**NET ZERO CITIES**

## Comprehensive indicator framework

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## Summary

This deliverable D4.2.1 presents the concept for an overarching NetZeroCities indicator framework allowing for a holistic and multidimensional assessment of progress towards climate-neutrality among Mission Cities. The aim of this deliverable is to create an integrated framework of indicators and support the evaluation of Climate City Contracts (CCCs) and the monitoring of implementation of 2030 Climate Neutrality Action Plans and Investment Plans as well as of the NetZeroCities city pilots This deliverable describes the concept for the integrated indicator framework, i.e. the structure the NetZeroCities partners agreed on and the underlying rationale. Specific sets of indicators will be developed in Deliverables D2.5, D2.6, D2.7 and D2.8, with deadlines at the end of September 2022. The updated version of this report, D2.4.2., will then integrate these specific sets of indicators into the structure defined in D4.2.1 to create an ?Integrated Indicator Framework? ready for monitoring. This will also require alignment among the specific sets of indicators.

Approval

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# Concept for a Comprehensive Indicator Framework

**Deliverable D2.4.1**

Version N°0.2 after review

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# Abbreviations and acronyms

| Acronym | Description |
|---------|-------------|
| AFOLU | Agriculture, Forestry and Other Land Use |
| EC | European Commission |
| EoL | End of Life |
| EU | European Union |
| GHG | Green House Gas(ses) |
| CCC | Climate-Neutral City Contract |
| CNAP | Climate Neutrality Action Plan |
| IPPU | Industrial Processes and Product Use |
| JRC | Joint Research Center of the European Comission |
| NBS | Nature-Base Solution(s) |
| NZC | NetZeroCities |
| TOC | Theory of Change |
| WP | Work Package |

# Summary

This deliverable D2.4.1 presents the concept for an overarching NetZeroCities indicator framework allowing for a holistic and multidimensional assessment of progress towards climate-neutrality among Mission Cities. The aim of this deliverable is to create an integrated framework of indicators and support the evaluation of Climate City Contracts (CCCs) and the monitoring of implementation of 2030 Climate Neutrality Action Plans and Investment Plans as well as of the NetZeroCities Pilot interventions.

The deliverable describes the concept for the integrated indicator and process design framework for the monitoring, evaluation, and learning (MEL) activities, namely the structure the NetZeroCities partners agreed on and the underlying rationale. Specific sets of indicators were developed in Deliverables D2.5, D2.6, D2.7 and D2.8. The updated version of this report, D2.4.2., will integrate these specific sets of indicators into the structure defined in D4.2.1 to create an "Integrated Indicator Framework" ready for monitoring. This will also require alignment among the specific sets of indicators and MEL processes.

# Keywords

Climate Neutral Cities, Monitoring, Impact Assessment, Evaluation, Learning, Theory of Change

# 1   Aim and Scope of the Deliverable

This deliverable D2.4.1  presents the concept for an overarching NetZeroCities indicator framework allowing for a holistic and multidimensional assessment of progress towards climate-neutrality among Mission Cities. The aim of this deliverable is to create an integrated framework of indicators and support the evaluation of Climate City Contracts (CCCs) and the monitoring of implementation of 2030 Climate Neutrality Action Plans and Investment Plans as well as of the NetZeroCities city pilots.

Deliverable 2.4.1 is structured as follows:

**Chapter 2** explains the need for Monitoring, Evaluation and Learning (MEL) in the Climate-Neutral and Smart Cities Mission and summarizes the requirements for the MEL outlined in the Mission Implementation Plan. Furthermore, the European State of the Art is analyzed and gaps in existing indicator systems are highlighted.

**Chapter 3** presents a concept for an integrated indicator system that responds to the need of the Climate-Neutral and Smart Cities Mission, and it outlines the rationale and the structure of this integrated indicator framework and presents its monitoring domains. The indicator system needs to serve four main purposes: 1) To monitor the commitments cities make in the climate city contracts, 2) to track their progress towards their climate neutrality goals, 3) to assess co-benefits of their journey towards climate neutrality and 4) to monitor the quality of the transition process to inform and enable mutual learning between the cities. Furthermore, the system should be designed in a way that it can be used not only for climate city contracts and climate neutrality action plans, but (with certain modifications) also for the monitoring and impact assessment of the Pilot Cities' interventions of the Climate Neutral and Smart Cities Mission, but also for the monitoring of the impact of the mission as a whole.

**Chapter 4** explains how the indicator system will be used for the monitoring, evaluation and learning can be used in practice and describes the steps that mission cities will do to setup/ customize NZC monitoring framework for themselves.

**Chapter 5** discusses the suitability of the proposed indicator framework for monitoring pilot projects (lower level) for monitoring the EU mission.

**Chapter 6** summarizes the main findings of this report and gives and outlook to the next steps.

# 2  Background

This chapter explains the need for Monitoring, Evaluation and Learning (MEL) in the Climate-Neutral and Smart Cities Mission and summarizes the requirements for the MEL outlined in the Mission Implementation Plan. Furthermore, the European State of the Art is analyzed and gaps in existing indicator systems are highlighted.

## 2.1 Requirements for Monitoring in the Smart and Climate-Neutral Cities Mission

The European Climate-Neutral and Smart Cities Mission has specific requirements regarding monitoring, evaluation, and learning (MEL). Some of the requirements are laid down in the Mission Implementation Plan published in September 2021. An in-depth analysis of these requirements for monitoring in the Smart and Climate-Neutral Cities Mission can be found in NetZeroCities deliverable D2.1. In addition, the deliverable D2.3 (which is a report on the output of the workshop with cities that took place in the spring 2022) has provided with more insights on what cities' think is missing from their current monitoring and evaluation practices and exploring what other ways (methods, data, processes etc.) would be needed to improve. This chapter provides a summary thereof, including updated findings and discussions.

The info kit for cities published by the Joint Research Center (JRC) in late 2021 (European Commission, 2021b) addresses cities interested in participating in the call for expression of interest for participating in the 100 Climate-Neutral and Smart Cities by 2030 of the EC and states several selection criteria.

By design, the Cities Mission and associated approach for MEL must cover a very broad range of cities. To tackle the different levels and requirements of involved cities, the MEL will seek to use as much data as possible that the cities provide in other tasks anyway (for example: data from the questionnaire to cities included in the Expression of Interest (EOI) application process by the EC (if available to the NZC Consortium).

The Info Kit mentions MEL as important for cities. In connection to the net zero emission definition of the Cities mission, the Info Kit outlines emission sources to be covered and defines the scope and validity of key mitigation efforts next to $CO_2$ equivalent reduction. MEL will need to cover at minimum scope 1 and scope 2 emissions from stationary energy, energy generation transport, waste (including in this case scope 3, i.e., at point of disposal/treatment) as well as Industrial Processes and Product Use (IPPU) and the Agriculture, Forestry and Other Land Use (AFOLU).

Industrial facilities registered in the EU's Emission Trading System (ETS) are exempt from reporting. The share of residual emissions above net zero cannot exceed 20% and need to be compensated, i.e. by offsetting, or removing, either through Carbon Capture and Storage (CCS) – only when storage is permanent – or sequestrated through enlargement of natural sinks. Furthermore, and to account for developments in the national decarbonization ambitions, cities are advised to use local emission factors for grid supplied energy and heat, which can be adapted on an annual basis. Renewable energy purchases as well as the use of biomass with net zero emission factor are only permitted when the sustainability is certified. Monitoring design has not been defined, but monitoring should take place in iterations and be linked to the targets/CCCs.

The benefits of digitalization for low-carbon cities are seen among others in improving evidence-based decision making; a better understanding of cities preferences; real time data and technologies as well as advancing R&I and the digital economy, but also, for example, in monitoring, performance management and optimization. Data shall be as well collected on/for citizen engagement and provide incentives for bottom-up transition, whereby the data shall be used from across sectors to understand and analyze interdependencies. Creating a digital twin and an urban data platform as "the beating heart of the urban digital transformation" is mentioned explicitly. Hence, WP2 will need a discussion on (common) open standards and interfaces for the MEL, potentially also to ensure the compatibility and interoperability with other systems and urban platforms.

Citizens are key drivers of transitions and citizen engagement is important in co-creating and implementing the changes to achieve climate neutrality. Citizen participation is happening in cities, whether orchestrated or bottom-up. These processes need to be harnessed and multiplied. This has implications for the MEL and calls for the further alignment with the respective WPs in NZC.

In terms of social innovation (enabling fair transitions), it is important to highlight that both are a process and a strategy capable of fostering decarbonization and society's development by matching technological innovation with innovation in social practices and relations (social innovation both a process/aim AND a result). The characteristics of social innovation can serve as basis for operationalization in the MEL (European Commission, 2021b, pp. 68–69).

Finally, the Info Kit asks the question on the financing aspects. In order to facilitate investment readiness assessments, four different tools are mentioned to help cities in understanding their point of departure (European Commission, 2020; Sustainable Finance Taxonomy - Regulation (EU) 2020/852, n.d.; ICLEI & TAP, 2021) (The City Maturity Model for Climate-Smart Urban Infrastructure (Cities Climate Finance Leadership Alliance, 2021). A table on financial instruments and mechanisms for climate action is provided and needs to be taken up in the MEL (European Commission, 2021b, pp. 82–84).

This analysis of the impact package clearly shows the need for an integrated multi-domain MEL framework that combines quantitative and qualitative monitoring approaches. Although achieving climate neutrality is the goal of the Cities Mission, focusing on monitoring emission reduction only is not sufficient, as it would not be able to capture co-benefits, nor would it lead to any learning on drivers and barriers for successful decarbonization of cities.

## 2.2 State of the Art in KPIs for monitoring climate action of cities

Monitoring, Evaluation and Learning is not a new topic. There is, for example, extensive literature and practice on urban indicator systems (Neumann et al., 2015). During the course of WP2, an analysis was conducted on key performance indicators (KPIs) for future Net Zero Cities and indicators of implemented frameworks, as outlined by WP2. This helped detecting possible existing indicator gaps and gave an overview about the significance of different indicators, such as which indicators are used in current frameworks.

To run our analysis, we mapped the EU commission's Implementation Plan (European Commission, 2021a, p. 40) [1] and compared related indicators with our list of existing reporting frameworks, indicator sets and accounting methods (see D2.1), to establish a matrix of indicator usage per framework (see Annex B, C). None of the existing systems, however, is aligned with the requirements of the Carbon-Neutral and Smart Cities Mission.

Previous research has suggested classifying indicators into different types (e.g. input, process, output, outcome, impact) thus allowing selection of most suitable indicators for specific use and phase in cities' transition to carbon neutrality (e.g. planning, implementation, ex-post evaluation) (Huovila et al., 2019). Although impact indicators, such as GHG emission reduction, are most relevant for final assessment of success, it is recommended to combine those with short-term metrics, such as outcome (or result) indicators, that help to monitor the effectiveness of climate plan implementation.

The Cities Mission Implementation Plan proposes a simple, yet robust set of indicators grouped in relation to implementation, results, impact, GHG emissions and air pollution:

***Implementation indicators:***

- The Level of city's interest for climate neutrality

- City preparedness

- Diversity of city

***Results indicators***

- City commitment to climate neutrality

- Diversity of EU/regional/national funding

- Mobilization of EU/regional/national funding and private investment capital

*Impact indicators:*

- Actual progress towards climate neutrality

- Overall contribution towards 55% target of European Green Deal

- Number of climate neutral cities

*GHG emission indicators (MyCovenant and CDP/ICLEI):*

- emissions from buildings, industry, transport, waste treatment (solid waste and wastewater), agriculture and forestry and from other activities within city boundaries

- indirect emissions due to consumption of grid-supplied electricity and indirect emissions due to consumption of grid-supplied heating and/or cooling within the geographic boundary

- emissions from "out-of-boundary" emissions from treatment of waste produced within the geographic boundary, out-of-boundary emissions from transmission and distribution of energy consumed within the geographic boundary, out-of-boundary emissions from transportation of citizens living within the geographic boundary, out-of-boundary emissions from consumption made within the geographic boundary (food, clothes, furniture, materials, etc.) and other indirect emissions.

