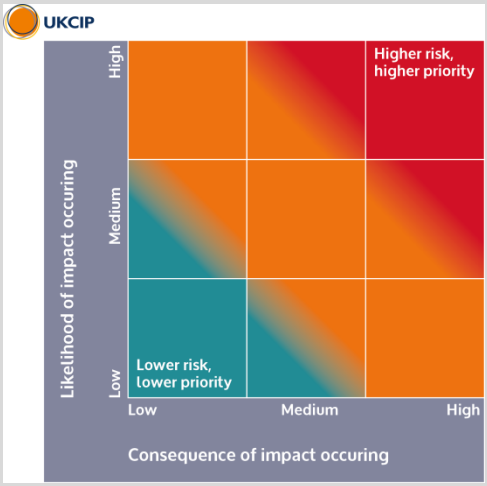


Figure 2

Source: https://ukcip.ouce.ox.ac.uk/about-us/

Box 5. Example

Often climate hazards with high probability of occurrence but medium high/medium consequence (e.g., rain storms or flash floods) could also be considered as *significant* risk for local governments as the prevalence of such hazards demands constant attention, resources and disaster risk management effort to mitigate the imminent "moderate" risk. However, local governments shall report based on conducted CRVA or estimations of past risk and further explain how these "moderate" hazards affect their jurisdiction (i.e. scale of hazard, loss and damage to assets, loss of lives, environmental and other impacts).

4.2.2 Identifying current (last 5 to 10 years) and future (mid-century) climate hazards and their impacts

Local governments shall identify the climate hazards faced by the community and are asked to define how they expect climate change to trigger these climate hazards **in the future**. For each identified climate hazard, the local government **shall** report the following information:

- **Future risk level (probability x consequence) and expected change in intensity and frequency, as well as the timescale[35] of expected changes of the identified climate hazards**.

[35] Immediately = hazard is already taking place; short term = by 2025; medium term = 2026 -2050; long term= after 2050; not known= city has no information on when this hazard will occur or if hazard has already occurred.

EXAMPLE of how to report expected climate hazards:

City A's recent CRVA shows that the main climate hazards affecting their jurisdiction are: drought, extreme hot days and flash floods. It is projected that in the next two decades these hazards will intensify and be more frequent and erratic. It is also projected that warmer conditions are expected to reduce extreme cold days. Lastly, if no adaptation effort is taken, an under-projected increase of urbanisation, cholera and E.coli outbreaks are expected to increase in the City in the long-term future.

City A would report the following:

Hazards	**Frequency**	**Intensity**	**Timescale**
Drought	Increase	Increase	Medium-term
Extreme hot days	Increase	Increase	Medium-term
Flash/surface floods	Increase	No change	Medium-term
Extreme cold days	Decrease	Decrease	Not known
Water-borne disease	Increase	Not known	Long-term

- **Description of expected future impacts.** Local governments **should** describe the future-expected impacts as a result of the identified climate hazards, including loss of human lives, non-economic and economic losses (direct and indirect, if possible), environmental and other context-specific impacts. Local governments **shall** report all relevant sectors, assets or services that are expected to be most impacted by the identified hazards in the future and the magnitude of the impact for each of them (ranging from high, moderate to low, or unknown). The sectors to analyse here refer to the same sectors as presented above. See also the next section for more detailed information on how to report this required information.

Furthermore, local governments **should** assess which **vulnerable population groups will be most affected by the identified hazards in the future** (see the next section for further details).

4.3. Step 2: Vulnerability and adaptive capacity

4.3.1. Step 2a: Identifying population groups vulnerable to climate hazards

The local government **should** (when such information is available) provide information on **vulnerable population groups** (to be specified for each hazard) that are affected by hazards in the past and future (see Box 6). This information can help the local government to gain better understanding of the vulnerability dimension of risks and in prioritizing climate adaptation actions.

Box 6. Description of future expected impacts: the example of Bologna

Population composition and its density are important vulnerability factors in the urban area for a diverse range of hazards, such as extreme heat, extreme precipitation and landslides. 29% of inhabitants consist of vulnerable groups (children and the elderly), even if not all of them can be considered vulnerable. Other vulnerability factors to consider are the lack of green areas and the density, state of health and census of the population.

Vulnerabilities related to water scarcity and drought can impact the entire population, as well as agricultural and industrial activities, and they can severely affect the economic welfare of the metropolitan area.

Extreme rainfall events and flooding affect only a small part of the population living near the rivers and on the hills but can severely increase the costs related to the land/infrastructure reinstatement in case of landslides or floods.

Source: Covenant of Mayors initiative.

Such vulnerable groups are local-context-bound and could include: women and girls, children and youth, the elderly, indigenous population, marginalized groups (due to race, ethnicity, social/political conditions, etc.), persons with disabilities, persons with chronic diseases (e.g., HIV/AIDS, malaria, etc.), low-income households, unemployed persons, persons living in sub-standard housing, etc.

These vulnerable groups often experience differential impacts from the *same* hazard. For example, richer households may have better capacity to cope with flooding, for instance, either through insurance schemes or physical protection of their assets. As such, they would be less affected by the same hazard compared to poor households.

Ultimately, the impacts of a hazard depend on specific socioeconomic, political, personal, institutional and environmental conditions that determine the coping and adaptive capacity of the affected population. Vulnerable communities affected by flooding, for example, have different socioeconomic specificities and adaptation deficits compared to the people impacted by extreme hot temperatures.

It is important to correctly identify the factors that drive urban vulnerability to climate threats through literature review and through engaging community members, vulnerable groups and climate experts in the adaptation plan.[36,37]

There exist different methodologies for assessing vulnerabilities at the level of local governments and they differ in terms of technical capacities and resources required. Indicator-Based Vulnerability Assessment has been widely used to assess climate change vulnerability in urban contexts.[38] This approach is particularly suitable for smaller and mid-size cities since it does not demand particularly technical skills or modelling tools and can be fed by using publicly available datasets.

4.3.2 Step 2b: Assessing adaptive capacity

Adaptive capacity refers to the degree in which people and other organisms, assets, institutions and sectors are able to adapt to climate change (see Annex 2 for the definition). It includes factors, conditions and local realities that enable a city to adjust its systems in view of current and future risks, adequately respond to their impacts and even leverage the new climate conditions to yield opportunities for the city and the community.

The CRF pre-identifies five broad categories containing non-exhaustive factors that will affect the city's adaptive capacity and influence climate resilience efforts by either hindering or enabling climate change adaptation actions within the city jurisdiction.

Local governments shall therefore identify the categories and factors that are more relevant in their context, and briefly describe how each of the most relevant factors are enhancing their jurisdictions'

[36] Hernandez, Y., Barbosa, P., Corral., S., Rivas, S., 2018. An institutional analysis to address climate change adaptation in Tenerife (Canary Islands). Environ. Sci. Policy 89, 184-191.
[37] Hernandez, Y., Guimarães Pereira, Â., Barbosa, P., 2018. Resilient futures of a small island: a participatory approach in Tenerife (Canary Islands) to address climate change. Environ. Sci. Policy 80, 28–37.
[38] Weber, S., Sadoff, N., Zell, E., Sherbinin, A., 2015. Policy relevant indicators for mapping the vulnerability of urban populations to extreme heat events: a case study of Philadelphia. Applied geography 63, pp. 231-243.

adaptive capacity. Next, local governments are asked to report the *degree* in which the selected factors challenge (as opposed to support) the adaptive capacity and obstruct the city's climate resilience efforts. Reporting entities have a choice between "high," "moderate," "low," "do not know" and "no concern." The latter could mean that the specific factor(s) has/have a neutral or positive influence on adaptive capacity. To reduce reporting burden, cities are asked to focus on factors that challenge adaptive capacity. Provided that cities have this information, they are also welcome to describe factors that have a positive influence on their adaptive capacity.

For example, a city having recently experienced an unexpected influx of migrants could report the following:

Factor	Description	Degree to which this factor presents a challenge to your jurisdiction's adaptive capacity
Migration	In the past 3 years, City B has received an unprecedented number of refugees, Internally Displaced People and asylum seekers. This has tested the preparedness and resilience capacity of the local government and local community in terms of housing and provision of basic services to the newcomers. However, the migrant population has also boosted economic development, human capital and urban diversity supporting City B to better respond to climate shocks and stresses in the future.	No concern

Whereas City C, having in the past decade experienced high turnover of political leadership could report the following:

Factor	Description	Degree to which this factor presents a challenge to your jurisdiction's adaptive capacity
Political stability	City C has observed that short political terms and high turnover of committed political leaders and skilled technical city staff undermines long-term adaptation plans. In 20xx City C experienced extreme water scarcity, which added to the political instability by boosting informal groups and organized crime's prominence in informal water delivery (in the black market). This led to citizen demonstrations and social unrest, which led to further political instability.	High
Safety and	Thanks to its robust law and order system, rooted in tradition and community engagement,	Low

security	City C is able to avoid massive violence outbreaks and is able to preserve a certain level of public safety. In the case of water scarcity, the City considers that its consorted efforts might be challenged in future years by the increase in the intensity and frequency of this hazard.	

Chapter 5 – Energy Access Assessment

This chapter will be added to the Guidance Note as soon as the energy access pillar of the CRF has been fully defined and formally adopted (expected in Q4 2019).

Chapter 6 – Target and Goal Setting

Local governments **shall** submit their city-wide greenhouse gas emissions reduction target(s) to GCoM within two years upon joining GCoM. New targets should be reported when previously reported targets have expired or been revised.

The following guidance elaborates on the key components of the targets that **shall** be determined and reported by the local governments, as well as provides advice and recommendations for good practice.

6.1 Prepare for target setting

Setting city-wide mitigation targets **should** start with understanding the needs and opportunities to reduce emissions, including but not limited to:

- **Global mitigation needs:**

  Recent findings from climate science, such as latest IPCC reports, can help cities understand the magnitude of emission reductions needed to avoid the most dangerous climate change impacts.