*Levels of air pollution within city boundaries*

1. PM 2.5 concentration levels – highest annual mean observed at (sub)urban background stations

2. NO 2 concentration levels (highest annual mean observed at traffic stations).

## Table 1: Discussed Frameworks

| Framework | Type |
|---|---|
| CDP/ICLEI Unified Reporting Platform | Reporting Framework |
| My Covenant | Reporting Framework |
| Global Protocol for Community-Scale GHG Emissions (GPC) | Accounting Method |
| BISKO Standard (Germany) | Accounting Method |
| GHG Footprinting | Accounting Method |
| Science Based Targets (SBTs) – Global Climate Allicance | Accounting Method |
| The Climate Change Adaptation MER (CCA-MER) framework by Rambøll & C40 Cities | Reporting Framework |
| Urban Climate Action Impacts Framework (UCAIF) by C40 & Rambøll & partners | Learning Framework |
| Nature Based Solution Policy tracker | Learning Framework |
| The Greenhouse Gas Protocol (WRI and WBCSD) | Accounting Method |

| The CURB Tool: Climate Action for Urban Sustainability | Accounting Method |
|---|---|
| Data-driven Life Cycle Assessment tool | Accounting Method |
| UN/IPCC Common Reporting Framework | Accounting Method |
| The Reference Framework for Sustainable Cities (RFSC) | Reporting Framework |
| PAS 2070:2013+A1:2014 European Standards for GHG emission assessment of cities (Direct Plus Supply Chain) | Accounting Method |
| SIMRA | Indicator Set |
| Evaluating the Impact of Nature-based Solutions | Indicator Set |
| euPOLIS | Indicator Set |
| RESINDEX | Indicator Set |
| Solutions for NetZeroCities | Indicator Set |
| INCLUSION Process Evaluation Framework | Learning Framework |
| CIVITAS Evaluation Framework | Indicator Set |
| Sustainable Urban Mobility Indicators (SUMI) | Indicator Set |
| Energy Indicators | Indicator Set |
| Energy Indicators | Indicator Set |
| mySMARTLife Evaluation Framework | Indicator Set |
| REMOURBAN Evaluation Framework | Indicator Set |
| SmartEnCity Evaluation Framework | Indicator Set |
| City Resilience Framework | Indicator Set |
| Citizen Engagement Impact Framework | Learning Framework |
| Transformative Theory of Change | Learning Framework |
| Indicator standard by ISO (International Organization for Standardization) – ISO37120 | Indicator Set |
| United 4 Smart sustainable cities: Collection methodology for key performance indicators for smart sustainable cities (U4SSC) | Indicator Set |
| EU Smart Cities Information Systems Monitoring | Indicator Set |
| CITYkeys indicators for smart city projects and smart cities | Indicator Set |
| ClimateView | Reporting Framework |
| ClearPath | Reporting Framework |

We scanned well-defined frameworks accordingly to detect KPI indicators in use (a comprehensive list of frameworks is available in Table 1). If the KPIs mentioned do not follow predefined terms, there was a need to summarize and aggregate similar topics to broader themes enabling us to run the analysis (such as aggregating indicators regarding *financial* and *economic* topics, or indicators regarding

population *demographics*, *social* and *cultural* topics), resulting in indicator groups that have been used in multiple frameworks.

Annex B shows a comprehensive matrix of discussed frameworks (x-Axis) and KPI indicator sets (y-Axis), as suggested by the Implementation Plan. Annex C shows indicator sets that were found in addition to them in the frameworks.

Within the EC Indicators (Annex B) we found a high variance in application of listed indicators. For instance, we found most used indicators coming from the group of "Implementation Indicators", such as "Level of city interest for climate neutrality" or "City Preparedness" that have been of use in multiple discussed frameworks. We found furthermore a high usage of indicators from Transport and Energy, same as GHG emission indicators, such as "Emissions from buildings, industry, transport", "indirect emissions", "emissions from out of boundary" and "transmission and distribution of energy".

The group of "Result indicators" and "impact indicators", such as on the city's diversity and commitment, or the actual progress towards climate neutrality, however, were used less often or not used at all by discussed frameworks.

From our frameworks, we found various indicators that have not been listed by the EC Implementation Plan but were used frequently. Main detected indicator gaps include *social*, *environmental* and *economic* factors, as well as population's *health*, *water / wastewater* management, *resilience* and *urban design / urban characterization*. These topics were found to be highly important due to being included in most frameworks, while they were left out of the discussion in the Implementation Plan. These findings indicate the need for reconsideration of indicators and their definition in an integrated indicator framework, filling such existing gaps.

Previous studies have identified a gap in indicators that measure the effectiveness and impact of cities' own climate actions. While the widely used final measure of carbon neutrality, city's GHG emissions, is largely affected by national measures (e.g. emission factor of national electricity grid) and external stakeholders, cities need progress indicators to measure the success of local climate actions (Damsø et al., 2017; Huovila et al., 2022; Laine et al., 2020). Therefore, it will be important to develop suitable, comparable indicators and MEL processes for cities' climate neutrality action plan monitoring.

# 3 Concept for the integrated MEL indicator framework

This chapter presents a concept for an integrated indicator system that responds to the need of the Climate-Neutral and Smart Cities Mission. The system should enable Mission Cities to monitor (i.e. to self-assess) their progress towards reaching climate neutrality by 2030. Furthermore, the integrated indicator framework should ensure that the data collected by the cities is comparable to facilitate cross-cutting analysis, benchmarking, and mutual learning among cities.  This will also enable the European Commission to follow the progress of the Climate and Smart City Mission and obtain validated data for future policies and decision making.

Cities need to be able to measure, monitor and evaluate the implementation of the Action Plan towards climate neutrality by 2030. A set of auditable, reportable, and verifiable key performance indicators is an important precondition for the monitoring and evaluation as well as the continuous analysis of the city´s achievements. Data collection, analysis and reporting processes should enable climate action learning for all local stakeholders as well as contribute to systemic innovation and transformation towards climate neutrality.

The climate actions taken by the Mission Cities will have direct and indirect impacts. The expected direct impact will be a dramatic reduction in greenhouse gas (GHG) emissions, which is a *conditio sine qua non* for urban climate neutrality. Literature suggests that the efforts cities take to become climate neutral will have additional positive impacts on urban sustainability, such as improved air quality and biodiversity. We call these expected indirect impacts "co-benefits", and they also need to subject of monitoring, as it is unknown to what extent they will materialize.

However, it will not be sufficient to look at emission reduction alone. Social, economic and environmental drivers must also be taken into account to ensure acceptance as well as technical and financial feasibility of the transition towards climate neutrality. The NetZero City project has thoroughly analyzed which decisions cities need to take to make climate neutrality happen. Based on this analysis, a Theory of Change (ToC), which outlines the systemic levers necessary to reach climate neutrality, was developed. These systemic levers are Governance Innovation, Democracy and Participation, Social Innovation, Finance & Funding, and Learnings & Capabilities.

Thus, in summary, the impact domains to monitor and evaluate in relation to the 2030 Climate Neutrality Action Plan implementation include: 1) Monitoring of direct benefits (emission domains), 2) Monitoring of indirect benefits ( also known as co-benefits), and 3) Process monitoring of action portfolios and systemic levers, following defined transition pathways (see Figure 1).

These impact domains are then broken down into several subdomains, as shown in Figure 2.

The subdomains rationale for the subdomains is the following: 1) The subdomains for Direct Benefits (reduction in GHG emissions) are aligned with the emissions domains of MyCovenant and the CDP/ICLEI GHG reporting framework, to facilitate data collection through existing reporting channels. 2) The subdomains of Indirect Benefits  take up the co-benefits of climate neutrality identified by WP10. 3) The subdomains of Systemic Levers reflect the Systemic Levers described in the Theory of Change.

As a next step, the subdomains will be populated with indicators. Several deliverables have already proposed indicators for climate (D2.5), nature-based solutions (D2.6), social innovation (D2.7) as well as finance and funding (D2.8). Eventually, these indicators will be integrated to a comprehensive set of Monitoring, Evaluation and Learning (MEL) indicators (Deliverable D2.4.2.) It will be available as of March 2023 to guide Mission Cities, contains information on the progress and impact monitoring, reporting and evaluation of 2030 Climate Neutrality Action Plans. Indicators sets developed thereafter will be available for selection and adaption by the cities during their Action Plan development process
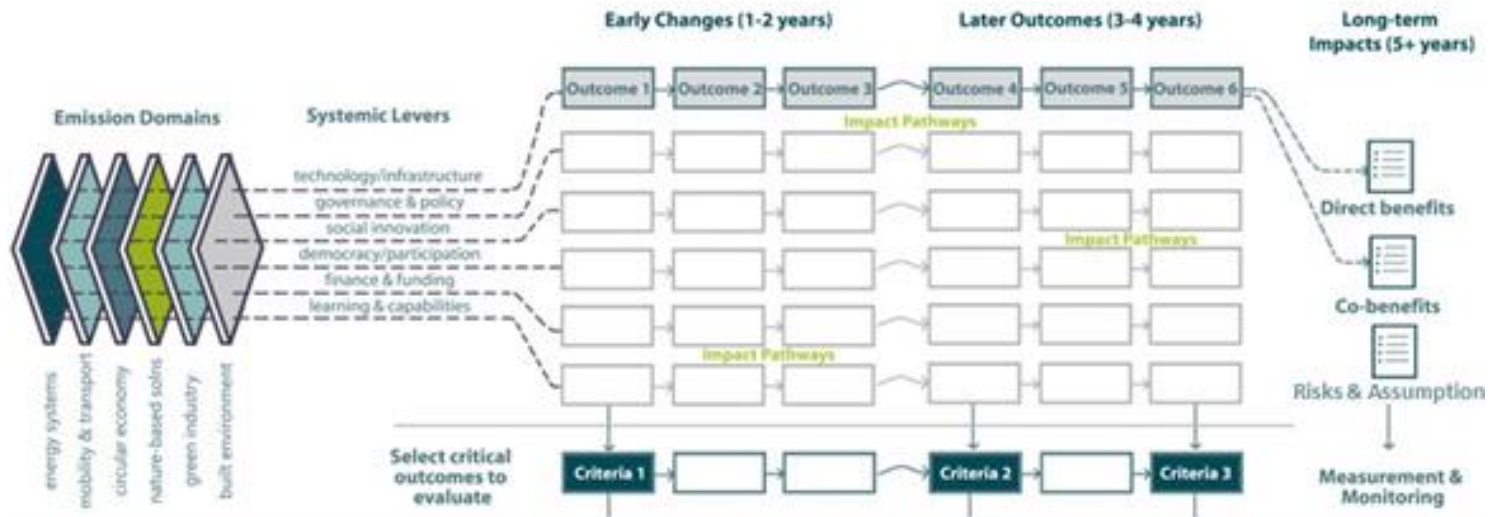
**Figure 1: Schematic overview of impact pathways for Action Plans and Pilot Cities' reporting framework**
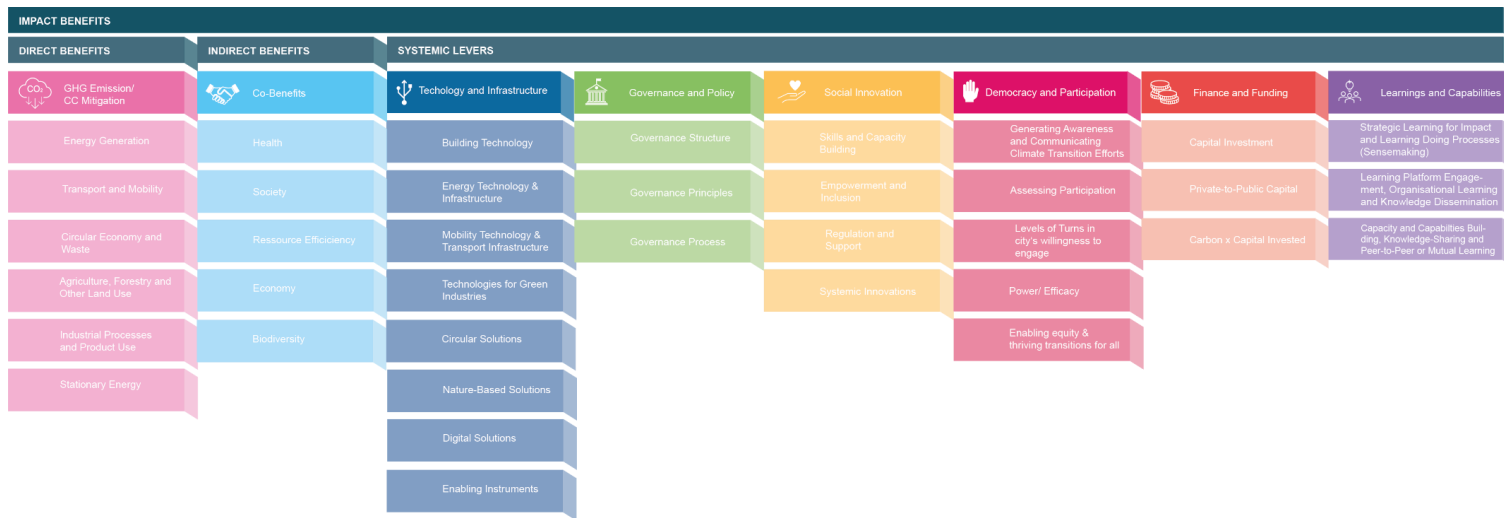


**Figure 2: Domains and subdomains of the integrated indicator framework**

## 3.1 Monitoring of direct benefits

To meet the targets of the European Green Deal and become the first climate-neutral continent by 2050, the greenhouse gas emissions of the Mission cities need to be monitored following a structured and coherent framework. With regard to streamlining the process – for both the Mission cities and the NZC Consortium – two prominent and widely used GHG reporting frameworks will be allowed as entry platforms for Mission reporting. This entails the European Covenant of Mayors (also known as EURCoM, CoM, or MyCovenant) and the CDP/ICLEI Track reporting platform. Both platforms already cover 50% of the Mission Cities current reporting practices, and the CDP/ICLEI platform offers great flexibility to integrate other reporting frameworks such as the Greenhouse Gas Protocol (GPC) and the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. A thorough review of these reporting platforms and their indicators can be found in deliverable 2.10 Cities can continue using reporting methodology that they already have in use – and import their emissions data to CDP-ICLEI Track. Important to note is that it is advised to stick to one reporting methodology as to prevent double counting of emissions.

The following subchapters are divided based on the greenhouse gas emission sectors as proposed by the JRC Info Kit. These sectors largely overlap with the GHG reporting categories within MyCovenant and the CDP/ICLEI platform. For each sector, the scope will be identified and some preliminary indicators as how to measure these emissions will be suggested. A more in-depth analysis of the sectors and the accompanying indicators will follow in deliverables 2.4.2 and 2.5.

### 3.1.1 Energy Generation

The Energy Generation sector encompasses GHG emissions that result from the generation of grid-supplied energy. These include all emissions from the generation of energy for grid-distributed electricity, steam, heating, and cooling.  Preferably, local emission factors that can be updated annually should be used for this calculation. To avoid double counting, these emissions are distinguished as scope 2 emissions and do not form a part of the GHG emissions inventory total. This represents all grid-supplied electricity, steam, heating, and cooling consumed within the city boundary. Electricity is the most used type of grid-supplied energy, mostly used in offices, homes, outdoor lighting, other buildings. Using grid-supplied energy entails emissions produced at generation facilities off-site from the consumption facilities. To avoid double counting, scope 1 (and 3) are excluded from the calculations that fall under this sector. Cities shall report scope 1 and 2 separately and not sum them together.
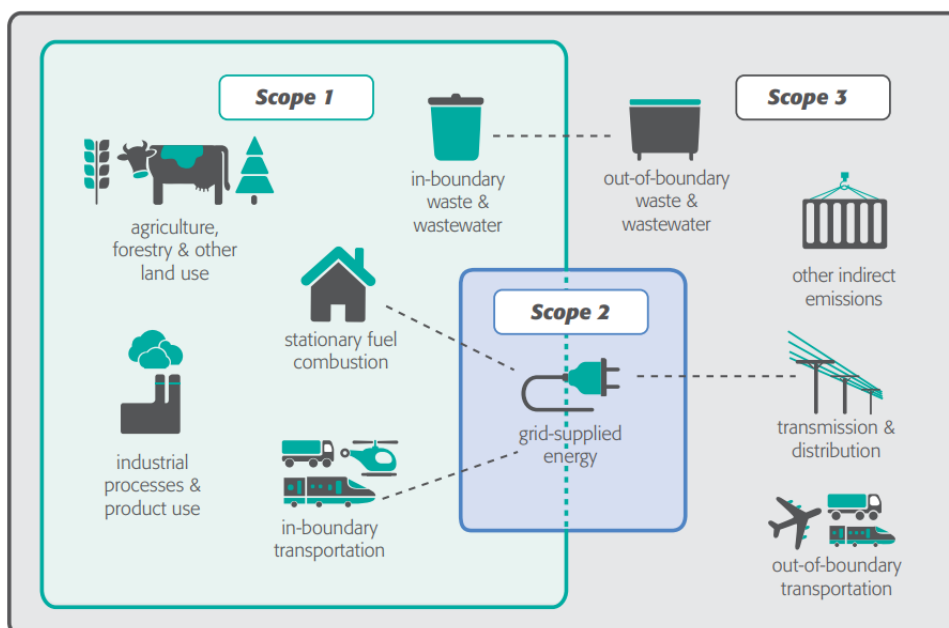


**Figure 3: Sources and boundaries of city greenhouse gas emissions (GPC, 2014)**

*Example indicators:*

The indicators that are part of the Energy Generation sector usually fall under Stationary Energy sector. Some examples of grid-supplied energy indicators could be:

- Fugitive emissions from fuel transformation

- Fugitive emissions from natural gas systems

- Share of renewable energy in gross final energy supply

## 3.1.2 Transport and Mobility

This monitoring dimension will assess the progress mission cities make towards their targets for climate-neutral transport and mobility. Greenhouse gas emissions as part of the Transport sector are emissions from transportation occurring in the city from the transport of people and freight within the city boundary (scope 1). Emissions from grid-supplied energy used in the city for transportation (scope 2) must be included as well. Emissions from the portion of transboundary journeys occurring outside the city, and transmission and distribution losses from grid-supplied energy from electric vehicle use (scope 3) are not part of the Mission mandate and are only recommended to be included by 2030.

*Example indicators:*

- Well-to-wheel GHG emissions by all passenger and freight transport modes in the urban area

- Air pollutant emissions of all passenger and freight transport modes (exhaust and non-exhaust for PM2.5) in the urban area

Indicators to measure the greenhouse gas emissions from urban transport can be drawn from the set of Sustainable Urban Mobility Indicators (SUMI) (European Commission, n.d.)[1].. The SUMI indicators are a tool for cities and urban areas to identify the strengths and weaknesses of their mobility system and to focus on areas for improvement. As cities and urban areas continue to develop Sustainable Urban Mobility Plans (SUMPs) and work towards EU policy goals, it is important for this progress to be documented to ensure that such achievements become visible. The European Commission has developed a comprehensive set of practical and reliable indicators that support cities to perform a standardized evaluation of their mobility system and to measure improvements that result from new mobility practices or policies. Next to indicator #7 (Greenhouse gas emissions) also indicators #3 (Air pollutant emissions) and #9 (Energy efficiency) are relevant for Mission Cities. But also, most other indicators are highly pertinent because of the societal and political imperative to achieve a just transition to zero carbon, which includes issues like affordability, accessibility, equity, health etc. The EC is currently funding a follow-up project (Eltis/ SUMI2) to revise a few of the indicators to a certain extent (Rupprecht Consult GmbH, n.d.) (Thereafter, the indicator set will be a key instrument for the EC, as outlined in the recently published EC Urban Mobility Framework.

For a broader assessment of the impact of mobility measures, cities may also use indicators from the CIVITAS Evaluation Framework. The CIVITAS Evaluation Framework is THE guideline for the impact assessment and process evaluation of CIVITAS projects, primarily Innovation Action (IA) projects (less so for Research and Innovation (RIA) projects). It presents the overall objectives of a methodically robust assessment and evaluation framework and spells out clear related quality criteria and suggests key steps in such a process. One chapter is dedicated to in-depth explanations of the impact assessment and another chapter presents the rationale and approach to process evaluation. The document also gives guidance on evaluation reporting and even provides concrete reporting templates.

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1 Sustainable Urban Mobility Indicators (SUMI): https://transport.ec.europa.eu/transport-themes/clean-transport-urban-transport/sumi_en, [date]

When it comes to process evaluation of transport measures cities could make use of the INCLUSION process evaluation framework which was developed to guide the process evaluation of the Horizon 2020 project INCLUSION. It presents the general purposes of a process evaluation as a precondition to truly understand the causal mechanism behind those phenomena, which are typically captured / observed through a (quantitative) impact assessment. Process evaluation is thus a critical ingredient of any attempt to make informed statements about the transferability of certain measures. The INCLUSION process evaluation framework spells out the specific rationale, approach and concrete methods deployed in the INCLUSION project. It explains concrete data gathering methods as well as related responsibilities and pertinent data analysis methods, based on qualitative data analysis software. The framework also features a set of concrete evaluation questions (a so called "questions bank") and elaborates on important ethical aspects and data protection issues of the process evaluation.

### 3.1.3 Circular Economy and Waste

Greenhouse gas emissions as part of the Waste sector are either emissions from waste generated and managed/sent to landfill within the city boundary (scope 1) or emissions from waste generated within the city boundary but managed/sent to landfill outside the city boundary (scope 3). Waste is a pivotal sector since under the framework of the Climate Neutral and Smart Cities Mission, because only scope 3 emissions associated with waste disposal/management will be included under the definition of climate neutrality. That means that other scope 3 emissions such as transport do not fall under the Mission compliance. However, cities are allowed to include other scope 3 emissions at their own discretion – which is what NetZeroCities will advocate for by offering the measurement of 'aspirational' indicators that cover scope 3 emissions besides waste emissions.

***Example indicators:***

- Biological treatment

- Share of Municipal solid waste going to incineration and open burning

- Circular Material Use rate

- Material imports dependency

- End of Life (EoL) recycling input rates

- Material footprint per capita

- Proportion of MSW sorted and recycled

### 3.1.4 Agriculture, Forestry and Other Land Use (AFOLU)

GHG emissions as part of the Agriculture, Forestry and Other Land Use sector are produced through a variety of pathways such as management of forests and other lands, methane produced in the digestive processes of livestock, changes that alter the composition of vegetation and soil, and nutrient management for agricultural purposes.  Scope 1 emissions in this category are in-boundary emissions from agricultural activity, land use and land use change. Important to note is that GHG emissions associated with the manufacture of nitrogen fertilizers – which account for a significant part of agricultural emissions, are not counted under AFOLU but instead under IPPU. Scope 2 emissions are not applicable for this sector since emissions from the use of grid-supplied energy in buildings and vehicles in farms or other agricultural areas shall be reported in Stationary Energy and Transportation, respectively. Emissions from land-use activities outside the city (Scope 3), such as agricultural products that are imported for consumption within the city boundary, are not covered by this framework.

Nature-Based Solutions (NBS) are a unique way of occupying the land and renaturing the cities. They are key in sequestering (capturing or storing) carbon emissions, and very much more related with the co-benefits than with climate mitigation per se. Restoring and preserving biodiversity overall at the soil level helps to increase the carbon sequestration, which is also key in the pathway of climate neutrality.

*Example indicators:*

- Greenhouse facilities

- Livestock facilities

- (NBS-related) Carbon stored in vegetation

- (NBS-related) Avoided GHG emissions from reduced building energy consumption

## 3.1.5 Industrial Processes and Product Use (IPPU)

Greenhouse gas emissions as part of the Industrial Processes and Product use sector result from non-energy uses of fossil fuel related to industrial activities and product uses. As part of the mission compliance, there is solely a need to report to territorial emissions from industrial processes and product uses occurring within the city (scope 1). The most important pollutants in the IPPU sector are greenhouse gases (GHG) (especially $CO_2$ and F-gasses), NMVOC, $SO_2$, PM2.5 and some heavy metals. IPPU emissions can be further subdivided into smaller groups of sources such as: Mineral industry, chemical industry, metal industry, non-energy products from fuels and solvent use, electronics industry, product uses as substitutes for ozone depleting substances, and other product manufacture and use such as the use of electrical equipment.

*Example indicators:*

- Production and use of mineral products, e.g. cement production

- Mass of material input or product output for the production of metals within the city boundary e.g. iron foundries

## 3.1.6 Stationary Energy

Greenhouse gas emissions as part of the Stationary Energy sector are emissions from fuel combustion as well as fugitive emissions released in the process of delivering, generating and consuming useful forms of energy (such as electricity or heat). These include emissions from all buildings, facilities, and permanent infrastructure/equipment within the city boundary (scope 1). Indirect emissions as part of the Stationary Energy sector (also known as 'Buildings' sector) include emissions from outside the city boundary due to the use of grid-supplied energy (electricity or district heating/cooling) within the city boundary. However, under the division of the JRC infokit, these fall under the Energy Generation section (3.1.1).

*Example indicators:*

- GHG emissions per unit of fuel used in residential buildings

- GHG emissions per unit of fuel used in commercial buildings & facilities

## 3.2 Monitoring of Indirect Benefits (Co-Benefits)

### 3.2.1 Climate Change Adaptation Co-Benefits

Climate Change Adaptation is an important co-benefit, manly when focusing on reducing the risk to natural and climate hazards, and when enhancing the resilience of the urban infrastructure.

In addition, co-benefits are often quite difficult to measure their impact in a quantitative way, since they depend a lot on numerous factors, such as the main impact/benefit (measured in KPI) and the other associated co-benefits that are linked with the action itself.

### 3.2.2 Health Co-Benefits

Climate neutrality should increase physical and mental wellbeing; in particular, it should lead to environmental co-benefits (related to improve air quality, reduce noise pollution, reduce hot spots/urban heat islands, temperature reduction, reduction of road danger) and Wellbeing co-benefits (enhance attractiveness of the cities, healthier and more attractive lifestyles, better physical activity of individuals, better access to living areas).

### 3.2.3 Social Co-Benefits

The overall goal should be wellbeing for all. Acting for climate neutrality, should thus consider social aspects (such as social inclusion, social wellbeing, social cohesion, social capacity building, and enhance citizen participation, connectivity and community, safety) and education co-benefits (including improve access to environment and social information; raise awareness/behavioral change toward climate neutrality; increase skill development; and improve access to green job opportunities).

### 3.2.4 Resource Efficiency Co-Benefits

Cities actions towards climate neutrality go hand in hand with energy and resource efficiency. Better waste management and promotion of the materials cycle lead to waste efficiency. Better water quality and water management promote water efficiency. Food efficiency is achieved by sustainable and resilient food systems and reduce food waste. And finally, improved land use management and soil health lead to efficient land use.

### 3.2.5 Economic Co-Benefits

Economic co-benefits are key to the investment cases underpinning a city's transition to climate neutrality and should be quantified to concretely support cities' investment decisions. The main economic benefits include increased employment and improved health and wellbeing for the citizens.

Firstly, local job creation follows the undertaking of work on primarily energy efficiency and deep retrofits of buildings which is predominantly undertaken by local businesses. Domestic demand and overall growth are stimulated, and the employment rate will increase, often providing low-income families with financial security. In addition, future maintenance costs of the stationary environment decrease.

Secondly, improved health and wellbeing for the citizens result from the electrification of the transportation system as well as the shift from motorized vehicles to human-powered transport. These benefits lower society's costs of healthcare and citizens benefit from improved air quality, increased physical activity and reduced noise levels. A shift to public transportation as well as biking and walking moreover is associated to improved road safety and a reduced number of injured and deaths in traffic accidents.