- **Relevant policy objectives:**

  A city's mitigation targets **should** adequately reflect its contribution to the climate goals committed by the international community and national/regional governments (e.g., the Paris Agreement's goals[39], the Nationally Determined Contribution (NDC)[40], any other mitigation targets committed by national or regional government, etc.), and demonstrate its leadership.

  Local governments **should** also identify other relevant environmental and development agendas that could potentially be facilitated by its climate mitigation goals and actions, e.g., any target to reduce air pollution, to increase energy access, etc.

- **Local emissions level, profile and mitigation opportunities:**

  In order to set a target that is specific, measurable, achievable, realistic and time-bound (SMART), local governments need to understand its current level and profile of emissions, especially the big emitting sectors and opportunity areas, through developing a comprehensive and robust city-wide GHG emissions inventory (often referred to as the base year inventory). This also helps the local government assess its fair share of contribution to national or international climate goals. Further insights can be obtained by examining through historic inventories how the emission profile has evolved over time.

[39] C40 Cities Climate Leadership Group have conducted studies on how to interpret Paris Agreement's goals at city level. More details can be found in the Deadline 2020 report available at: https://resourcecentre.c40.org/resources/deadline-2020

[40] See e.g., UNFCCC NDC List, Climate Tracker, CLIMATEWATCH

6.2 Define the target boundary

The target boundary refers to the geographic area[41], emission sources and GHGs covered by the target. How the boundary is defined has a significant impact on the emission reductions that can be generated under the target, as well as the mitigation opportunities available for achieving the target.

Local governments **shall** set a target boundary that is consistent with the boundary of the GHG emissions inventory that they will have submitted to GCoM. This means alignment in terms of the geographic boundary, emission sources and GHG gases covered.

If the target is set jointly with another signatory, the city should report their share of the target where possible. Otherwise, the joint target can be reported as long as the boundary is clearly described.

It is possible for local governments to exclude sources that are not controlled by them from the target boundary or include additional emission sources. In this case, any additions or exclusions **shall** be specified and justified. All exclusions **shall** be indicated by the notation key "Included Elsewhere" (IE), along with clear justification. For example, emissions sources that are already included in the EU Emissions Trading System are required to be included in the inventory as described in Chapter 3, but cities may choose to not include these emissions in their target (boundary); in some other cases, a city may choose to include emissions related to waste imported from outside the city boundary but treated in facilities located within and controlled by the city, which are not part of the mandatory inventory reporting level defined in Chapter 3.

Local governments are also **recommended** to develop and report any sector-level targets alongside their city-wide target(s).

6.3 Choose the target type

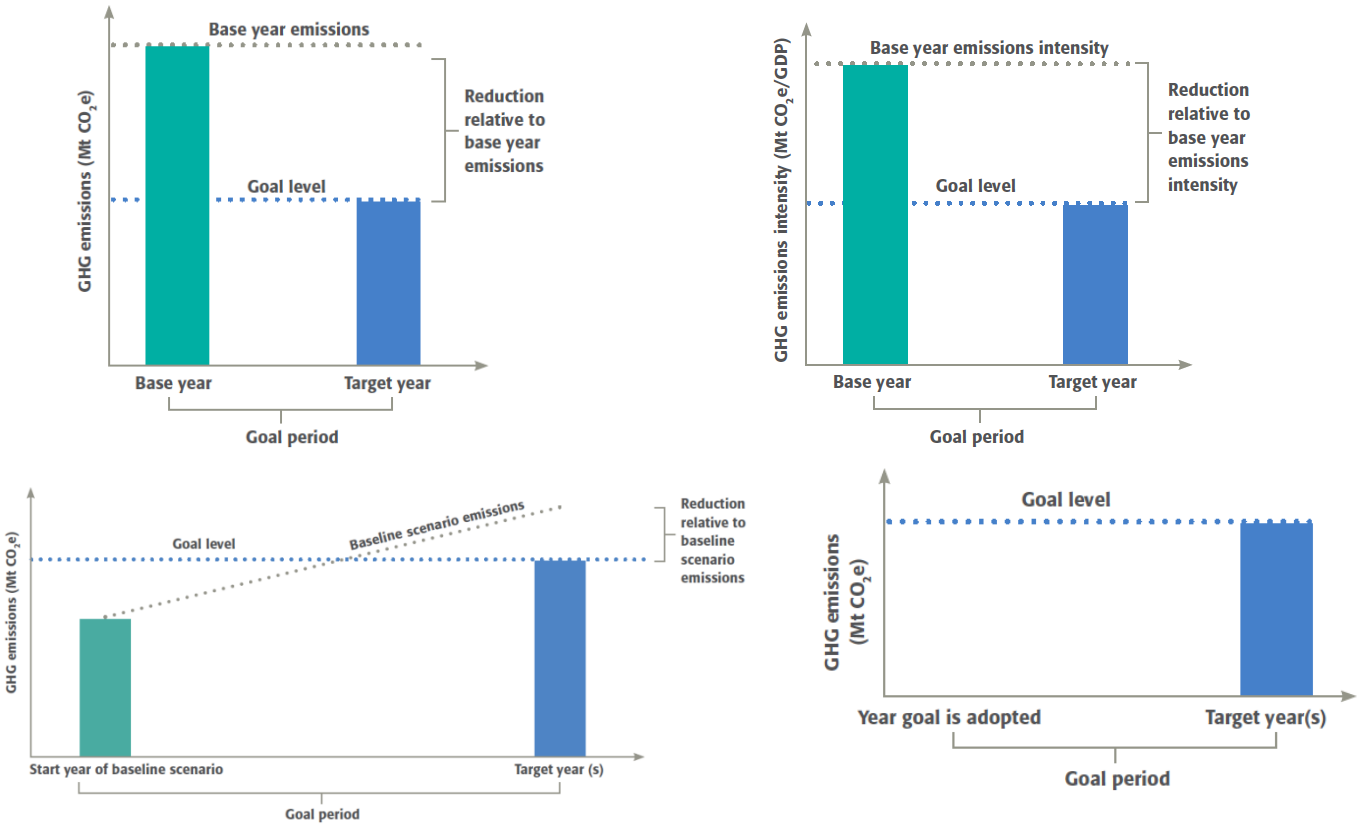
After defining the goal boundary, the next step is to choose the target type. Cities **shall** use one of the following four target types when designing targets[42]:

- **Base year emissions target***:* Reduce emissions by a specified quantity relative to a base year. For example, a 25% reduction in emissions from 1990 levels by 2030.
- **Base year intensity target:** Reduce emissions intensity (emissions per unit of another variable, typically GDP or capital Gross Domestic Product – GDP or per capita) by a specified quantity relative to a base year. For example, a 40% reduction in emissions intensity per capita from 1990 levels by 2030.
- **Baseline scenario target:** Reduce emissions by a specified quantity relative to a projected emissions baseline scenario. A Business as Usual (BAU) baseline scenario is a reference case that represents future emissions most likely to occur if the current trends in population, economy and technology continue and in the absence of changes in current energy and climate policies. For example, a 30% reduction from baseline scenario emissions in 2030.

[41] Please note that the local government's administrative boundary may go beyond to the city's geographic boundary. According to the GCoM all the emission within the "city boundary," even beyond the geographic boundary, shall be reported to the GCoM.

[42] Please refer to the *Greenhouse Gas Protocol Mitigation Goal Standard* for more details on these target types.

- **Fixed-level target:** Reduce, or control the increase of, emissions to an absolute emissions level in a target year. One type of fixed-level target is a carbon neutrality target, which is designed to reach zero net emissions by a certain date (e.g., 2050).



(1) Key considerations

Cities may refer to the targets adopted in the Nationally Determined Contribution (NDC[43]) or targets set by Regional/National Covenants to determine which type of target to set. In addition, cities should also consider the ease and transparency of accounting and demonstrating impacts.

Base year emissions targets and fixed-level targets are the simplest to account for, they more clearly articulate the target outcomes in terms of emissions and provide more transparency. This is because the emission levels in the target year can be easily calculated when the target is being set, and progress can be tracked using the GHG inventories alone.

To understand future emission levels associated with base year intensity goals, projections and assumptions are needed regarding the population (or GDP) in the target year, which may introduce uncertainty. It may be difficult to determine whether a reduction in emissions intensity translates to an increase or decrease in absolute GHG emissions, and by how much, given that the level of output is not fixed and will vary.

Baseline scenario goals are the most challenging to assess. The development of baseline scenarios typically requires a large amount of data, advanced modelling techniques, specialised technical capacity and assumptions about the likely development of various emissions drivers. In addition, projections of the future are inherently uncertain and can vary widely based on underlying methods,

[43] See e.g., UNFCCC NDC List, Climate Tracker, CLIMATEWATCH

models and assumptions. From a transparency perspective, it may be difficult to determine whether a reduction relative to a baseline scenario translates to an increase or a decrease in absolute emissions. If the baseline scenario emissions are overestimated, it would compromise the environmental integrity of the target.

Local governments may choose multiple target types and may also frame short-term goals differently than long-term goals. For example, Barcelona has now set a short-term base year emissions target (i.e. 45% reduction by 2030 from 2005 level) to reach a longer-term, fixed-level target (i.e. carbon neutrality by 2050).

Some target types can be translated and framed as another type of goal. Given the disadvantages of baseline scenario goals as described above, cities may reframe baseline scenario goals as a base year emissions goal or fixed-level goal, by calculating and specifying the emissions level that the city aims to achieve in the target year.

(2) Reporting requirements:

For local governments that adopt base year (or base year intensity) emissions targets, the level of emissions (or emissions intensity) in the base year **should** also be reported and ideally supported by an inventory. The emissions **should** be accounted in line with the GCoM requirements for inventories as set out in Chapter 3. Where there are major discrepancies, they **should** be identified and explained.

For local governments that adopt baseline scenario targets, the projected level of emissions at the target year under the baseline scenario **should** also be reported. The modelling methodologies and parameters[44] **shall** be transparently described.

6.4 Set the target timeframe

(1) Target year

The target year represents the year by which the local government commits to achieving the specified target.

Local governments **shall** set a target year that is the same, or later than, the target year adopted in the NDC or as set by Regional/National Covenants. This is important for demonstrating the city's contribution to achieving the NDC (or the vision or commitment of the Covenant), and its leadership if its target year goes further beyond the NDC (providing that it also has higher level of ambitions).