### 3.2.6 Biodiversity Co-Benefits

Restoring and preserving biodiversity is an important co-benefit as well very much related with the climate change mitigation and needed as well to achieve the net zero emissions in cities. Biodiversity in cities includes following elements as key actors for a greater and good biodiversity: the increase of species, the increase of pollinators, the increase of the ecological connectivity, the reduction of the risk of epidemics, as well as the reduction of the ecological footprint and the creation or increasing of green awareness in citizens.

These are all indirect impacts to the climate change mitigation and reduction of emissions, by ensuring energy savings (mainly through the implementation of urban NBS, such as through the reduction of the surface area temperature by several degrees, or the heat island effect in cities among others.

## 3.3 Process monitoring according to action portfolios and systemic levers

The above described direct and indirect benefits are the outcomes of the transition process a city undergoes to become neutral. Monitoring these outcomes is very important, as they will be the evidence for the success of the Smart and Climate Neutral City Mission. However, we are convinced that is equally important to monitor the quality and effectiveness of the transition process as such, as it lays the foundations for the success of the Mission: The transition process must be organized in a way that all relevant questions are discussed and resolved, that citizens and all relevant stakeholders are involved, that the technologies and the financial resources necessary to make climate neutrality become a reality are available and that the city administration builds capacities and grows competences. We call these "systemic levers" To monitor the quality and effectiveness of the transition process, we propose to look at the six levers of changed described the ToC: 1) Technologies & Infrastructure;2) Governance & Policy, 3) Social Innovation, 4) Democracy & Participation, 4) Finance & and Funding, and 6) Learning & Capabilities.

As the cities involved in the Climate Neutral Cities mission are very different in terms of geographical location, climate zone, population, governance, and economic situation, also their transition pathways will be different. The MEL framework will help cities to self-assess their process according to their specific local needs: It will help them to structure the process, ask the right question and select those monitoring tools and indicators that will work in the specific local context. This process monitoring will be mostly a qualitative self-assessment, while the monitoring of direct and indirect benefits will be qualitative <u>and</u> quantitative.

### 3.3.1 Technology & Infrastructure

Upgrading urban infrastructure (e.g. buildings, utilities and energy networks, transport networks) and using zero carbon technology is key for achieving climate neutrality. Cities need to decide early in their climate neutrality on the technology portfolio they will bring forward to climate-proof their infrastructure, and they should self-assess the progress in implementing this portfolio.

The field of action "Technology & Infrastructure" is structured according to the thematic areas identified in WP10: Building Technology, Energy Technology and Infrastructure, Mobility Technology and Transport Infrastructure, Technologies for Green Industry, Circular Solutions, Nature-Based Solutions, Digital Solutions and Enabling Instruments. All of these thematic areas are highly relevant for cities to become climate neutral. Cities are therefore encouraged to identify the zero carbon technologies during their action plan process and to define targets for their deployment. The progress in rolling out these key technologies, and the factors enabling or hindering their deployment should be subject to monitoring, and the integrated indicator framework will suggest a set of relevant indicators.

***Example indicator:***

- # of realized deployment by key technology / number of deployments by ley technology foreseen in the climate neutral city action plan

### 3.3.2 Governance & Policy

Governance innovation in NZC is considered as a lever of systemic change for connecting and coordinating their NZC actions (CCC, Mission-Planning, Pilots, Platform engagement) to create pathways towards transformative governance and regulatory change. Therein, the city will be supported to assesses its gaps in governance capacities/capabilities and systemic barriers that hinder shifting legacy principles, processes, and structures.

Early outcomes comprise understanding a diverse set of governance models, which are gradually deployed as new forms of inter-departmental collaborations and are set up to make climate targets an overarching issue and agenda across the municipality. This includes new multi-actor collaborative governance modalities and mechanisms through which the CCC and the Mission prove to be effective organizational tools to raise climate ambitions and steer collective and coordinated actions.

These mechanisms will support the city to test and iterate innovative governance and policy instruments, including among others new multi-actor collaborative governance mechanisms and regulatory innovation tools such as regulatory 'sandboxes'.

As the city's governance innovations are implemented, later outcomes include effective utilization of learning and reflexive governance processes, which in turn enable rapid feedback on which solutions work or not. This is expected to lead to decision-making processes becoming highly adaptive and collaborative, allowing for quick and transparent adoption of actionable insights and course-correction towards long-term mission objectives. Additionally, multi-level governance mechanisms may also influence critical actors and partners at the national, regional, and local scales through the city's steering role as an intermediary.

## 3.3.3 Democracy and Participation

Involving citizens in the development of climate neutrality plans and co-creating solution portfolios with them is as important for the transition process as democratic and transparent decision making. A consensus-driven and participatory approach can influence both internal processes and structures (e.g., operations and climate budgeting) and external engagement with multi-level and trans-local networks and innovation ecosystems. Achieving climate neutrality requires changes in infrastructure and behaviors that respond to the needs and lived experiences of citizens from all backgrounds. At the same time, it also requires that citizens and city stakeholders can understand, endorse, and take up these changes. In this sense, some indicators under this lever overlap with indicators under the Social Innovation lever as co-creation is needed to design and implement the changes required.

The changes needed to transition to clime neutrality require engaging beyond those who usually participate, ensuring representation from all backgrounds directly or through civil society organizations and associations best placed to reach these groups. Representativeness and inclusion are therefore an important aspect to be explicit about when monitoring progress.

It is anticipated that the city's leadership also gradually becomes more distributed and facilitative, and through this process the role of public agencies becomes that of a driver and enabler of collective change rather than just a conventional provider of public services. Protecting democratic values and processes is particularly important in the context of a transition where important life-changing decisions to the running and functioning of the city are made.

### 3.3.3.1 Generating Awareness and Communicating Climate Transition Efforts

*Scope:*

A necessary step for people's involvement in decision-making process to transition to net zero is knowledge and awareness of the need for changes in the city that can help achieve climate neutrality. Awareness can be assessed in general terms but also in relation to the policies, such as awareness of the impact of transport and mobility on climate change. Often, lack of effective and access to knowledge brokerage and wider communication can limit people inclusion and access to cities climate action, and in consequence, weakened their engagement and active involvement on the transition.

*Example indicators:*

- % of citizens who agree that it is a priority for cities to make changes to reach climate neutrality

- % of citizens who agree they understand what reaching climate neutrality means

- Representativeness of citizens who understand what reaching climate neutrality means (representativeness in relation to the socio-economic strata of the city)

- % of citizens who agree that it is important to make changes e.g., to the transport and mobility, retrofitting of their buildings, for the city to address climate change.


### 3.3.3.2        Assessing Participation

*Scope:*

Assessing the level and quality of participation is important to demonstrate public engagement as part of the transition plans. Participation not only helps to add legitimacy to big changes in policies but also help to ensure that these policies respond to the realities and needs of citizens and diverse communities. This can help with uptake and change acceptance.

*Example indicators:*

- # of civil society organizations and other stakeholders (i.e. Schools, business associations) who have taken part in participatory and deliberative processes related to the transition plans, policies and actions to reach climate neutrality

- # of engagement processes that involved co-design and co-creation of changes and/or policies

- Representativeness of citizens who have taken part in participatory processes (representativeness in relation to the socio-economic strata of the city)

- % of citizens who think they have a say in how the city will reach climate neutrality

- Proportions of citizens by socio-economic strata who feel they have a say in how the city will reach climate neutrality

- % of citizens involved in participatory and deliberative process who agree their opinion was listened to and respected


### 3.3.3.3        Levels of Trust in city's willingness to engage

*Scope:*

Trust is essential in processes of collective change. This trust can be fostered through awareness and participation but can also enable participation because people can be more willing to engage if they trust that the city is genuinely committed to listening to citizens and working towards change together with them. Trust can also be strengthened if people are also entitled and invited to co-create pathways and logics to transitioning towards Climate Neutrality.

*Example indicators:*

- % of citizens who agree that their city provides opportunities for participation in relation to decisions on climate neutrality

- % of citizens who think that their city is committed to involving citizens in decisions related to reaching climate neutrality

### 3.3.3.4    Power/Efficacy

*Scope:*

Public engagement can help empower citizens to be involved in the transition to climate neutrality. It can help foster collective mobilisation needed to organise and implement changes and actions as well as individual or household-level change.

*Example indicators:*

- % of citizens who agree that they have a role to play in helping the city reach climate neutrality

- % of citizens who think it is important for them to be involved in decisions related to climate neutrality in the city

### 3.3.3.5    *Responsiveness*

*Scope:*

Related to trust and the potential for legitimacy that participation can bring, it is important for governments and actors to be transparent, accountable and responsive. For citizens to feel that the city is genuine about listening to people's needs and suggestions, and for citizens to feel empowered and willing to change behavior themselves, it is important that there can be spaces for reflection and response from governments on how decisions are being followed up and implemented. Involving citizens at the start but not during and after policies have been decided or implemented can damage trust.

*Example indicators:*

- Instances of feedback and engagement spaces and/or mechanisms to respond to citizens' input in decision-making processes

- # of cases in which recommendations made in participatory and deliberative processes are followed up and responded to

- # of public engagement processes that include a roadmap and communications plan for informing citizens throughout of the actions taken after

### 3.3.3.6    *Enabling equity & thriving transitions for all*

*Scope:*

Climate neutrality can be achieved through different pathways, but if it does not consider equity, justice and inclusiveness, it can disproportionately affect underserved and systematically excluded communities. Exposure and vulnerability to climate related impacts, from energy poverty to extreme weather events are driven by demographics, socio-economic development, and ecosystem degradation. Therefore, NZC is highly focused on building democratic and participative interventions to include different voices meaningfully and thoughtfully, especially, from underserved communities.

*Example indicators:*

- *% of citizens participation from marginalised and underrepresented groups*

- % of citizens from marginalised and underrepresented groups who agree that they have a role to play in helping the city reach climate neutrality

- % of citizens from marginalised and underrepresented groups perceived their recommendations were taken into account and reflected on the Portfolios interventions

### 3.3.4 Social Innovation

Social innovation for climate neutrality can be evaluated on two levels: at the general/strategic level of the action plan and at the specific level of the social innovation programs and initiatives' outcomes.

NZC considers social innovations primarily as a lever of change toward climate neutrality. The social practices linked to this domain can be impacted by diverse systemic solutions (i.e., urban planning) both top-down and bottom-up, actively reducing GHG emissions. Building on the Theory of Change developed as part of NZC, social innovation is enacted through an impact pathway that encompasses four main building blocks: (1) Skills and capacity building of public officials, citizens and urban stakeholders regarding social innovation for climate neutrality, (2) Empowerment and inclusion, by co-creation and co-production of social innovation initiatives and policies with citizens and all urban stakeholders, (3) Regulation and support for social innovation programs and initiatives through funding, public procurement and other types of support (i.e., public-private partnerships) to scale beyond small scale and pilot projects, and (4) top-down systemic solutions for climate neutrality that include social innovation as policy making, thus encompassing wider organizational change as well as specific strategic actions (i.e., urban planning or favoring resource circularity through social initiatives – energy communities).

#### 3.3.4.1 Skills and capacity building

*What is the level of skills and knowledge of citizens and public officials about social innovation for sustainability?*

**SI capacity building of public officials and policy makers**

Public official, citizens and urban stakeholders need to work collaboratively to reach climate neutrality. Training public officials and policymakers regarding human centric approaches is very important, for instance through a pilot city demonstrator carried out at inter-departmental city group (involving the administration as well as private and third sector organizations and citizen) to co-create and co-deliver new solutions (e.g.: public-private-social urban regeneration program involving mobility, NBS and retrofit buildings actions). The final result could be a dedicated team, or a SI task force established within the municipality, leading to the embedding of social and behavioral factors throughout the ideation, design and development of public interventions, as well as to new service delivery models. An example is given by the internal competencies created within the city of Helsinki (e.g. design-skills – human-centered perspective for public service design).

**Example indicators:**

- # of civil servants with increased knowledge of SI

- # of participants completing the training

- Establishment of SI task force

**SI skills of citizens and urban stakeholders**

The implementation of social innovation can support citizens and urban stakeholders (including for-profit and non-for-profit organizations) in learning new practices for collaborating among themselves or with the municipality for proposing and implementing new ideas toward sustainability. This can also contribute to raising awareness on the long-term impacts of individual behaviors. Further, individuals can become proficient in developing green and sustainable initiatives. Examples of this stemming from social innovation might encompass initiatives directed at regenerating fragile neighborhoods, mobility, and urban renewal (through infra- interventions and services, like urban farms, food coops, others), initiatives linked to social entrepreneurship, new startups and business propositions that master and adopt new sustainability paradigms and tools, initiatives for energy savings heat island reduction. This

category aims also at facilitating conversations around socio-economic challenges that leveraging social innovation as a lever for novel solutions.

***Example indicators:***

- # of citizens and organizations with increased knowledge of SI

- # of participants completing social innovation training

### 3.3.4.2      Empowerment and inclusion

*What is the level of involvement of citizens and urban stakeholders in the formulation and implementation of initiatives and policies for social innovation for climate neutrality?*

***Co-design of policies with social innovators and urban stakeholders***

Several studies show that involving citizens and urban stakeholders in governmental processes and empowering them through active engagement boosts the acceptance of policy decisions and new regulations, reinforces the awareness of citizens' needs in public administrations, and increases the citizens' sense of belonging and inclusion. This can be done by improving the engagement strategies of urban stakeholders and citizens in policy making processes and strengthening the link with public-sector bodies. Examples of this might include co-designing policies, public funding decision-making with citizens, institutionalizing organizational practices that enable working with and for communities. This kind of interventions also entail the need to implement in the administration a continuous experimental approach (i.e., policy prototyping) for policy formulation and implementation. As mentioned earlier, this set of indicators overlaps with some indicators under the Democracy and Participation systemic lever. These do not need to be collected twice and this relevance simply shows the importance of democracy and participation as a lever that interacts with other systemic levers too.

***Example indicators:***

- # of policies co-creation activities

- # of participants to co-creation activities

- # of citizens with increased perception of empowerment

***Co-creation of social innovation initiatives with citizens and urban stakeholders***

Establishment of SI hubs, living labs, SI transfer centers to support the development of social innovation initiatives aimed to increase awareness and to change behavior towards lifestyles with lower environmental impact. This can entail consuming locally or using shared transport. This category is focused on cultural transformation.

***Example indicators:***

- # of participants to co-creation activities

- #  of SI hubs

- # of new SI initiatives

- # of new networks that collaborate for climate neutrality

- # of citizens willing to change their behavior toward sustainable practices

- # of participants to behavioral changes activities leading sustainability

### 3.3.4.3 Regulation and support

*How does the city mobilize resources to support community-led initiatives of social innovation for sustainability?*

***Funding/supporting community-led initiatives and small-scale pilots/experimentations:***

Support and emphasize initiatives that provide innovative responses to the needs and challenges of the society, focusing for instance on strengthening social entrepreneurship locally or other grassroots initiatives for climate neutrality (i.e., shared mobility).

Example indicators:

- # of social innovators supported

- # of supported social entrepreneurs

***Enabling/supporting social innovation initiatives scale-up beyond pilots***

This area considers the possibility to implement actions that enable the scaling, replication or adaptation, and acceleration of socially relevant initiatives, including for instance initiatives of seeding for social enterprises, social businesses, social innovation accelerator programs and the reinforcement of the social economy at large.

***Example indicators:***

- # of social innovation initiatives experimentations

- # of small-scale social innovation experimentations funded

- # of social innovation activities scaled up

- # of SI/SE accelerator activities

***Testing and prototyping new funding mechanisms***

This area entails the development of new funding tools trailed and shared with citizens (i.e. civic crowdfunding). Further, it entails increasing direct aid to the wider social economy and reinforcing its local ecosystem.

***Example indicators:***

- # of new social innovation funding tools implemented

- # of small-scale social innovation experimentations funded

***Public procurement of social innovation services for sustainability***

New procurement plans are very important to support the development of sustainability solutions that involve citizens. A possibility in this area is to establish 'Public Procurement Pathfinders' to connect government agencies with social innovation actors (including civic start-ups, civic-tech initiatives, social innovation-focused SMEs or other social economy players). The area entails also the follow up on diversification of contract awarding methods, promotion of the social economy to purchasers, promotion of value purchaser-supplier best practices, conduction of periodic evaluations of practices established with stakeholders.

***Example indicators:***

- # of social innovation services procured

- # of public procurement procedures implemented

### 3.3.4.4 SI systemic approaches
*Are systemic innovations for climate neutrality that involve social innovation implemented at city-wide level?*

***Urban planning for social innovation***

Systemic solutions (top-down or collaborative) for climate neutrality that involve social innovation implemented at the level of Urban planning (as for example the 15-minute city in Paris which re-configures social practices and leads to more sustainable behaviors).

***Example indicators:***

- Extent of urban planning systemic solutions implemented by the city

***Resource circularity***

Systemic solutions (top-down or collaborative) for climate neutrality that involve social innovation implemented at the level of city's circularity of resources (i.e. waste).

***Example indicator:***

- Extent of resource circularity solutions implemented by the city

## 3.3.5 Finance & Funding

The economic case looks different for different climate mitigation measures; some provide great savings while others carry significant costs. In general, mitigation measures require substantial upfront investments, coupled with capital costs over time, whilst the savings arise from reduced costs of operations. This holds true for a variety of measures across the different impact domains, such as new investments in renewable power generation, grid improvements that reduce transmission and distribution losses, electric vehicles that replace internal-combustion vehicles, energy efficiency measures in the stationary environment as well as some investments that improve the circularity of waste management.

The financial case looks to maximize the use of public and private investment capital towards accelerating the transition to net zero for cities. It will scope out the applicability of funding mechanisms across national and local programs, as well as sustainable financial instruments such as green bonds, green mortgages, revolving funds and others.

The purpose of financial indicators is to monitor the effective use of capital sources throughout the journey to reach climate neutrality. Such indicators can include the ratio between public and private capital allocated towards climate neutrality, or percentage of capital allocated towards climate neutrality over total budget. The set of indicators will allow financial and funding stakeholders to monitor the cities success in their use of climate capital over time.

## 3.3.6 Learning & Capabilities

Selection of the emission domains and pathways (based on an impact narrative) will support the city's learning journey by identifying key learning goals and assigning dedicated resources and personnel by the city to learning activities. This will include understanding and adopting the varied learning and capacity building services offered by NZC Platform (covering online/offline and individual/collective formats of engagement). The shared understanding around a city's desired impacts towards climate-neutrality can usefully serve as a focal point for identifying learning questions or learning goals. These learning objectives then guide the framing of monitoring and evaluation activities. In this way, it helps to keep the focus on outcomes and results, linking the MEL activities to these and avoiding any tendency to try and measure everything or measure changes or data not relevant for the city's mission.

The city's learning goals, and the MEL activities used to address them can be included in a learning plan to serve the NZC initiative during its lifespan for cities beyond the project duration. As well as using the Theory of Change (TOC) for framing the learning goals, it can also be used for ongoing reflection and sensemaking as the initiative proceeds. When new insights emerge, city's TOC may need to be adjusted to reflect any changes that have occurred which are pertinent to impact.

Participation in learning clusters and collective sensemaking with fellow cities shall enable the city to refine and reframe their impact logic and learning outcomes to co-create ambitious narratives of transformation. Therein, the city will also be supported with tools for undertaking periodic stocktaking and synthesis of their actions and monitoring, to feed these insights generated into decision-making processes for climate-action planning, finance, and policies.

Peer-learning and exchanging spaces include later outcomes, such as, build mutual trust amongst cities and creation of a safe environment for them to deliberate upon barriers and failures to create a culture of course-correction based on actionable insights. These interactions also aim at accelerating trans-local and transnational collaborations, to further strengthen cities' orchestration and transition capabilities through joint actions. This can be complemented by targeted capacity and capability building around different cities' particular needs, whether through NetZeroCities or national platforms. At the same time, the knowledge and body of evidence generated by cities can enable effective communication and dissemination, in turn resulting in positive shifts in engaging citizens, ecosystems and potential funders.

# 4  Monitoring Process & Timeline

The MEL framework presented in this deliverable is designed to help cities to self-assess the progress they make in their journey to climate neutrality and to share their achievements with other cities and the European Commission (EC). We call this "monitoring".

Monitoring is usually carried out as a sequence of steps that starts with an analysis of the current situation (also called baseline) and the definition of objectives. Indicators must be defined to make objectives measurable, and the data sets necessary to calculate the indicators must be available. Once this is ensured, indicators are calculated at specific points in time (usually every one or two years) and benchmarked against the baseline, which shows whether progress was achieved or not. This is the monitoring progress

This chapter describes more in detail nine steps cities would take in an ideal monitoring process to achieve high quality results. These steps are 1) Define the scope, 2) Identify objectives, 3) Select indicators, 4) Select impact pathways, 5) Identify data sources, 6) Assess and report the baseline, 7) Evaluate and report progress after two years, 8) Evaluate and report progress after four years, 9) Assess and report long-term impacts.

However, cities need to customize this trajectory based on their data-preparedness and maturity. This customization usually needs to go through several iterations.
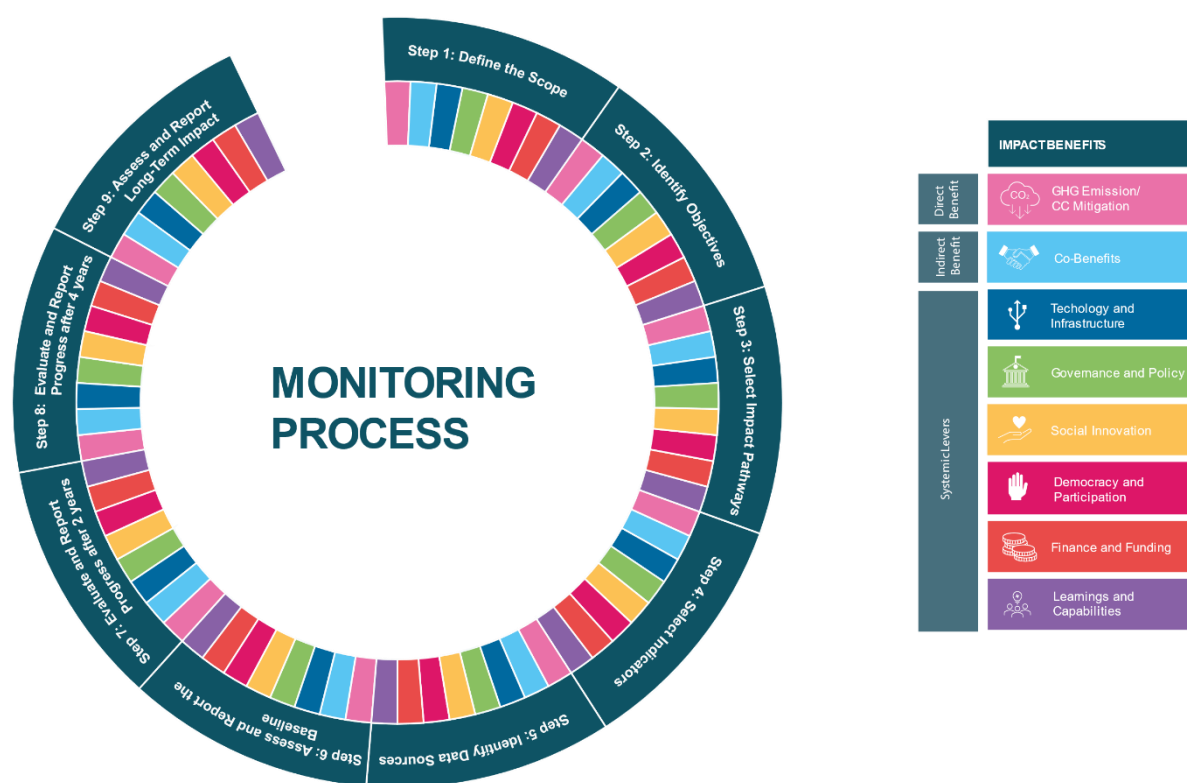


Figure 4: The Monitoring Cycle of NetZeroCities

## 4.1 Step 1: Define the Scope

Cities are different, and so are their GHG emission profiles: In some cities, the lion's share of greenhouse gas emissions comes from energy generation, while in others transport or industry are the dominant sources of emissions. This has implications for the priorities cities will set in their climate neutral city action plans. Also, in the application for the climate neutral and smart cities mission, cities were allowed to exclude GHG emission sectors from their application meaning that these sectors will also not be covered by the Climate Neutral City Action Plans. Another option for cities was to limit the territory that shall become climate-neutral by 2030 to a subdivision of the municipality (e.g. one or several neighborhoods, or administrative districts), or to exclude certain areas of the municipal areas, such as large industrial parks, ports and airports. Only those greenhouse gas emission sectors and only those subdivisions of the municipal territory that are covered by the Climate-Neutral City Action Plan are subject to monitoring, evaluation, and learning. This is to be determined on Step 1, where cities declare which sectors and stretches of territory will be subject to the Climate Neutral City Action Plan and thus will be the focus of MEL-related to Co-Benefits.

Cities have joined the Climate-Neutral and Smart Cities Mission for multiple motives, not only to become climate-neutral, but also to improve the quality of life, to stimulate technological innovation and create new jobs, to make governance processes more effective, to tap new funding streams, and for many other reasons. Expectations on these so-called co-benefits are thus huge, but diverse. It is important that every city reaches clarity on its goals at the very beginning of the process, for the co-benefits, and to document them.

The Mission Investment Plan will identify the capital needed for the city to reach climate neutrality. Through an iterative process it will identify the optimal allocation between public and private capital across the identified portfolio of actions and resulting impact. Once the Investment Plan has been developed, portfolio or single large projects will be identified to start the implementation towards climate neutrality.

Engaging in the Mission for Climate Neutral and Smart Cities is a challenge, but also a great opportunity to learn new ways of working and grow the capabilities of the organization. It should be useful for cities to approach this opportunity in a structured manner and to discuss at the beginning of the process the areas where the biggest learnings should be achieved, and the most relevant learnings are expected.