Setting a single target year that is too near in the future does not demonstrate the local government's long-term vision, whilst setting a target that is too far in future could make it challenging for short to mid-term action planning. Therefore, local governments that set a target year beyond 2030 (such as 2050) **shall** also include an interim target between now and 2030 that is consistent with an emissions trajectory that can achieve the longer-term target. If the NDC target is before 2030, local governments **should** additionally set a target for 2030.

[44] If using baseline scenario targets, local governments are highly recommended to develop BAU scenarios using local-specific parameters (i.e. growth rates of local population, economy, sector-specific factors that drive emissions to change, etc.) where possible. Simplified parameters, such as national coefficients derived from national BAU scenarios and growth rates of parameters at national level, may be used in the absence of local specific parameters.

(2) Base year *(only for base year emissions target and base year intensity target)*

A base year is a specific year of historical emissions (or emissions intensity) data against which current and target year emissions (or emissions intensity) are compared.

Where possible, local governments **should** choose the same base year set in the NDC or set by Regional/National Covenants, to allow for demonstrating their contribution to the NDC (or the vision or commitment of the Covenant).

Where there is a difference (e.g., where a city has previously adopted another base year or due to a lack of data availability), this **shall** be explained. Where possible, cities should also describe the target in relation to the base year of the NDC.

6.5 Set the level of ambition

This is the final stage of target setting. The level of ambition represents the quantity of emission reductions within the target boundary in the target year that the local government commits to achieve. For base year/base year intensity/baseline scenario targets, the level of ambition **shall** be reported as a percentage (%) reduction from the base year or scenario year. The absolute emissions in the target year(s) in metric tonnes CO_2e **shall** also be reported for all target types.

As outlined in section 4.1, when setting the ambition level, local governments **should** consider the global mitigation needs, international/national/local climate and relevant policy objectives, local emissions profile and mitigation opportunities.

(1) Minimum requirements

At a minimum, targets adopted by local governments **shall** be as ambitious as the unconditional components[45] of the NDC (if available), in order to demonstrate their fair share of contribution to national targets. To demonstrate leadership, local governments **should** set targets that are more ambitious than the NDC. When a national government increases their NDC, local governments **shall** have a maximum of five years to ensure their target remains as ambitious as the unconditional components of the NDC.

Where target (and base/scenario) years are different between the local government and NDC, GCoM will apply linear interpolation (i.e. by comparing the rate of reduction per annum[46]) to both targets to determine whether the above requirement is met.

When reporting the level of ambition, cities **should** also provide an explanation to justify that their targets are more ambitious than (or as ambitious as) the NDC, especially if their target (and

[45] Many countries have submitted two sets of NDC targets: unconditional targets, to be implemented without any explicit external support; and conditional targets. The latter are more ambitious than unconditional targets and require external support for their fulfilment. This includes financial support, and policies or action in other countries which support or facilitate a given country's mitigation policy (e.g., adoption of carbon taxes in a particular country may be conditional on the widespread use of carbon taxes in other countries, to ensure that domestic industry is not unduly impacted).

[46] For example, the national government has set a base year emissions target of 60% reduction by 2030 from 1990 level. The local government's target is set as 60% reduction by 2030 from 2000 level. Assuming straight line of reduction, the national government's target is equivalent to 1.5% reduction per annum, the city's target is equivalent to 2% per annum and thus can be considered more ambitious than the NDC.

base/scenario) years are different from the NDC, or if transferrable emissions units are used below or the target contains conditional components (see sections below).

(1) Examine local mitigation opportunities

In order to determine a level of ambition that is achievable and realistic, local governments need to understand their current level and profile of emissions, especially the big emitting sectors and opportunity areas, informed by a recent or the base year GHG emissions inventory. Where data is available, local governments can internally also examine how the emission profile has evolved over time and carry out benchmarking exercise against other cities that have a similar socio-economic-geographic profile.

In addition, local governments **should** look at future emission scenarios, including a business-as-usual scenario in the absence of future local mitigation actions, and alternative scenarios under different mitigation strategies and options, as well as the potential delivery costs and benefits. More guidance on developing emission scenarios, including tools, are available from GCoM partners.[47]

(2) Decide on the use of transferable emissions

Unless specified otherwise, the targets reported by local governments are related to absolute emissions. Local governments **may** choose to set a target on net emissions using transferable emissions units.[48]

However, the use of transferrable units is only permissible when the local government's target ambition without transferrable units exceeds the unconditional components of the NDC.

For example, the NDC's unconditional component is 50% reduction in (absolute) emissions by 2030 from 2000 level. The city may set a target of 60% reduction in (net) emissions by 2030 from 2000 level with transferable emissions units, as long as the target without transferrable units is no less than 50%.

Where a city cannot match the NDC's unconditional component without transferrable emissions units, justification needs to be provided to the relevant Regional/National covenant who will decide on whether the above requirement is met.

Where this is the case, the local government **shall** report the target, with and without the transferable emissions units, as well as identify the source of the transferable emissions units.

(3) Specify the conditionality

Unless specified otherwise, the targets reported by local governments are unconditional, i.e. not conditional on explicit external support, or in other words, the targets can be fulfilled under existing/planned national/local policy and actions and future mitigation actions that the local government has the power and resources to deliver. Some local governments may choose to a

47 Examples of relevant tools: Climate Action for Urban Sustainability (CURB) Tool, Pathways Model (available from C40 upon request), WRI's mitigation goal standard. Examples of relevant guidance: EU Covenant of Mayors guidebooks on developing 2020 and 2030 BAU scenarios.

48 These are emissions allowances and offset credits from market mechanisms outside the target boundary that are used toward meeting a target. Please refer to the Greenhouse Gas Protocol Mitigation Goal Standard for more details.

stretch target, where actions are identified for other key stakeholders beyond that which they have committed to themselves.

Any conditional components included in the target **shall** be identified and, where possible, the conditional components **should** also be quantified.

For example, a local government has set a target of 50% reduction in GHG emissions by 2030 from 2000 level. One of the key assumptions is that the carbon-intensity of the national electricity grid will need to be reduced by 50% by 2030 from 2000 level, which is higher than what has been committed in the NDC or official government policy (e.g., 30%). The city's modelling demonstrates that if the carbon intensity has only been reduced by 30%, the local government's GHG emissions would only drop by 35% by 2050. Therefore, the conditional component of the local government's target is 15%.

However, the use of conditional components is only permissible when a local government's target ambition exceeds the unconditional components of the NDC.

Where a city cannot match the NDC's unconditional component, justification needs to be provided to the relevant Regional/National covenant who will decide on whether the target is acceptable.

6.6 Summary of reporting output

Local governments may use existing reporting platforms/tools/templates available from GCoM partners or other bespoke tools to develop targets, as long as all information set out in Table 8 are provided (format may vary).

Table 8. Mitigation target reporting output summary

***Colour coding**: green cells – required for mandatory reporting, blue cells – optional*

A. Target setup

Is the geographic boundary of the city-wide target aligned with the latest GHG inventory submitted?	*Yes / No*
If not, briefly describe the difference	
Are the emission sources covered by the city-wide target consistent with the latest GHG inventory submitted?	*Yes / No*
If not, briefly describe any exclusion or addition for the target	*Yes / No*
Briefly describe relevant mitigation targets at regional and/or national level, incl. reference	

B. Target information

	Explanatory notes	
Sector	*City-wide or specify the sector (report city-wide and sectoral targets in separate columns)*	
Target valid from	*Enter the year or exact month/date the target was adopted*	
Target type	*Select from dropdown*	
Base year	*Optional for fixed-level target*	
Target year	*Report interim targets in separate columns*	
Base year emissions (or intensity)	*Only required for base year emissions (or intensity) targets*	
Baseline scenario emissions	*Only needed for baseline scenario targets*	
Units	*Units of the base year/baseline scenario data reported*	
Level of ambition (%)	*% reduction from base year (or baseline scenario)*	
Are transferrable emissions units used?	*Yes or no*	
If yes, briefly describe transferrable units	*Particularly the source of the transferable units*	
Level of ambition (%) - without transferrable units	*Only required if transferrable emissions units are used*	

Are the targets conditional?	*Yes or no*	
If yes, briefly describe the conditionality	*What the conditional components are and why*	
Level of ambition (%) - unconditional	*Optional, only applicable if targets are conditional*	
Explain why your city-wide targets are more ambitious than the NDC (if available)	*Optional*	
Specify the name of policy or legal document where the target is adopted	*Optional*	
Provide the URL address where the target is published	*Optional*	

C. Supplementary information

If a city-wide baseline scenario target is reported, describe the modelling methodologies and parameters:	
Provide the baseline scenario development report	

6.7 Setting adaptation goals

Adaptation goals **shall** be formulated based on the results of the risk and vulnerability assessment (see Chapter 4 – Climate Risk and Vulnerability Assessment). The goal statement **shall** include the baseline year as well as the delivery date.

Cities should also report how they are planning to track progress toward the achievement of the goal – ideally by formulating concrete indicators or key performance indices – and the monitoring plans put in place.

The following considerations are **optional** but suggested to help signatories to assess the robustness of the adaptation/resilience goals set[49]:

1. **Criteria of completeness:** Is the direction of goals clearly indicated?
   E.g., if heatwaves have been considered a hazard that may negatively impact elderly inhabitants, then the goal could be "minimise the number of elderly exposure to heatwaves" or "reduce the number of hospital admissions." Therefore, a goal would be required for every hazard implying a risk (hazard x exposure x vulnerability = risk).
2. **Criteria of internal coherence:** Is the adaptation goal coherent, i.e. aligned with the identified risks?
   Once the risks have been identified in the RVA (either "not known," "moderate," "high," etc.), the goals set under the initiative should be coherent with the identified risks and hazards.
3. **Criteria of quantification:** Have the goals been quantified to the extent possible and complemented with measurable metric/indicators?
   For example, if a goal is "minimise the number of heat-related mortality," then the metric could be "reduce the number of heat-related mortality by 25% by the year 2030 from the year xx."