**NET ZERO CITIES**

| FIELDS OF ACTION | | STEP 1: Define the Scope and envisioning Impact |
|---|---|---|
| Direct Benefit | GHG Emission/ CC Mitigation | In which domains & subdomains will the city take actions to reach climate neutrality by 2030? |
| Indirect Benefit | Co-Benefits | What are the expected co-benefits of the climate-neutral city action plan? |
| Systemic Levers | Techology and Infrastructure | What are the key technologies the city intends to use to become climate neutral? |
| | Governance Innovation | Which governance innovations are needed to reach climate neutrality by 2030? |
| | Social Innovation | Which elements of social innovation need to be developed to support climate neutrality by 2030? |
| | Democracy and Participation | How can citizens be involved in the development of the climate neutrality plans and the creation of solution portfolios? |
| | Finance and Funding | How will the city mobilize sufficient ressources to achieve climate neutrality by 2030? |
| | Learnings & Capabilities | Which learnings does the city expect to make and to share? |

**Figure 5: Guiding Questions on Step 1**

## 4.2 Step 2: Identify Objectives

On step 2, cities will determine their objectives in each monitoring dimension. For the monitoring dimension "Greenhouse Gas Emissions / Climate Change" Mitigation, this is straightforward, as key objectives on climate neutrality are an essential component of the Climate City Contract, and sector-specific objectives on the reduction of Greenhouse Gas Emissions will be defined in the Climate-Neutral City Action Plan.

The Investment Plan will identify and map over time the total cost for the city to reach climate neutrality. It will also provide an estimate of the capital allocation between public and private investment to meet the identified cost. Public resource will be used to leverage investment capital at scale, which will be sourced through a range of financial instruments, including green and sustainability linked bonds, green loans, green mortgages, energy performance contracts, green equity, and others.

For the other monitoring dimension, it is important that cities determine objectives early in the process. This applies to the monitoring dimension "Co-Benefits" (regarding climate change adaptation, health, social aspects, resource efficiency, economic effects, and biodiversity) as well as to the more process-oriented monitoring dimensions "Democracy and Participation", "Social Innovation" and "Governance Innovation", and "Learnings & Capabilities". Objectives should be phrased in a "smart" way, that means they need to be specific, measurable, achievable, realistic, and timely.



**Figure 6: Guiding Questions on Step 2**

## 4.3 Step 3: Select Impact Pathways

As illustrated in Figure 8 below, the city would be supported to self-assess and identify a sequenced hierarchy of changes and outcomes, culminating into long-term impacts and co-benefits for the city's climate mission. Online tools and guidelines would be made available for cities to conduct this exercise with their internal teams. These sequential and interconnected causal chains, known as impact pathways, outline the fundamental mechanisms through which larger and more complex long-term systems change is envisioned to be influenced by the city towards climate-neutrality. As cities will act on more than one lever, the impact pathways are expected to converge and overlap, thereby necessitating coordinated actions and interventions across the portfolio and emission domains.
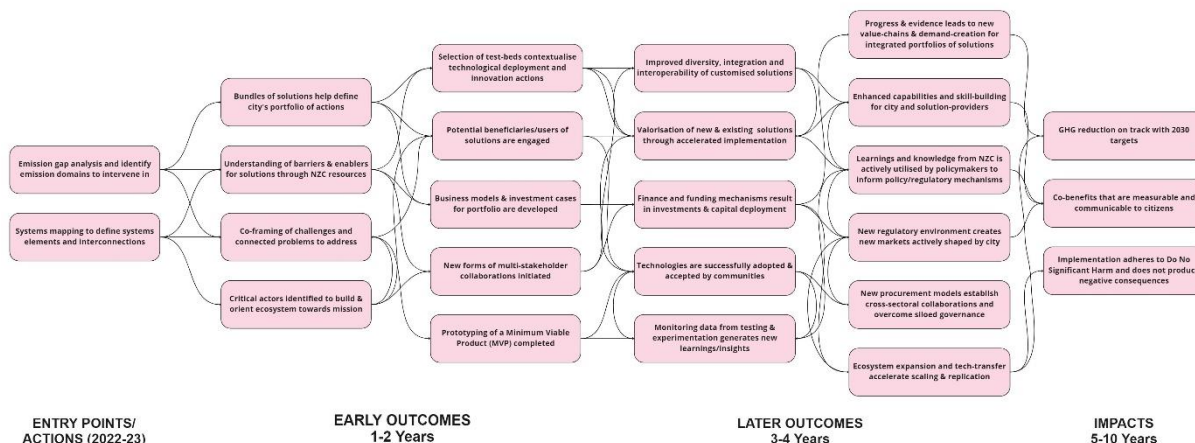


Figure 7: Sample format of outcomes and impact pathways for each of the Systemic Levers

The process (from left to right) begins with the key Entry-Points (EP) as the city's portfolio of actions or tangible interventions, which set in motion the parallel and overlapping impact pathways. These Entry Points are defined based on the city's CCC or Pilot initiatives, as well as their Mission Plans or current climate actions and policies. Next elements are the Early Changes (EC) which create the necessary pre-conditions or achievement of 'low-hanging fruit' as a basis for subsequent, more ambitious progress. These are followed by the Later Outcomes (LO) and Impacts (I) which are expected to emerge as a result of real-world implementation of CCCs and Mission plans, deployment of Pilot actions, and application of sensemaking, learning and knowledge-sharing practices.

The connections within impact pathways are derived from the city's assumptions and perceived risks around how changes are expected to occur and help integrate discrete outcomes into a more holistic vision of what 'good' systemic transformation looks like. Additionally, the pathways are structured in the form of milestones – or grouped interim outcomes – for 1-2 years (Early Changes), 2-3 years (Later Outcomes), 5+ years (impacts from the city's NZC activities) which continue until the culmination of the Mission in 2030.

The co-creation of such impact pathways (for Impact Domains and Systemic Levers selected by the city) is aimed at supporting the city in identifying the most critical outcomes or impacts – also known as 'leverage points' in the systems – to monitor, evaluate, report, and learn during implementation. The selection of these impacts enables the city to find the pertinent evidence gaps, key indicators and metrics to measure and report progress, as well as set up their data collection, analysis, and visualization process. Subsequently, analysis of the qualitative and quantitative data will be utilized for strategic learning and sensemaking processes to inform decision-making within the city and enable knowledge-transfer across the NZC Platform.

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Figure 8: Guiding Questions on Step 3

## 4.4 Step 4: Select Indicators

Step 3 is about selecting indicators that allow cities to monitor their progress in each monitoring dimension and for all of the objectives. For each objective, at least one indicator needs to be chosen. The NetZeroCities will support cities in choosing the right indicators by providing a guidance note and an indicator repository. There will be mandatory indicators that cities need to report on and optional ones on which cities can use for the internal self-reporting. The indicators concept, the repository and the guidance note will be included in D2.4.2.



| FIELD OF ACTION | Step 4: Identify Data Sources |
|---|---|
| **Direct Benefit** — GHG Emission/ CC Mitigation | How can emissions and emission reduction be measured in each sector? |
| **Indirect Benefit** — Co-Benefits | How can co-benefits be measured in each sector? |
| **Systemic Levers** — Techology and Infrastructure | How can status and progress regarding the roll-out of key technologies be measured? |
| Governance Innovation | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? |
| Social Innovation | How can status and progress regarding social innovation be measured? |
| Democracy and Participation | How can the status and progress regarding citizen engagement and co-creatio be measured? |
| Finance and Funding | How can status and progress regarding funding and financing be measured? |
| Learnings & Capabilities | How can status and progress regarding learnings and capabilities be measured? |

**Figure 9: Guiding Questions on Step 4**

## 4.5 Step 5: Identify Data Sources

Once indicators are selected, the city needs to identify the data sets that are necessary to calculate the indicators and to check if local data for calculating the indicators is available, accessible, and up to date. In case the data set is nonexistent, cannot be accessed, is outdated, or will not be updated at least once per year, it might be better to go back one step and chose another indicator that can be calculated more easily. This means that Step 3 and Step 4 need usually several interactions until a set of indicators is in place that allows to monitor local objectives with locally available data sets.

The indicator repository (D2.4.1) will suggest potential data sources for the indicators included, but these suggestions need to be checked against the local situation, as not all data sets will be available in each city.

| FIELD OF ACTION | Step 5: Assess & Report the Baseline |
|---|---|
| **Direct Benefit** — GHG Emission/ CC Mitigation | What are accessible data sources for calculating the indicators? |
| **Indirect Benefit** — Co-Benefits | What are accessible data sources for calculating the indicators? |
| **Systemic Levers** — Techology and Infrastructure | What are accessible data sources for calculating the indicators? |
| Governance Innovation | What are accessible data sources for calculating the indicators? |
| Social Innovation | What are accessible data sources for calculating the indicators? |
| Democracy and Participation | What are accessible data sources for calculating the indicators? |
| Finance and Funding | What are accessible data sources for calculating the indicators? |
| Learnings & Capabilities | What are accessible data sources for calculating the indicators? |

**Figure 10: Guiding Questions on Step 5**

## 4.6 Step 6: Assess & Report the Baseline

Once it is clear what the city wants to achieve and how these objectives can be measured, it is time to assess where the city starts from. This is called the baseline assessment. For this, a base year needs to be chosen and each indicator needs to be calculated for this base year. This will allow to assess progress by benchmarking the monitoring values reported for year two and year four against the baseline values.



| FIELD OF ACTION | Step 6: Evaluate & Report Progress after 2 Years |
|---|---|
| GHG Emission/ CC Mitigation | What is the status in each domain & subdomain in the base year? |
| Co-Benefits | What is the baseline for assessing the co-benefits? |
| Techology and Infrastructure | What is the baseline for assessing the roll-out of key technologies? |
| Governance Innovation | What is the baseline for assessing the progress in governance innovation? |
| Social Innovation | What is the baseline for assessing the progress in social innovation? |
| Democracy and Participation | What is the baseline for assessing the progress in democracy & participation? |
| Finance and Funding | What is the baseline for assessing the progress in funding & financing? |
| Learnings & Capabilities | What is the baseline for assessing the progress in learnings and capabilities? |

**Figure 11: Guiding Questions on Step 6**

## 4.7 Step 7: Evaluate & Report Progress after 2 Years

At the end of year 2 of the NetZeroCities project, all cities are required to report on their progress. This will be done by calculating values for each indicator based on data sets from year 2 and benchmarking them against the base year and against the smart objectives. The indicator need to be reported on the NetZeroCities platform, which is expected to be fully operational in the second half of the project.

| FIELD OF ACTION | Step 7: Evaluate & Report Progress after 2 Years |
| --- | --- |
| Direct Benefit — GHG Emission/ CC Mitigation | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Indirect Benefit — Co-Benefits | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Systemic Levers — Techology and Infrastructure | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Governance Innovation | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Social Innovation | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Democracy and Participation | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Finance and Funding | What is the progress achieved after 2 years, benchmarked against the objectives? |
| Learnings & Capabilities | What is the progress achieved after 2 years, benchmarked against the objectives? |

**Figure 12: Guiding Questions on Step 7**

## 4.8 Step 8: Evaluate & Report Progress after 4 Years

The evaluation and reporting described in step 7 will be repeated in year 4, which is the final year of the NetZeroCities project. The procedure will be essentially the same as described in Step 7.



**Figure 13: Guiding Questions on Step 8**

## 4.9 Step 9: Assess & Report Long-Term Impact

Finally, NetZeroCities will ask cities to give an outlook on their expected impact after ten years. This outlook should be given at the end of year 4 based on data from that year.



| FIELD OF ACTION | Step 9: Assess & Report Long-Term Impact |
|---|---|
| **Direct Benefit** — GHG Emission/ CC Mitigation | By when will the objectives be met? |
| **Indirect Benefit** — Co-Benefits | By when will the objectives be met? |
| Techology and Infrastructure | By when will the objectives be met? |
| Governance Innovation | By when will the objectives be met? |
| Social Innovation | By when will the objectives be met? |
| Democracy and Participation | By when will the objectives be met? |
| Finance and Funding | By when will the objectives be met? |
| Learnings & Capabilities | By when will the objectives be met? |

*(Left vertical labels: Systemic Levers)*

**Figure 14: Guiding Questions on Step 9**

| Fields of Action | Step 1: Define the Scope | Step 2: Identify Objectives | Step 3: Select Impact Pathways | Step 4: Select Indicators | Step 5: Identify Data Sources | Step 6: Assess & Report the Baseline | Step 7: Evaluate & Report Progress after 2 Years | Step 8: Evaluate & Report Progress after 4 Years | Step 9: Assess & Report Long-Term Impact |
|---|---|---|---|---|---|---|---|---|---|
| **Direct Benefits** — GHG Emission / CC Mitigation | In which domains & subdomains will the city take actions to reach climate neutrality by 2030? | What are the specific objectives for emission reduction in each domain? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can emissions and emission reduction be measured in each sector? | What are accessible data sources for calculating the indicators? | What is the status in each domain & subdomain in the base year? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| **Indirect Benefits** — Co-Benefits | What are the expected co-benefits of the climate-neutral city action plan? | What are the specific objectives for co-benefits in each domain? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can co-benefits be measured in each sector? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the co-benefits? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| **Systemic Levers** — Technology & Infrastructure | What are the key technologies the city intends to use to become climate neutral? | What are the roll-out-targets for the key technologies? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can status and progress regarding the roll-out of key technologies be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the roll-out of key technologies? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| Governance & Policy | Which governance innovations are needed to reach climate neutrality by 2030? | What are the specific objectives regarding governance innovations? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can the status and progress regarding governance innovation be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the progress in governance innovation? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| Social Innovation | Which elements of social innovation need to be developed to support climate neutrality by 2030? | What are the specific objectives regarding social innovations? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can status and progress regarding social innovation be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the progress in social innovation? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| Democracy & Participation | How can citizens be involved in the development of the climate neutrality plans and the creation of solution portfolios? | What are the specific objectives regarding democracy & participation? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can the status and progress regarding citizen engagement and co-creatio be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the progress in democracy & participation? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| Finance & Funding | How will the city mobilize sufficient resources to achieve climate neutrality by 2030? | What is the volume of investment the city will need to reach climate neutrality, and how will it be financed? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can status and progress regarding funding and financing be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the progress in funding & financing? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |
| Learnings & Capabilities | Which learning does the city expect to make and to share? | What are the specific objectives regarding learning and capabilities? | What are relevant impact pathways leading to long-term impacts and co-benefits for the city's climate mission? | How can status and progress regarding learnings and capabilities be measured? | What are accessible data sources for calculating the indicators? | What is the baseline for assessing the progress in learnings and capabilities? | What is the progress achieved after 2 years, benchmarked against the objectives? | What is the progress achieved after 4 years, benchmarked against the objectives? | By when will the objectives be met? |

**Figure 15: Monitoring Domains and Monitoring Steps**

# 5 Adaptability of the concept for different levels of monitoring

The integrated indicator system was designed in a way that it can be used not only for climate city contracts and climate neutrality action plans, but (with certain modifications) also for the monitoring and impact assessment of Pilot Projects, and for a high-level monitoring of the Climate Neutral and Smart Cities Mission as a whole.

Progress towards climate neutrality is achieved on several spatial levels, and this needs to be reflected in the monitoring approach and methodology as well as in the structure of the integrated indicator system. We have designed the integrated indicator system in a way that it works on three levels:

1. **On the city level**, focused on the climate neutrality goals defined in the climate-neutral city contract, and on the related measures described in the climate-neutral city action plan and in the investment plan. The target year for the climate neutral city action plans and the investment plans is 2030. By then, climate neutrality shall be achieved in all cities that have joined the climate-neutral and smart city mission. NetZero Cities will guide and support the cities in their journey until 2025.

2. **On the level of pilot projects**: Pilot projects are innovative implementation actions targeting a specific sector or a specific technology in an integrated manner. Pilot projects are supposed to make an outstanding contribution to the climate neutrality goals of the city they are in and serve as reference for other cities. There is one call for pilot projects within the NetZeroCities project, which will open on 5 September and close on 4 November 2022. Pilot projects will be implemented within a timeframe of two years.

3. **On the level of the Climate Neutral and Smart Cities Mission:** The mission-wide monitoring will rely on a set of selected high-level indicators that can be calculated based on aggregate data from the climate-neutral city action plan monitoring. It will give a regular overview over the achievements of the mission. NetZeroCities will suggest for the mission monitoring, however it will be implemented by the Joint Research Center (JRC) of the European Commission. The Mission Monitoring is expected to be in place until the end of the Climate Neutral City and Smart City Mission in 2030.

# 6 Conclusions and next steps

This deliverable describes the concept for the integrated indicator framework, i.e. the structure the NetZeroCities partners agreed on and the underlying rationale. Specific sets of indicators will be developed in Deliverables D2.5, D2.6, D2.7 and D2.8, with deadlines at the end of September 2022. The updated version of this report, D2.4.2., will then integrate these specific sets of indicators into the structure defined in D4.2.1 to create an "Integrated Indicator Framework" ready for monitoring. This will also require alignment among the specific sets of indicators.

# ANNEX A: Matrix Gap Analysis – Frameworks and Indicators as suggested by the Implementation Plan

| Framework / KPI Indicators | Level of city interest for climate neutrality / Governance & City plans and regulations | City preparedness / Suitable urban infrastructures | Diversity of city | City commitment to climate neutrality | Diversity of EU/regional/national funding | Mobilization of EU/regional/national funding | Actual progress towards climate neutrality | Overall contribution towards 55% target of European Green Deal | Number of climate neutral cities | Transport (SUMP) / City transportation diagnosis | Energy, SECAP | GHG emissions from buildings, industry, transport, waste treatment, agriculture, forestry within city boundaries | indirect emissions due to consumption of grid-supplied electricity and due to consumption of grid-supplied heating / cooling | GHG emissions from treatment of waste produced within the geographic boundary | out-of boundary emissions (transportation of citizens, consumption made and other indirect emissions) | air quality: PM 2.5 concentration levels | air quality: NO 2 concentration levels (highest annual mean observed at traffic stations). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CDP/ICLEI Unified Reporting Platform | X | X | | | | | | | | X | X | X | X | X | X | | |
| My Covenant | X | X | | X | | | | | | | X | X | X | X | X | | |
| Global Protocol for Community-Scale GHG Emissions (GPC) | | | | | | | | | | | | X | X | X | X | | |
| BISKO Standard (Germany) | | | | | | | | | | | X | X | X | X | X | | |
| GHG Footprinting | | | | | | | | | | | | | | | | | |
| Science Based Targets (SBTs) - Global Climate Allicance | | | | | | | | | | | | | | | | | |
| CCR MER | | | | | | | | | | | | | | | | | |
| Urban Climate Action Impacts Framework (UCAIF) by C40 & Rambøll & partners | | | | | | | | | | | | | | | | | |
| Nature Based Solution | | | | | | | | | | | | | | | | | |

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| Framework / KPI Indicators | Level of city interest for climate neutrality / Governance & City plans and regulations | City preparedness / Suitable urban infrastructures | Diversity of city | City commitment to climate neutrality | Diversity of EU/regional/national funding | Mobilization of EU/regional/national funding | Actual progress towards climate neutrality | Overall contribution towards 55% target of European Green Deal | Number of climate neutral cities | Transport (SUMP) / City transportation diagnosis | Energy, SECAP | GHG emissions from buildings, industry, transport, waste treatment, agriculture, forestry within city boundaries | indirect emissions due to consumption of grid-supplied electricity and due to consumption of grid-supplied heating / cooling | GHG emissions from treatment of waste produced within the geographic boundary | out-of boundary emissions (transportation of citizens, consumption made and other indirect emissions) | air quality: PM 2.5 concentration levels | air quality: NO 2 concentration levels (highest annual mean observed at traffic stations). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Policy tracker | | | | | | | | | | | | | | | | | |
| The Greenhouse Gas Protocol (WRI and WBCSD) | | | | | | | | | | | | | | | | | |
| The CURB Tool: Climate Action for Urban Sustainability | | | | | | | | | | X | X | | | | | | |
| Data-driven Life Cycle Assessment tool | | | | | | | | | | | X | | | | | | |
| UN/IPCC Common Reporting Framework | | | | | | | | | | | X | X | X | X | X | | |
| The Reference Framework for Sustainable Cities (RFSC) | | | | | | | | | | | | | | | | | |
| PAS 2070:2013+ A1:2014 European Standards for GHG emission assessment of cities (Direct Plus Supply Chain) | | | | | | | | | | | | X | X | X | X | | |
| SIMRA | | | | | | | | | | | | | | | | | |
| Evaluating the Impact of Nature-based Solutions | X | | | | | | | | | | | | | | | X | X |
| euPOLIS | | | | | | | | | | | | | | | | | |

| Framework / KPI Indicators | Level of city interest for climate neutrality / Governance & City plans and regulations | City preparedness / Suitable urban infrastructures | Diversity of city | City commitment to climate neutrality | Diversity of EU/regional/national funding | Mobilization of EU/regional/national funding | Actual progress towards climate neutrality | Overall contribution towards 55% target of European Green Deal | Number of climate neutral cities | Transport (SUMP) / City transportation diagnosis | Energy, SECAP | GHG emissions from buildings, industry, transport, waste treatment, agriculture, forestry within city boundaries | indirect emissions due to consumption of grid-supplied electricity and due to consumption of grid-supplied heating / cooling | GHG emissions from treatment of waste produced within the geographic boundary | out-of boundary emissions (transportation of citizens, consumption made and other indirect emissions) | air quality: PM 2.5 concentration levels | air quality: NO 2 concentration levels (highest annual mean observed at traffic stations). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RESINDEX | | | | | | | | | | | | | | | | | |
| Solutions for NetZeroCities | | | | | | | | | | | | | | | | | |
| INCLUSION Process Evaluation Framework | | | | | | | | | | | | | | | | | |
| CIVITAS Evaluation Framework | | | | | | | | | | | | | | | | | |
| Sustainable Urban Mobility Indicators (SUMI) | X | | | | | | | | | X | | X | X | X | X | X | X |
| Energy Indicators | | | | | | | | | | | | | | | | | |
| Energy Indicators | | | | | | | | | | | | | | | | | |
| mySMARTLife Evaluation Framework | X | | | | | | | | | X | X | X | X | X | X | | |
| REMOURBAN Evaluation Framework | X | | | | | | | | | X | X | | | | | X | X |
| SmartEnCity Evaluation Framework | | X | | | | | | | | X | X | | | | | | |
| City Resilience Framework | | | | | | | | | | | | | | | | | |
| Citizen Engagement Impact Framework | | | | | | | | | | | | | | | | | |
| Transformative Theory of Change | | | | | | | | | | | | | | | | | |
| Indicator standard by ISO (International Organization for Standardization) - ISO37120 | | | | | | | | | | | | | | | | | |

**NET ZERO CITIES**

| Framework / KPI Indicators | Level of city interest for climate neutrality / Governance & City plans and regulations | City preparedness / Suitable urban infrastructures | Diversity of city | City commitment to climate neutrality | Diversity of EU/regional/national funding | Mobilization of EU/regional/national funding | Actual progress towards climate neutrality | Overall contribution towards 55% target of European Green Deal | Number of climate neutral cities | Transport (SUMP) / City transportation diagnosis | Energy, SECAP | GHG emissions from buildings, industry, transport, waste treatment, agriculture, forestry within city boundaries | indirect emissions due to consumption of grid-supplied electricity and due to consumption of grid-supplied heating / cooling | GHG emissions from treatment of waste produced within the geographic boundary | out-of boundary emissions (transportation of citizens, consumption made and other indirect emissions | air quality: PM 2.5 concentration levels | air quality: NO 2 concentration levels (highest annual mean observed at traffic stations). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| United 4 Smart sustainable cities: Collection methodology for key performance indicators for smart sustainable cities (U4SSC) | | | | | | | | | | | | | | | | | |
| SCIS EU Smart Cities Information Systems Monitoring | | | | | | | | | | X | X | | | | | | |
| CITYkeys indicators for smart city projects and smart cities | X | | | | | | | | | | | | | | | | |
| ClimateView | | | | | | | | | | | | | | | | | |
| ClearPath | | | | | | | | | | | | | | | | | |
| ISO 37120 | X | X | X | | | | | | | | | X | X | X | X | X | X |
| U4SSC | | | | | | | | | | | | | | | | | |

# ANNEX B: Matrix Gap Analysis – Frameworks' additional Indicators not suggested by the Implementation Plan

| Framework / KPI Indicators | social / cultural | environmental / climate change | economic / financial | Propagation (potential for upscaling and replication) | Health | Citizen engagement | resilience / hazards | water / waste management | biodiversity | Capacity Building for sustainable uran planning | ICT / City Platform | Urban Design / City Characterization |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CDP/ICLEI Unified Reporting Platform | | | | | | | X | X | | | | |
| My Covenant | | | | | | | X | | | | | |
| Global Protocol for Community-Scale GHG Emissions (GPC) | | | | | | | | | | | | |
| BISKO Standard (Germany) | | | | | | | | | | | | |
| GHG Footprinting | | | | | | | | | | | | |
| Science Based Targets (SBTs) - Global Climate Allicance | | | | | | | | | | | | |
| CCR MER | | | | | | | | | | | | |
| Urban Climate Action Impacts Framework (UCAIF) by C40 & Rambøll & partners | | | | | | | | | | | | |
| Nature Based Solution Policy tracker | | | | | | | | | | | | |
| The Greenhouse Gas Protocol (WRI and WBCSD) | | | | | | | | | | | | |
| The CURB Tool: Climate Action for Urban Sustainability | | | | | | | | X | | | | X |
| Data-driven Life Cycle Assessment tool | | | | | | | | | | | | X |
| UN/IPCC Common Reporting Framework | | | | | | | | X | | | | |
| The Reference Framework for Sustainable Cities (RFSC) | | | | | | | | | | | | |
| PAS 2070:2013+A1:2014 European Standards for GHG emission assessment of cities (Direct Plus Supply Chain) | | | | | | | | | | | | |
| SIMRA | | | | | | | | | | | | |
| Evaluating the Impact of Nature-based Solutions | X | X | X | | X | | X | X | X | X | | |
| euPOLIS | X | X | X | | | | X | | X | | | |
| RESINDEX | X | | X | | | | | | | | | |
| Solutions for NetZeroCities | | | | | | | | | | | | |
| INCLUSION Process Evaluation Framework | | | | | | | | | | | | |
| CIVITAS Evaluation Framework | | | | | | | | | | | | |
| Sustainable Urban Mobility Indicators (SUMI) | X | X | X | | X | | | | | | | |
| Energy Indicators | | | | | | | | | | | | |

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| Framework / KPI Indicators | social / cultural | environmental / climate change | economic / financial | Propagation (potential for upscaling and replication) | Health | Citizen engagement | resilience / hazards | water / waste management | biodiversity | Capacity Building for sustainable uran planning | ICT / City Platform | Urban Design / City Characterization |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Energy Indicators | | | | | | | | | | | | |
| mySMARTLife Evaluation Framework | X | | | | | | | | | | X | |
| REMOURBAN Evaluation Framework | X | X | | | X | | | X | | | | X |
| SmartEnCity Evaluation Framework | X | X | X | | | X | | | | | | X |
| City Resilience Framework | | | | | | | | | | | | |
| Citizen Engagement Impact Framework | | | | | | | | | | | | |
| Transformative Theory of Change | | | | | | | | | | | | |
| Indicator standard by ISO (International Organization for Standardization) - ISO37120 | | | | | | | | | | | | |
| United 4 Smart sustainable cities: Collection methodology for key performance indicators for smart sustainable cities (U4SSC) | | | | | | | | | | | | |
| SCIS EU Smart Cities Information Systems Monitoring | X | X | X | | | | | | | | X | |
| CITYkeys indicators for smart city projects and smart cities | X | X | X | X | | | | | | | | |
| ClimateView | | | | | | | | | | | | |
| ClearPath | | | | | | | | | | | | |
| ISO 37120 | X | X | X | | X | | | | | | | X |
| U4SSC | X | X | X | | | | | | | | | |

# ANNEX C: CCC Evaluation

This annex outlines the scope and purpose of the CCC Evaluation (below) and defines basic evaluation criteria which will serve as basis for the evaluation of the CCC document and its development process. The evaluation criteria and the suggested process will be validated with several Mission Cities, whereafter recommendations for finalization of the framework will be documented (D2.11) and implemented as part of the final MEL framework (D2.4.2).