[49] Adapted from Barbosa, P., Hernandez, Y., Rivas, S., Silina, D., Sgobbi, A. and Blondel, L. Covenant of Mayors for Climate & Energy: adaptation to climate change – Evaluation procedure and assessment criteria, EUR 29128, doi:10.2760/43991.

Chapter 7 – Developing a Climate Action Plan(s) (short summary)

7.1 Key principles and requirements for climate action plan(s)

Local governments that joined the GCoM are committed to taking concrete measures with long-term impact to tackle the interconnected challenges of climate change mitigation, adaptation and access to secure, affordable and sustainable energy. At the core of this commitment stands an officially adopted plan that captures the intentions and concrete policies and measures foreseen to (i) reduce/limit greenhouse gas emissions, (ii) prepare for the impacts of climate change and (iii) increase access to secure, affordable and sustainable energy[50] in the community and within the boundaries of the local government. It is also important that the climate action plan(s) put in place by the local government include clear provisions for tracking progress and regular progress reporting.

A key requirement of the initiative is that climate action plan(s) adopted by the signatory adequately cover all 3 pillars of the initiative – i.e. the local government has to develop plans for climate change mitigation, adaptation/resilience and energy access. The local government is free to decide whether to adopt a standalone document that integrates all or several of the three pillars or whether to adopt separate plans for each of the three pillars. It is also an option to mainstream[51], i.e. integrate targets/goals and actions related to the three pillars into other plans developed and officially adopted by the local government, such as in the energy sector or local development plans. What is important is that the following requirements are met, irrespective of which approach for climate action planning is being chosen:

- The plan(s) **shall** be formally adopted[52] by the local government.
- The plan(s) **should** be in an official language used by the local government.
- When mainstreamed in sectoral or local development plans, the climate and energy objectives and actions **should** be clear and able to be monitored.

Further, the climate action plan(s) adopted by the local government have to include the following information for both climate change adaptation and mitigation[50]:

- The mitigation target(s) and adaptation/climate resilience goal(s)[53], including (if available) sectoral targets, **shall** be clearly stated, including the baseline and delivery year(s).
- The plan(s) **shall** name the local government(s) which formally adopted the plan and the date of adoption.
- The plan(s) **shall** state who was the lead author team/Action Plan responsible/coordination team in the local governments.
- The plan(s) **shall** describe how different stakeholders were involved in the development of the plan(s).

[50]Please note that the concrete requirements for energy access plans will be specified at a later stage.
[51] The term mainstreaming refers to the integration of climate change mitigation and/or adaptation into related local government policies in relevant sectors.
[52] According to local government's procedures.
[53] The mitigation target(s) and adaptation/resilience goals have to be in line with requirements outlined in **Error! Reference source not found.**

- The plan(s) **shall** assess potential synergies, trade-offs and co-benefits of mitigation and adaptation actions.
- The plan(s) **should** include metrics (or key performance indicators) for tracking the progress and monitoring plans.
- The plan(s) **should** mention the internal and/or external bodies or mechanisms that will coordinate the implementation of the climate action plan as a whole.
- Where a stand-alone action plan is made, an indication of how the actions have been incorporated into statutory and sectoral development plans of the local government **should** be added.

The core element of the climate action plan(s) certainly form(s) the actions envisaged by the local government. Plans shall include the following information for each reported action:

- All actions of priority sectors have to be included in the plan(s). The actions **should** respond to the priority sectors and areas of intervention identified from the GHG emissions inventories and climate risk/vulnerability assessment(s).
- A brief description of each action, action area or sector **shall** be provided. This means that the measures included in the action plan can be targeting an entire sector, a sub-sector or the plan can name all individual actions foreseen in a specific area.
- Besides a brief description, each action, action area or sector **should** be accompanied by:
    - a financial strategy for implementation, i.e. an indication from which sources and by which instruments the action is planned to be financed;
    - information on the implementation status, cost and timeframe;
    - the identification of policy instrument(s) foreseen to implement the actions;
    - a description of who will be involved in the implementation of the action, including those directly responsible for the execution of the measure and other stakeholders.
- In addition, the plan **should** contain information on how the actions contained in the plan have been prioritized.

Specifically, for mitigation actions, the action plan **shall** provide an assessment of the expected energy saving, renewable energy production and GHG emissions reduction resulting from the implementation of each action, action area or sector.

7.2 Key considerations on developing and implementing climate action plan(s) at the municipal level[54]

The previous section outlined the mandatory and recommended elements of a climate action plan(s). This section provides a short summary of key considerations that should be considered when developing, monitoring and implementing these plans. References to available extensive guidance materials and resources are given at the end of this chapter.

Scoping/setting the boundary

[54]This section builds on the guidance provided in the series of JRC guidebooks on how to develop a Sustainable Energy and Climate Action Plan (SECAP). Please see Annex 3 for further references.

The climate action plans are the key documents outlining how a signatory city intends to reach the targets and goals set under the initiative. It should build on a thorough assessment of the current situation, including the existing policy and regulatory framework and the results of the GHG emission inventories and climate risk and vulnerability assessment(s). The plans should ideally cover the whole jurisdiction/geographical area of the signatory and focus both on the public and private sector within its territory. Ideally, it should also provide a description of how the plan fits in the national/regional plans and strategies, in terms of synergies and alignment, but also contribution to reaching the national objectives and goals. The municipality is of course expected to pay attention and lead by example in sectors over which it has the largest degree of influence, for example the municipal building stock or public transport.

The development of a climate action plan should not be considered as an objective, but rather as a tool that allows a local government to:

- Outline a longer-term vision of how the city will look in the future, in terms of, for instance, energy production and consumption, mobility, infrastructure and land use, resilience, population, consumption patterns and climate projections;
- Analyse current action in the field of energy, transport, waste and climate resilience and build a systematic plan, starting from the existing experience with a view of reaching an ambitious longer-term target/goal;
- Translate this vision into concrete actions, with clearly assigned responsibilities, deadlines and budgets;
- Communicate and share this vision and the roadmap for achieving it with the stakeholders;
- Serve as a reference during the implementation and monitoring process.

Action planning

The core part of any climate action plan[55] relates to the policies and measures that will allow the city to reach the targets and goals previously set. While each climate action plan should concentrate on actions aimed at reducing CO_2 emissions and the final energy consumption by end users, increasing the city's resilience and ensure access to secure, affordable and sustainable energy by the whole community, the adequate policies and measures are dependent on the specific context of each local government. Following these few steps is therefore recommended when elaborating the action plan:

1. Make use of good practices and lessons learned by peers

Consult good practice examples to identify which actions have delivered effective results in similar contexts, following similar objectives. The GCoM community offers a vast pool of case studies, best practice examples and lessons learned accessible to signatories around the world.

2. Set priorities and select key measures/actions

In view of limited available resources, capacities and existing trade-offs, an adequate selection of actions in a given time period is required. A preliminary analysis of possible actions could focus on assessing each possible action along a set of criteria which can be weighted according their

[55] When referring to Action Plan, note that this could include more than one document/plan.

importance to the municipality, including cost, required investment, energy savings, co-benefits, political and social acceptability, timeframe, payback period, etc. The assessment can consider different scenarios and should follow a participatory process.

3. Carry out a risk analysis

The selection of actions and measures should also be based on an estimation of risks associated with their implementation, including risk of failing or not delivering the expected results, etc. (see Chapter 4 for further details).

4. Specify actions in detail

Once the actions have been selected, clearly specify their timing, responsibilities for implementation, stakeholders to be involved, costs and financing sources. This allows easier planning of the implementation and tracking of the results, ensuring the success of the action. It is also important to assess the anticipated impact of actions (e.g., their expected GHG emissions reduction potential and potential synergies, trade-offs and co-benefits of adaptation and mitigation actions).

Implementation

Once the climate action plan has been drafted and formally adopted by the municipal council, actions have to be put into practice and the plan's implementation has to be well-managed and closely monitored. A clear and well-structured plan with carefully designed actions largely facilitates this process. Regular monitoring, using relevant indicators (ideally already included in the plan), followed by revisions of the plan allows the municipality to understand whether it is on track in achieving its targets/goals and to set corrective actions in a timely manner if required. GCoM signatories are therefore committed to submitting a progress report every two years after submitting the climate action plan(s) (see chapter 8 for further details).

The climate action plans should not be regarded as fixed and rigid documents: as circumstances change, new opportunities arise and ongoing actions provide results and experience, it may be useful and necessary to revise and update the plan, involving all relevant stakeholders. Regular monitoring followed by adequate adaptations of the plan(s) allows initiating a continuous improvement cycle.

Reporting

Local governments are encouraged to report actions in as much detail as possible. On the one hand, planning and reporting actions in detail helps to assess and receive feedback on whether the actions envisaged by the local government are sufficient and adequate to meet the targets and goals set under the initiative. It allows tracking and showcasing progress, provides valuable information to peers and is an important prerequisite for accessing climate finance. Both at the level of individual cities and at the aggregate level, the disclosure of projects contained in climate action plan(s) with the related financial information is critical to better evaluate what new levels of access to technical assistance, investments and financing are needed and increases investors' confidence in the city's ability to deliver with accountability and good governance.

7.3 Joint action planning with neighbouring local governments

Local governments have the option of developing a climate action plan(s) together with one or a group of neighbouring communities, covering one or more of the three pillars of the initiative. These plans can but don't have to be built on joint GHG emissions inventories (see chapter 3 for further details) and/or Climate Risk and Vulnerability Assessments inventories (see chapter 4 for further details). This can also but does not have to involve shared target setting (see chapter 6 for further details). In any case, it remains a requirement that each individual GCoM signatory individually officially adopts the joint action plan document(s) according to local government procedures.

Local governments may decide to develop a joint climate action plan(s) aiming, for example, at fostering institutional cooperation and joint approaches among neighbouring communities. Some local governments might conclude that joint approaches may allow for achieving more effective results in some areas than individual actions. In some circumstances, opportunities for high-impact actions can be more easily identified within the administrative boundaries of an aggregation of neighbouring local governments. This can be the case for measures targeting public transport, local energy production, water management or the provision of advisory services to citizens. Furthermore, municipalities involved in joint implementation of measures can also sometimes benefit from economies of scale, such as in public procurement. In addition, municipalities might wish to bundle scarce human and/or financial resources to jointly engage in action plan preparation, implementation and monitoring.[56]

The joint climate action plan(s) can contain both individual and shared measures, while shared measures are being encouraged.

While there are no restrictions on who and how many local governments can engage in developing joint action plan(s), this option is particularly suited for the case of small-sized neighbouring local governments. An urban agglomeration, like a metropolis and its suburbs can also consider joint action planning.

Example: The eight municipalities of Elba Island, Italy, with a total population of 31,000 inhabitants decided to develop a joint Sustainable Energy Action Plan for the whole island territory. The Province of Livorno provided support in this process. The choice was based on the desire to combine human and economic resources in plan development and implementation as well as the opportunity to achieve better results than they would by having each municipality act alone. The joint plan of Elba Island was the first step toward a more ambitious long-term goal of making Elba Island carbon neutral. A working group including representatives from all municipalities, the province and consultants was established to support data collection and define the target and measures. The plan provides a detailed characterisation of the measures incl. costs, support from private actors or necessary means of financing (e.g., through ESCOs). Some of the joint actions include the modification of buildings' regulations in order to foster energy efficiency and renewable energies and the collaboration between the municipalities and the tourist operators in order to reduce energy consumption from tourist accommodations.

[56] Adapted from Covenant of Mayors for Climate & Energy Office (2017), Quick Reference Guide - Joint Sustainable Energy & Climate Action Plan.

Source: Covenant of Mayors for Climate & Energy Office (2017), Quick Reference Guide - Joint Sustainable Energy & Climate Action Plan

Chapter 8 – GCoM monitoring and reporting

8.1 Reporting platforms and overall reporting timelines

Monitoring and reporting progress is an important cornerstone of the GCoM initiative. Once a local government has joined the GCoM and completed the steps related to assessment, target/goal setting and planning, the city should regularly monitor progress in implementing the action plan and toward achieving the targets and goals set. A robust monitoring system and timeline should be put in place from the beginning and be an integral part of the climate action plan(s) adopted by the city (see chapter 7 for further details). This also involves a clear mechanism for reviewing and updating the plans as required.

Next to closely monitoring the progress in implementing the climate action plan(s), signatories are also required to regularly update their GHG emissions inventories (see chapter 3 for further details) and Climate Risk and Vulnerability Assessments (see chapter 4 for further details). The climate action plan can be updated according to needs, new opportunities and implementation barriers appearing during the monitoring phase: it should be a living document, which serves the local governments and reflects the monitoring of the progress (see chapter 7 for further details).

Monitoring of climate action plan implementation is conducted by each individual city and local government in accordance with locally applicable rules and provisions as identified in the plan(s). Submission of subsequent progress reports are done through one of the two officially recognized reporting platforms:

- CDP and ICLEI's unified reporting system[57]
- the SECAP reporting platform, available in "MyCovenant" (the European Covenant Extranet).

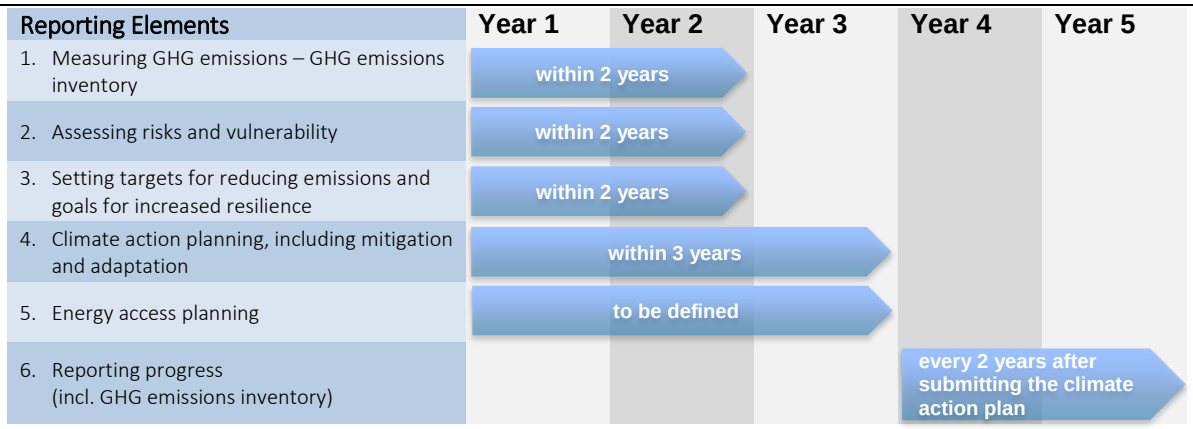
Each of the platforms has aligned with the GCoM framework and allows cities and local governments to report on the GCoM requirements and their progress.[58] Data reported to any of the reporting platforms may be converted by GCoM to allow for comparability and aggregation in line with the CRF. City and local governments will be asked to upload all relevant documents (most importantly climate action plan(s), GHG emission inventories and climate risk and vulnerability assessments) in either platform. They will also be required to update any relevant information related to:

- Basic information about the signatory (population, location, mayor, etc.)
- The target(s) and goal(s) set under the initiative

[57] By streamlining ICLEI's carbon*n* Climate Registry (cCR) and CDP's platform, the new unified reporting system will radically simplify the reporting process. CDP will manage the data intake process and publicly reported data (including GCoM data) will be automatically shared with ICLEI.
[58] The "MyCovenant" platform is expected to be updated in the course of 2019 in alignment with the GCoM CRF.

- GHG emissions in the sectors covered by the GCoM and a summary of the main methodological information related to the inventory (see chapter 3 for a detailed description of the requirements)
- The main results of the climate risk and vulnerability assessment
- A summary of the action plan, incl. a description of key actions

Each GCoM signatory must provide this information in accordance with the following the timeline, with year 0 being the year of joining GCoM, as indicated below:



EXAMPLE: A city that commits to GCoM in 2019 is asked to present the results of its GHG emissions inventory and Climate Risk and Vulnerability Assessment in the calendar year 2021, to set its goals and targets and submit its Climate Action Plan(s) by the end of 2022 the latest.[59]

Once the first five steps described in the above graph have been accomplished, the information on each of these steps must be confirmed or updated at a minimum of every two years. It is, however, recommended to report progress on an annual basis where possible.

Local governments may apply for an extension of reporting deadlines along with a clear justification. For previously committed cities, the year 2019 is considered a transition year, i.e. cities are granted more flexibility to familiarize themselves and start reporting against the new framework.

8.2 City-level monitoring and reporting to GCoM

The table below provides an overview of the most important elements a city-level monitoring framework related to the climate action plan(s) put in place under the GCoM should contain and explains the frequency and elements of reporting to the GCoM.

The monitoring information can be reported through the recognized online reporting platforms.

Table 9. Overview on city-level monitoring and reporting to GCoM

Monitoring element	Reporting to GCoM
GHG Emissions Inventory	
Regular update of the GHG emissions inventory The city is required to keep track of the city-wide	**Every two years** A more recent inventory must be reported to

[59] Please note that in the future the timelines for reporting may be directly linked to the exact date of joining GCoM. In this case, e.g., the inventory would be due on 5 May 2021 in case the city joined the GCoM on 5 May 2019. This change would only affect newly committed cities.

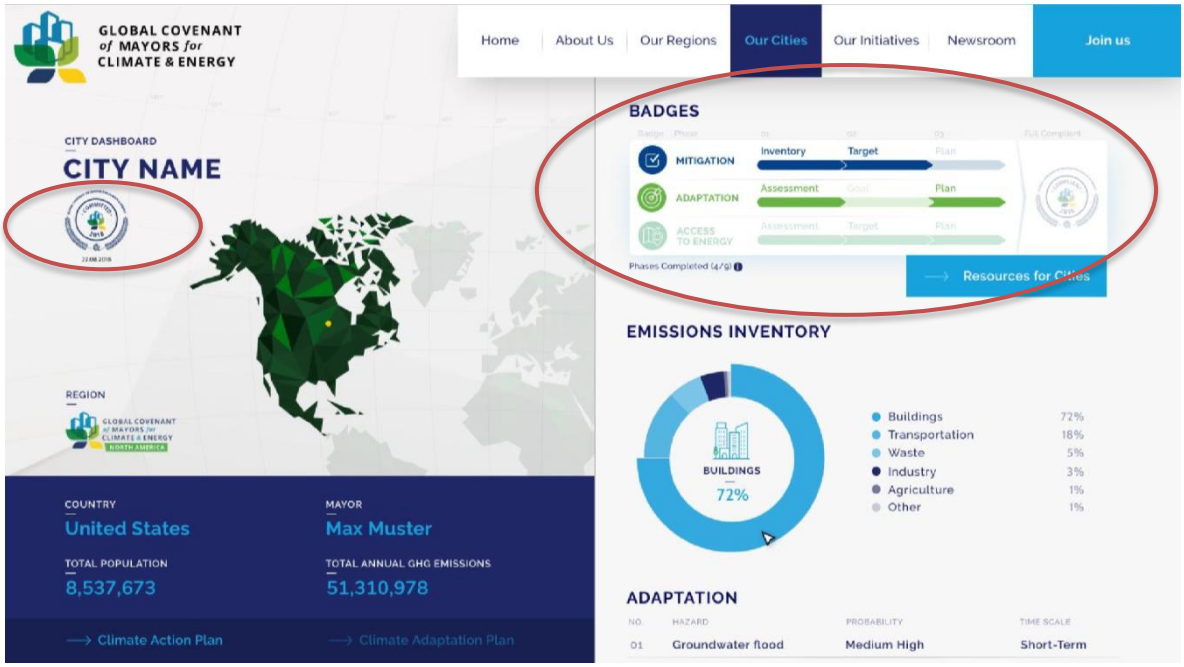
emissions. When updating inventories, cities must take into consideration all possible changes outlined in Table 6 in chapter 3, even if those changes are not significant.	GCoM.
Inventory update due to significant changes Signatories are required to update their inventories in case significant changes take place that trigger a recalculation of the inventory (as outlined in Table 6 in chapter 3, incl. changes in inventory boundary, calculation methodology, improvements in data accuracy, discovery of errors, etc.). This may also trigger the need for a recalculation of historic inventories (see chapter 3 for further details).	**As soon as possible; at the latest when the next inventory update is due**
Climate Risk and Vulnerability Assessment	
Regular update of the Climate Risk and Vulnerability Assessment The city should monitor the climate hazards it is exposed to, vulnerable population groups, as well as its adaptive capacity.	**Every two years** The assessment results and information reported previously must be confirmed or updated according to more recent assessments performed.
Climate Action Plan(s)	
Progress toward commitments in the climate action plan(s) Each signatory has to keep track on the progress toward achieving the mitigation target(s) and adaptation goal(s) set within the plans. This is performed by the city and must be publicly disclosed.	**Every two years** After the formal adoption of the climate action plan(s), a progress toward target/goal achievement must be reported every two years (i.e. if the plan was adopted in year 3 after joining the initiative, the first progress report is due in year 5)
Status of the implementation of each action/action area/sector in the climate action plan(s) Each signatory should keep track of the implementation progress of all mitigation and adaptation measures using the key performance indicators set in the adopted plan(s)	**Every two years** The status of implementation of each action/action area/sector contained in the plan(s) has to be reported every second year after submission of the action plan(s) (with the possibility to update or add actions).
Cost of each action/action area/sector It is recommended to also keep track of the implementation cost related to individual actions	**Every two years** The implementation costs of actions/action areas/sectors contained in the action plan(s) should be reported every second year after submission of the action plan(s)
Required revisions of the climate action plan(s) Cities are required to make provisions for regularly updating their action plan(s) when needed	**At the next reporting cycle** It is mandatory to resubmit the climate action plan(s) to GCoM when there are significant changes