Table 2: Framework for Monitoring and Evaluation of CCCs

|  | Monitoring | Evaluation |
|---|---|---|
| **Purpose** | Determine if CCCs are making progress | Determine the completeness, quality and ambition/impact of CCCs with via set evaluation criteria |
| **Use of findings** | Learning and sense-making<br><br>Take corrective actions and ensure objectives are met<br><br>Flow of information between City and NZC consortium<br><br>Transparency and accountability to local stakeholders | Incorporate lessons learned into tailored support to cities<br><br>Accountability towards the EU Mission Team |
| **Timings** | Continuous (as applicable) | Selective (via defined evaluation points, see timeline below) |
| **Focus** | Activities, outputs, results | Outcomes, impact |
| **Execution** | Mission Cities | Mission Cities<br><br>NZC Consortium (and EU Mission Team) |
| **Management/ quality assurance** | Mission Cities (supported by NZC Consortium) | NZC Consortium (and EU Mission Team) |
| **Deliverables** | N.a | Evaluation reports (non-contractual)<br><br>D2.11 (M12) |
| **Dissemination** | Local Stakeholders in Mission City<br><br>NZC Consortium | Concerned Mission City (bilateral, non-disclosed)<br><br>EU Mission Team |

Catering to the multi-purposed scope of the CCC Evaluation, proposed criteria are composed of a quantitative and qualitative dimension (KPI), still under development and subject to validation and discussion with Mission Cities. The methodology for administering the self-evaluation of Mission Cities' CCC in both quantitative (to allow for overarching evaluation and aggregation) and qualitative terms (to allow for learning and sense-making of the information) is described below.

The evaluation substance is grouped into three overall criteria: (1) **completeness of the CCC** and its annexes in order to get an high-level overview on the status of each Mission City's work progress as well as on the overall progress within the Mission; (2) **Process governance** in order to understand the depth of innovation good governance during the CCC development process with all its iterations; and (3) the **ambition of the CCC** and its annexes to understand whether it is suited to achieve the desired impact of the Mission. The three main criteria are divided into 13 evaluation criteria, which are

monitored via a set of Key Performance Indicators (KPIs) as well as qualitative indications designed to prompt learning and sense-making at city level.

Table 3: Evaluation criteria and KPIs for CCCs

| | Criteria | Key performance indicator (KPI) | Sense-making and learning |
|---|---|---|---|
| **Completeness** | **Completeness and maturity of the overall contract** | | |
| | **Completeness and maturity of the action plan** | | |
| | **Completeness and maturity of the investment plan** | | |
| **Process governance**[2] | **Sustainability -** balance of the social, economic, and environmental needs of present and future generations is reflected | | |
| | **Inclusivity -** equal access to urban decision-making, priority-setting and resource allocation processes and representation of all groups who want to be involved. | | |
| | **Citizenship -** empowerment to participate effectively in decision-making processes | | |
| | **Accountability** – transparency of and access to information; laws and public policies applied in a transparent and predictable manner; professional and personal integrity among elected and appointed officials | | |
| | **Due diligence & Effectiveness -** financially sound, efficient and cost-effective management of revenue sources and expenditures, the administration and delivery of services; responsiveness of policies and initiatives to the priorities and needs of citizens; facilitates contributions of civil society and private actors to urban economy | | |

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2 UN .HABITAT. Source: https://mirror.unhabitat.org/content.asp?typeid=19&catid=25&cid=2097

| | Criteria | Key performance indicator (KPI) | Sense-making and learning |
|---|---|---|---|
| | **Subsidiarity & Multi-level Governance -** High degree of multi-level governance of the CCC process where responsibility for service provision is allocated on the basis of the principle of subsidiarity | | |
| | **Stakeholder Participation –** wide stakeholder participation in the development of the CCC is crucial, enabling ownership of the CCC | | |
| **Ambition & prospective impact** | **Ambition of the commitment document –** the commitment document needs to reflect a high level of ambition through new or augmented targets | | |
| | **Ambition of action plan -** targets and actions are in line or go beyond the Mission requirement | | |
| | **Ambition of investment plan -** investment needs and modes are adequately planned and reflect needs of portfolios described in action plan | | |

### *Methodology, Process & Timeline*

Along the three main evaluation criteria, the evaluation is divided into a **quantitative and a qualitative part.** The quantitative part is derived from the monitoring of KPIs carried out by the Mission Cities. The monitoring information should be used by the Mission Cities and their Transition Teams to a) inform and **control CCC process** at local level at own discretion and b) to form the basis of the yearly **evaluation of the CCC process** carried out by the NZC consortium on that basis (see figure Figure 16 below) using a provided evaluation template with weighted scores and thresholds for each criterion, still under development and subject to discussion and validation by Mission Cities.
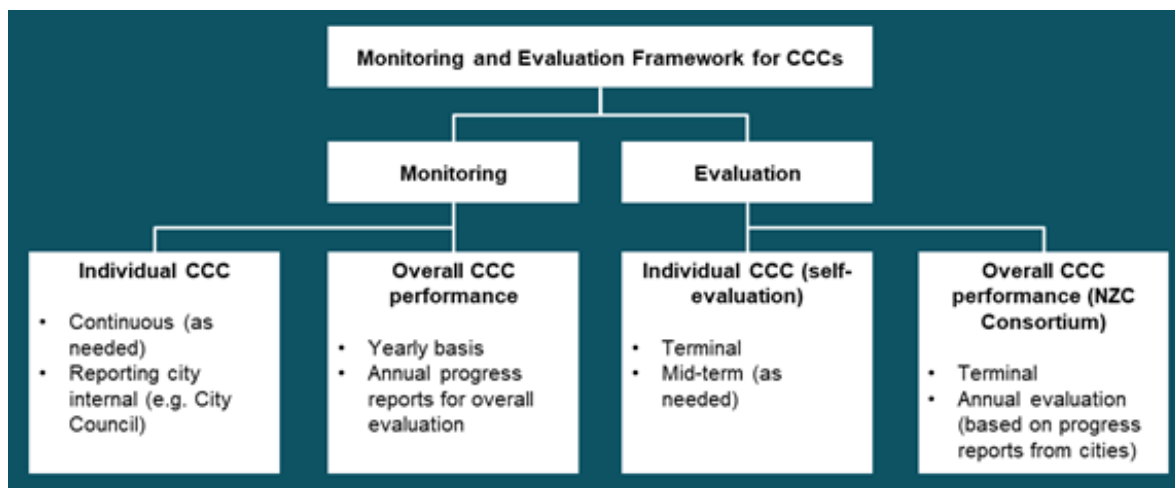
**Figure 16: Basic overview on quantitative CCC monitoring and evaluation**

The qualitative part consists of a set of questions per criteria, which is designed to provide information for facilitating learning and sense-making on the CCC process. The CCC self-assessment results will be made available through the Mission Portal to promote transparency and accountability and will prompt cities to reflect on and learn from how the CCC process and instrument itself contributes to their 2030 ambition, as well as to note changes in governance, partnerships and implementation. These reflections – and city-to-city exchanges about them - will take place as part of the cities' learning trajectories. The results of this reflective monitoring process provides input to all subsequent CCC-iterations by the Mission Cities.

Both the quantitative and qualitative parts will be operationalized through a **Joint Questionnaire** to be filled in by Mission Cities prior to each evaluation point. The Joint Questionnaire will be organized **along the Transition Map** and comprise of a set of quantitative and qualitative questions for each activity of the Transition Map (see Figure 17 below).
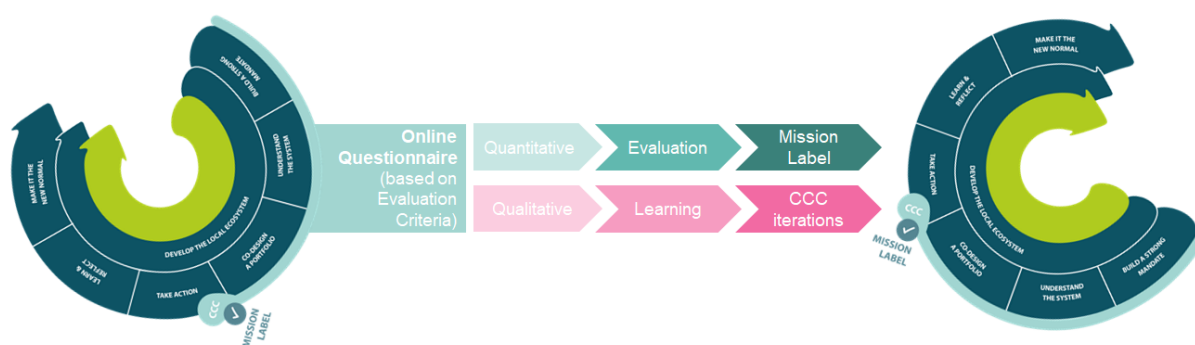


**Figure 17: Schematic overview of Join Questionnaire for evaluation of the CCC**

The Joint Questionnaire should be filled out online by cities on a yearly basis at each evaluation point (see Figure 18 below) starting after the first-year iteration cycle (i.e. October 2023) - as indicated by the timeline below.
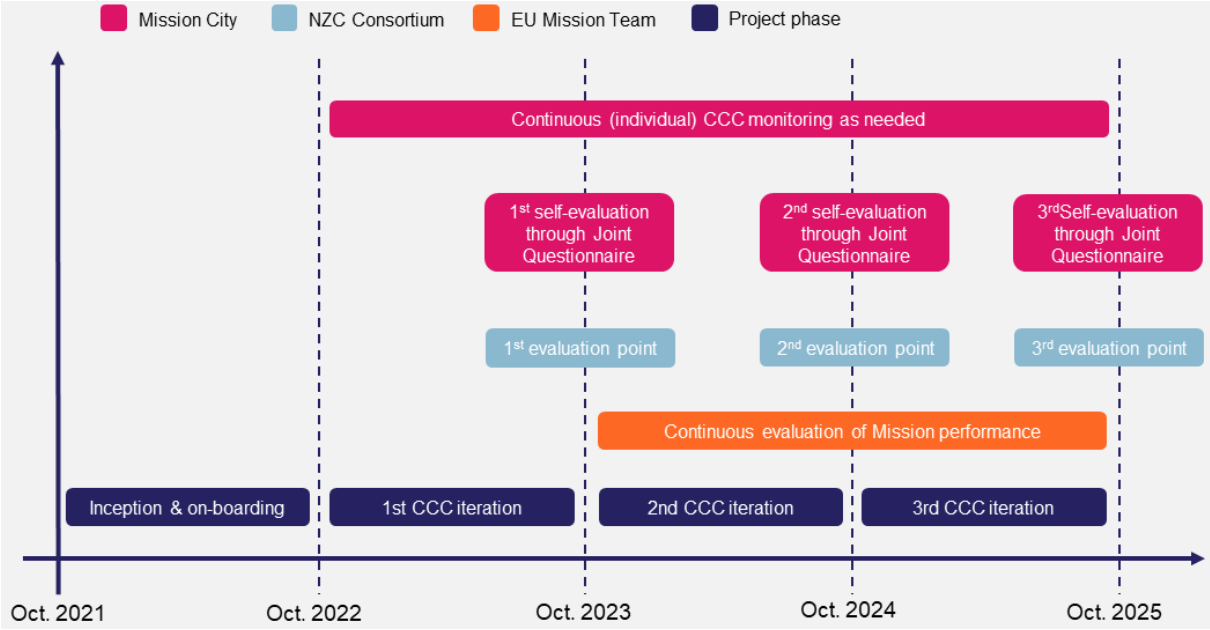
**NET ZERO CITIES**



**Figure 18: timeline for CCC evaluation**

**NET ZERO CITIES**

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