At each step, cities need to report their information only once through any of the recognized reporting platforms. Key city data under the GCoM, reported through any of the recognized

reporting platforms, will be shared with, consolidated and made publicly available through the GCoM website, used for analysis and aggregation and shared with the UN's NAZCA platform.[60]

8.3 Minimum requirements and GCoM badges

The progress of signatories as they advance under the initiative will be visually recognized by a system of badges which are being displayed on the signatory's profile (city dashboard) on the GCoM website. Each city's progress in accomplishing and reporting on each of the steps for each of the 3 pillars under the initiative will be visually recognized with a specific badge/progress bar, as sketched in the example city profile in the upper right corner.



Upon committing to the initiative (commitment letter signed by an appropriately mandated official according to local government procedures), a commitment badge is awarded to each city (in the example city profile above this is displayed in the upper left corner, below the city name).

The badges and progress bars will be awarded, as soon as the city has accomplished and reported on a specific step and the compliance with the GCoM requirements has been confirmed:

Badges	Inventory/assessment bars (within 2 years)	Target/goal bars (within 2 years)	Plan bars (within 3 years)
	The commitment badge is awarded upon committing to the initiative by submitting a commitment letter signed by an appropriately mandated official according to local government procedures, incl. the pledge to implement policies and undertake measures to (i) reduce/avoid greenhouse gas (GHG) emissions, (ii) prepare for the impacts of climate change, (iii) increase access to sustainable energy and (iv) track progress toward these objectives.		
Mitigation badge	Inventory	Target	Plan

[60]Non-State Actor Zone for Climate Action (NAZCA, http://climateaction.unfccc.int/) was launched at the UN Climate Change Conference in Lima and registers commitments to action by local governments, businesses, etc.

 *Badge lights up as soon as the first step is accomplished*	GHG baseline emissions inventory submitted and validated (Including all mandatory criteria) for meeting the GCoM requirements	GHG emissions reduction/low emission development target set and validated for meeting the GCoM requirements	Separate or integrated climate action plan covering climate change mitigation (following GCoM framework) submitted and validated for meeting the GCoM requirements
Adaptation badge  *Badge lights up as soon as the first step is accomplished*	Assessment Climate Risk & Vulnerability Assessment submitted and validated for meeting the GCoM requirements	Goal Climate change adaptation goal(s) set and validated for meeting the GCoM requirements	Plan Separate or integrated climate action plan covering climate change adaptation (following GCoM framework) submitted and validated for meeting the GCoM requirements
Access to Energy badge	*Criteria will be communicated in 2019*	*Criteria will be communicated in 2019*	*Criteria will be communicated in 2019*
	The final badge is awarded to cities that have accomplished all steps under all three pillars. They will keep the badge as long as they keep submitting progress monitoring reports within the required timeframe, validated for meeting GCoM requirements.		

Each badge is displayed/progress bar is ticked on the signatory's profile once the respective step has been reported and positively evaluated. The city keeps the badge/progress bar as long as it keeps meeting all monitoring requirements and related timeframes. The badge/progress bar is suspended in case the city does not meet subsequent reporting requirements.

Annexes

Annex 1 – Chapter 3: Mapping of emission source categories with other commonly used guidance

Sectors and sub-sectors in GCoM reporting framework	IPCC (ref no.)	GPC (ref no.)	European CoM reporting framework (subject to revision)
Stationary Energy			Final energy consumption in the 'buildings, equipment/facilities, industries' sector
Residential buildings	1A4b	I.1.1, I.1.2	Residential
Commercial building and facilities	1A4a	I.2.1, I.2.2	Tertiary/commercial
Institutional buildings and facilities	1A4a		Municipal (incl. public lighting)
Industrial buildings and facilities	1A1, 1A2	I.3.1, I.3.2, I.4.1, I.4.2	Industry
Agriculture	1A4c	I.5.1, I.5.2	Agriculture/Forestry/Fisheries
Fugitive emissions	1B1, 1B2	I.7.1, I.8.1	Other emissions (incl. fugitive emissions)
Transportation			Final energy consumption in the 'transport' sector (several sub-sectors proposed, incl. municipal, public, private and commercial)
On-road	1A3b	II.1.1, II.1.2	Road*
Rail	1A3c	II.2.1, II.2.2	Rail*
Waterborne navigation	1A3d	II.3.1, II.3.2	Local and domestic waterways*
Aviation	1A3a	II.4.1, II.4.2	Local aviation*
Off-road	1A3e	II.5.1, II.5.2	Other/Off-road*
Waste			Other emission sources (not related to energy consumption)
Solid waste disposal	4A	III.1.1, III.1.2	Waste management Sub-sectors: solid waste, biological waste, incinerated and burned waste *
Biological treatment	4B	III.2.1, III.2.2	
Incineration and open burning	4C	III.3.1, III.3.2	
Wastewater	4D	III.4.1, III.4.2	Wastewater management
Industrial Process and Product Use (IPPU)			Final energy consumption in the 'industry' sector
Industrial Process	2A, 2B, 2C, 2E	IV.1.1	Industry
Product Use	2D, 2F, 2G, 2H	IV.2.1	
Agriculture, Forestry and Other Land Use (AFOLU)			Other emission sources (not related to energy consumption)
Livestock	3A	V.1.1	Agriculture, Forestry and Fisheries
Land use	3B	V.2.1	
Other AFOLU	3C, 3D	V.3.1	
Energy Generation			Energy Supply
Electricity-only generation	1A1	I.4.4	Electricity production (incl. certified green electricity, local electricity production)
CHP generation			
Heat/cold generation			Local heat/cold production
Local renewable generation			Renewable energy generation

* *Note - Transport modes and waste subsectors will be integrated in the new, revised version of the European CoM reporting template to be released in 2019 (they are not integrated in previous versions).*

Annex 2 – Chapter 4: Core definitions for the climate risk and vulnerability assessment

Adaptation (climate change): The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.

Adaptive capacity: The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities or to respond to consequences.

Exposure: The presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure or economic, social or cultural assets in places and settings that could be adversely affected.

Hazard: The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. The term hazard usually refers to climate-related physical events or trends or their physical impacts.

Impact (climate change): Climate change impacts are effects of extreme weather and climate events and of climate change on humans and natural systems. Impacts generally refer to effects on lives, livelihoods, health, ecosystems, economies, societies, cultures, services and infrastructure due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system.[61]

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. The term risk is often used to refer to the potential, when the outcome is uncertain, for adverse consequences on lives, livelihoods, health, ecosystems and species, economic, social and cultural assets, services (including environmental services) and infrastructure.

Resilience: The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation.

Vulnerability: The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

HAZARD-RELATED DEFINITIONS[62,63,64]

Climate extreme (Extreme weather or climate event): See Extreme weather event.

BIOLOGICAL HAZARDS

Biological hazards: are of organic origin or conveyed by biological vectors, including pathogenic microorganisms, toxins and bioactive substances. Examples are bacteria, viruses or parasites, as well as venomous wildlife and insects, poisonous plants and mosquitoes carrying disease-causing agents.

Water-borne disease: Condition related to contamination of water. The great majority of evident water-related health problems are the result of microbial (bacterial, viral, protozoan or other biological) contamination (e.g., diarrhoea). Nevertheless, an appreciable number of serious health concerns may occur as a result of the chemical contamination of drinking-water (e.g., arsenic contamination). Climate change affects availability, access and quality of existing drinking water, as well as the presence of harmful pathogens in water bodies in urban and peri-urban areas.[65]

[61] IPCC (2014), Annex II: Glossary, in: "Climate Change 2014: Synthesis Report"
[62]IPCC, 2013: Annex III: Glossary [Planton, S. (ed.)]. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[63]IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 688.
[64] UN, 2016: Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction. United Nations.
[65] Definition adapted to the urban context from: World Health Organization (WHO), (2011), Guidelines for Drinking-water Quality, 4th Ed.

Vector-borne disease: Vector-borne diseases are human illnesses caused by parasites, viruses and bacteria that are transmitted by mosquitoes, sandflies, triatomine bugs, blackflies, ticks, tsetse flies, mites, snails and lice.[66]

Airborne disease: Condition caused by airborne pathogens, which are transmitted through inhalation of droplet nuclei that remain infectious over a long distance (e.g., > 1 m), and require special air handling (4, 5). The transmission of these pathogens can be exclusively through droplet nuclei deposited in the distal part of the lung (e.g., tuberculosis) or also through other routes (e.g., measles).[67]

Insect infestation: The pervasive influx, swarming and/or hatching of insects affecting humans, animals, crops and perishable goods. Examples are locusts and African bees.[68]

CHEMICAL CHANGE

Salt water intrusion: Displacement of fresh surface water or groundwater by the advance of salt water due to its greater density. This usually occurs in coastal and estuarine areas due to reducing land-based influence (e.g., either from reduced runoff and associated groundwater recharge, or from excessive water withdrawals from aquifers) or increasing marine influence (e.g., relative sea-level rise). [69]

Ocean acidification: Ocean acidification refers to a reduction in the pH of the ocean over an extended period, typically decades or longer, which is caused primarily by uptake of carbon dioxide (CO_2) from the atmosphere but can also be caused by other chemical additions or subtractions from the ocean. Anthropogenic ocean acidification refers to the component of pH reduction that is caused by human activity.

Atmospheric CO2 concentrations: The concentration of carbon dioxide (CO_2) that would cause the same radiative forcing as a given mixture of CO_2 and other forcing components. Those values may consider only greenhouse gases (GHGs), or a combination of GHGs, aerosols and surface albedo change. CO_2-equivalent concentration is a metric for comparing radiative forcing of a mix of different forcing components at a particular time but does not imply equivalence of the corresponding climate change responses nor future forcing. There is generally no connection between CO_2-equivalent emissions and resulting CO_2-equivalent concentrations.

EXTREME COLD TEMPERATURE

Extreme winter conditions: Damage caused by snow and ice. Winter damage refers to damage to buildings, infrastructure, traffic (esp. navigation) inflicted by snow and ice in form of snow pressure, freezing rain, frozen waterways, etc.[70]

Cold wave: A period of abnormally cold weather. Typically, a cold wave lasts two or more days and may be aggravated by high winds. The exact temperature criteria for what constitutes a cold wave varies by location.[71]

Extreme cold days: Days where maximum temperature, or nights where minimum temperature, falls below the 10th percentile, where the respective temperature distributions are generally defined with respect to the 1961–1990 reference period.

EXTREME HOT TEMPERATURE

Heat wave: A period of abnormally and uncomfortably hot weather.

Extreme hot days: Days where maximum temperature, or nights where minimum temperature, exceeds the 90th percentile, where the respective temperature distributions are generally defined with respect to the 1961–1990 reference period.

EXTREME PRECIPITATION

Rain storm: (heavy rain) rain with a rate of accumulation exceeding a specific value (e.g., 7.6 mm). [72]

Monsoon: A monsoon is a tropical and subtropical seasonal reversal in both the surface winds and associated precipitation, caused by differential heating between a continental-scale land mass and the adjacent ocean. Monsoon rains occur mainly over land in summer.

[66] World Health Organization: https://www.who.int/news-room/fact-sheets/detail/vector-borne-diseases
[67] Definition adapted to the urban context from: World Health Organization (WHO), (2014), Infection prevention and control of epidemic- and pandemic-prone acute respiratory infections in health care - WHO Guidelines
[68] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.
[69] IPCC 2014, Annex XX: Glossary
[70] CRED - CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS, (2009), *Classification*. EM-DAT: The International Disaster Database. CRED. [Online] Available from: https://www.emdat.be/Glossary
[71] Ibid
[72] World Meteorological Organization (WMO) (2015), Event types of hazards and extreme events, meeting at the Seventeenth Session of the World Climate Congress (Cg-17): https://public.wmo.int/en/events/meetings/task-team-cataloguing-extreme-weather-water-and-climate-events-iptt-cwwce

Heavy snow: (snowstorm) meteorological disturbance giving rise to a heavy fall of snow, often accompanied by strong winds.[73]

Fog: Suspension of very small, usually microscopic water droplets in the air, generally reducing the horizontal visibility at the Earth's surface to less than 1 km.[74]

Hail: Precipitation of either transparent, or partly or completely opaque particles of ice (hailstones), usually spheroidal, conical or irregular in form and of diameter very generally between 5 and 50 millimetres, which falls from a cloud either separately or agglomerated into irregular lumps.[75]

FLOOD AND SEA LEVEL RISE

The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods and glacial lake outburst floods. Sea level can change, both globally and locally due to (1) changes in the shape of the ocean basins, (2) a change in ocean volume as a result of a change in the mass of water in the ocean and (3) changes in ocean volume as a result of changes in ocean water density. Global mean sea level change resulting from change in the mass of the ocean is called barystatic. The amount of barystatic sea level change due to the addition or removal of a mass of water is called its sea level equivalent (SLE). Sea level changes, both globally and locally, resulting from changes in water density are called steric. Density changes induced by temperature changes only are called thermosteric, while density changes induced by salinity changes are called halosteric. Barystatic and steric sea level changes do not include the effect of changes in the shape of ocean basins induced by the change in the ocean mass and its distribution.

Flash/surface flood: Heavy or excessive rainfall in a short period of time that produce immediate runoff, creating flooding conditions within minutes or a few hours during or after the rainfall.[76]

River flood: River floods (also referred to as 'riverine' or 'fluvial' flood) occur over a wide range of river and catchment systems. Floods in river valleys occur mostly on flood plains or wash lands because of flow exceeding the capacity of the stream channels and spilling over the natural banks or artificial embankments.[77]

Coastal flood: Higher-than-normal water levels along the coast caused by tidal changes or thunderstorms that result in flooding, which can last from days to weeks.[78]

Groundwater flood: The emergence of groundwater at the ground surface away from perennial river channels or the rising of groundwater into man-made ground, under conditions where the 'normal' ranges of groundwater level and groundwater flow are exceeded.[79]

Permanent inundation: Landmass completely covered with water.

MASS MOVEMENT

Landslide: (or mudslide) is a rapid movement of a mass of soil, rock or debris downhill by gravity, often assisted by water when the material is saturated.[80]

Avalanche: Mass of snow and ice falling suddenly down a mountain slope and often taking with it earth, rocks and rubble of every description.[81]

Rock fall: The sudden and very rapid downslope movement of unsorted mass of rock and soil.[82]

Subsidence: Subsidence refers to the sinking of the ground due to groundwater removal, mining, dissolution of limestone (e.g., karst, sinkholes), extraction of natural gas and earthquakes.[83]

[73] Ibid
[74] Ibid
[75] Ibid
[76] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.
[77] World Meteorological Organization (WMO) (2015), Event types of hazards and extreme events, meeting at the Seventeenth Session of the World Climate Congress (Cg-17)
[78] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.
[79]] BGS - BRITISH GEOLOGICAL SURVEY. (2015) Groundwater flooding research overview. Natural Environment Research Council. [Online] Available from: http://www.bgs.ac.uk/research/groundwater/flooding/groundwater_flooding.html
[80] World Meteorological Organization (WMO) (2015), Event types of hazards and extreme events, meeting at the Seventeenth Session of the World Climate Congress (Cg-17)
[81] Ibid
[82] CRED - CENTRE FOR RESEARCH ON THE EPIDEMIOLOGY OF DISASTERS, (2009), *Classification*. EM-DAT: The International Disaster Database. CRED. [Online] Available from: https://www.emdat.be/Glossary

STORM AND WIND

Severe wind: (Definition for wind) Differences in air pressure resulting in the horizontal motion of air. The greater the difference in pressure, the stronger the wind. Wind moves from high pressure toward low pressure.[84] The severity of wind events is location-dependent.

Tornado: A violently rotating storm of small diameter; the most violent weather phenomenon. It is produced in a very severe thunderstorm and appears as a funnel cloud extending from the base of a cumulonimbus to the ground.[85]

Cyclone (Hurricane/Typhoon): Generic term for a non-frontal synoptic scale cyclone originating over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. *Tropical disturbance*: light surface winds with indications of cyclonic circulation. *Tropical depression*: wind speed up to 33 knots. *Tropical storm*: maximum wind speed of 34 to 47 knots. *Severe tropical storm*: maximum wind speed of 48 to 63 knots. *Hurricane*: maximum wind speed of 64 knots or more. *Typhoon*: maximum wind speed of 64 knots or more. *Tropical cyclone* (South-West Indian Ocean): maximum wind speed of 64 to 90 knots. *Tropical cyclone* (Bay of Bengal, Arabian Sea, South-East Indian Ocean, South Pacific): maximum wind speed of 34 knots or more. [86]

Extra tropical storm: A type of low-pressure cyclonic system in the middle and high latitudes (also called mid-latitude cyclone) that primarily gets its energy from the horizontal temperature contrasts (fronts) in the atmosphere. When associated with cold fronts, extratropical cyclones may be particularly damaging.[87]

Tropical storm: (see definition of cyclone/hurricane/typhoon above).

Storm surge: The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place.

Lightning/thunderstorm: Sudden electrical discharges manifested by a flash of light (lightning) and a sharp or rumbling sound (thunder). Thunderstorms are associated with convective clouds (cumulonimbus) and are, more often, accompanied by precipitation in the form of rain showers or hail, or occasionally snow, snow pellets or ice pellets.[88]

WATER SCARCITY

Drought: A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore, any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). Storage changes in soil moisture and groundwater are also affected by increases in actual evapotranspiration in addition to reductions in precipitation. A period with an abnormal precipitation deficit is defined as a meteorological drought. A mega-drought is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more.

WILD FIRE

Weather conditions conducive to triggering and sustaining wild fires, usually based on a set of indicators and combinations of indicators including temperature, soil moisture, humidity and wind. Fire weather does not include the presence or absence of fuel load.

Forest fire: Type of wild fire in forested/wooded area

Land fire: (brush, bush, pasture) type of wild fire in a non-wooded area such as bush, grassland, scrub or pasture.

Box 7. European example of climate modelling

Downscaling global climate models is necessary to capture the spatial and temporal variability of projected temperature, precipitation, wind, air humidity and climate extremes at urban scale. The EURO-CORDEX[89] provides regional climate

[83] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.
[84] Ibid
[85] World Meteorological Organization (WMO) (2015), Event types of hazards and extreme events, meeting at the Seventeenth Session of the World Climate Congress (Cg-17)
[86] Ibid
[87] Integrated Research on Disaster Risk. (2014). Peril Classification and Hazard Glossary (IRDR DATA Publication No. 1). Beijing: Integrated Research on Disaster Risk.
[88] Ibid

change projections for the EU domain from the CMIP5[90] experiments until 2100 with a grid resolution of about 12 km (0.11 degree).

Additionally, local data from city weather stations can be used to refine the calibration of the regional climate models, improving the accuracy of short-term scenario projections. Urban climate maps can help to identify heat island effect through the analysis of surface temperature and wind patterns according to building distribution and density.[91]

There are many examples of climate-impact models. The selection of the most suitable ones for the studied context depends on several factors, including data availability. Proxies can be used when desired data is unavailable;[92] proxies introduce an additional uncertainty to the analysis but represent a valid tool to overcome the lack of reliable or accessible information at local level. When data scarcity disables the use of detailed climate-impact models, GIS based tools can be used to link climate extremes to biophysical and socioeconomic data.

The model OUTPUT comes in the form of maps representing – for a specific time window and climate scenario[93] – the spatial variability within the urban perimeter of the potential impacts. The map is usually a raster file, whose resolution depends on the quality of INPUT data.

Other possible resources for reporting this information include national climate change projections or reports by the IPCC. Similar to past hazards, local governments report the probability and impact of the most relevant/significant hazards expected to occur within their jurisdiction. By reporting the probability and consequence of the hazards, local governments effectively report on the risk level of the identified climate hazards. Local governments are also required to indicate whether the frequency and intensity of climate hazards are expected to increase, decrease or remain the same (also possible to report no information/knowledge of change) and at which timescale the change is expected to occur. Reporting entities are expected to indicate the timescale based on the following list of values: Immediately = change in frequency/intensity already being felt (relevant for climate hazards which occur now or have occurred in the past); short-term = change in frequency/intensity anticipated by 2025; medium-term = change in frequency/intensity anticipated between 2026-2050; long-term = change in frequency/intensity anticipated after 2050. It is also possible to report "not known" when information/knowledge of projected change does not exist.

Annex 3 – Further guidance materials, tools and resources

Resource title and link	Description	Languages	Organisations
General Guidance (Chapter 2)			
IPCC (2014), "Climate Change 2014: Synthesis Report"	The Synthesis Report (SYR) of the IPCC Fifth Assessment Report (AR5) provides an overview of the state of knowledge concerning the science of climate change	English, Arabic, Chinese, French, Russian, Spanish	IPCC
Covenant of Mayors Europe online Library	Offers a wide range of useful resources, technical materials, thematic leaflets, case studies and best practice examples, webinar recordings, etc.	English and other EU official languages	Covenant of Mayors Europe
C40 Climate Action Planning Resource Centre	C40's Climate Action Planning Resource Centre brings together a wide range of resources and tools to support city climate planners in the process of delivering action consistent with the objectives of the Paris Agreement.	English	C40

[89] http://www.euro-cordex.net/.
[90] Coupled Model Intercomparison Project, Phase 5. https://pcmdi.llnl.gov/mips/cmip5/index.html.
[91] Katzschener, L., 2011. Urban Climate Maps. Available at: http://www-docs.b-tu.de/megacity-hcmc/public/02_Urban_Expansion/2_DPA_Roundtable_Katzschner_EN_lores.pdf.
[92] OECD and JRC, 2008. Handbook on constructing composite indicators. OECD press, pp.158.
[93] Global Climate Models provide information of temperature and precipitation, among others, according to RCPs scenarios.

Sustainable Energy and Climate Action Plan Guidebook	Part 1: The SECAP process, step-by-step toward low-carbon and climate-resilient cities by 2030	English	European Commission's Joint Research Centre, 2018
GHG Emissions Inventories (Chapter 3)			
City Inventory Reporting and Information System (CIRIS)	Excel-based tool to compile a GHG city-wide inventory in the format of the GPC	English	C40
ClearPath GHG Inventory tool	ClearPath Global is an online GHG inventory tool for local governments worldwide	English	ICLEI
Sustainable Energy and Climate Action Plan Template	Excel-based tool to compile a GHG city-wide inventory following the European Covenant of Mayors methodology (currently under revision)	English	Covenant of Mayors Europe
Sustainable Energy and Climate Action Plan Guidebook	Part 2: Baseline Emission Inventory (BEI) and Risk and Vulnerability Assessment (RVA)	English	European Commission's Joint Research Centre, 2018
2006 IPCC Guidelines for National Greenhouse Gas Inventories	2006 IPCC Guidelines to compile National Greenhouse Gas Inventories	English	IPCC
IPCC Emission Factor Database (EFDB)	International library of emission factors to estimate greenhouse gas emissions	English	IPCC
CAIT Climate Data Explorer	National GHG emissions data source	English	WRI
Risk and Vulnerability Assessments (Chapter 4)			
Urban Adaptation Support Tool	The (UAST) assists local authorities in developing, implementing and monitoring climate change adaptation plans. It outlines all the steps needed to develop and implement an adaptation strategy and makes references to valuable guidance materials and tools. Step 2 provides specific guidance on assessing climate change risks and vulnerabilities	English	European Environmental Agency, European Covenant of Mayors
City Climate Hazard Taxonomy	C40's classification of city-specific climate hazards	English	C40, Arup (2015)
European Covenant of Mayors E-learning tool	1 dedicated module on adaptation, available in MyCovenant	English, Spanish, Italian, French, German	Covenant of Mayors Europe
How to prepare for floods, heatwaves and	European Covenant of Mayors Leaflet	English	Covenant of Mayors

other climate change impacts			Europe, 2018
European Covenant of Mayors webinar recordings (select "webinars" under the "type" filter)	European Covenant of Mayors webinar recordings, incl.: - Co-creation of climate action and adaptation support tools by local governments and researchers (2019, English) - Implementing a pathway approach for climate change adaptation at the local level (2018, English)	English	Covenant of Mayors Europe
European Covenant of Mayors Reporting Guidelines	Adaptation chapters provide guidance on RVA	Available in all EU languages	Covenant of Mayors Europe
European Covenant Case Studies (select "case studies" under "type")	Urban adaptation case studies from European Covenant cities	English	Covenant of Mayors Europe
Sustainable Energy and Climate Action Plan Guidebook	Part 2: Baseline Emission Inventory (BEI) and Risk and Vulnerability Assessment (RVA)	English	European Commission's Joint Research Centre, 2018
Urban Risk Assessments: Understanding Disaster and Climate Risk in Cities	Tool to help cities manage disaster risk, placing priority on proactive, adaptive planning to reduce and manage the potential for disasters and climate-related weather events. The assessments are guided by three principals that collectively contribute to the understanding of urban risk: 1) hazard impact assessments, 2) institutional assessments and 3) socioeconomic assessments.	English	World Bank
Shaping climate-resilient development: a framework for decision-making	This document identifies significant potential for cost-effective adaptation measures based on local climate conditions, and for building more resilient economies.	English	Economics of Climate Adaptation (ECA) Working Group
UK Climate Impacts Programme, UKCIP	UKCIP's Adaptation Wizard is a 5-step process to help your organisation adapt to climate change. It's also a guide to useful information, tools and resources.	English	UK Climate Impacts Programme (UKCIP)
Planning for climate change: Guide	Framework for city planners to better understand, assess and take action on climate change at the local level - it includes specific sections on vulnerability assessments	English	UN-Habitat
Planning for climate change: Toolkit	Framework for city planners to better understand, assess and take action	English	UN-Habitat

	on climate change at the local level - it includes specific sections on vulnerability assessments		
C40 Cities Climate Change Risk Assessment Guidance	A guidance document to help cities conduct a climate change risk assessment	English	C40
The Vulnerability Sourcebook: Concept and guidelines for standardised vulnerability assessments	Tool for conducting vulnerability assessments at the national level	English, Spanish, French	GIZ, EURAC
Guideline - Impact and Vulnerability Analysis of Vital Infrastructures and built-up Areas	Practical guidelines for assessing impacts and vulnerabilities of urban areas and their infrastructure related to consequences of climate change	English	RESIN
Target setting (Chapter 6)			
Mitigation Goal Standard	Guidance to design national and subnational mitigation goals	English, Spanish, French	WRI
Climate Action Planning (Chapter 7)			
EC JRC SEACAP guidebooks (How to develop a Sustainable Energy (Access) and Climate Action Plan (SE(A)CAP))	Methodological guidebooks with a focus on specific regions, including Europe, Sub-Saharan Africa, EU Eastern Partnership Countries, North Africa and Middle East.	English, Russian	European Commission Joint Research Centre
Climate action for URBan sustainability (CURB)	Excel-based interactive scenario planning tool to help cities take action on climate change	English	C40, AECOM
Climate Action Planning Framework	The Climate Action Planning Framework was developed to support cities in developing climate action plans that are aligned with the objectives of the Paris Agreement.	English	C40
Urban Adaptation Support Tool	The tool provides step-by-step guidance to adaptation in the urban context, including identification, assessment and selection of adaptation actions.	English	European Environmental Agency, European Covenant of Mayors
UN-Habitat's 'Guiding Principles for City Climate Action Planning'	The principles establish benchmarks for action planning in cities, based on international evidence and best practices.	English	UN-Habitat
Planning for climate change: Guide	Framework for city planners to better understand, assess and take action on climate change at the local level	English	UN-Habitat

Planning for climate change: Toolkit	Framework for city planners to better understand, assess and take action on climate change at the local level	English	UN-Habitat
CDP's Open Data portal	The data portal contains cities' publicly reported data through CDP and is freely available	English	CDP
GHG Contribution Analysis	Toolkit designed to assist communities in the application of GHG Contribution Analysis	English	ICLEI USA
Adaptation and Mitigation Interaction Assessment Tool (AMIA)	The AMIA tool enables cities to methodically identify potential interactions between climate adaptation and mitigation measures	English	C40