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| **POLDER High Level and Holistic KPIs for Decision Makers**  **Deliverable 7.1**  POLicy Data Exploitation & Re-use  **POLDER**  Disclaimer:  The information in this document is provided as is and no guarantee or warranty is given that the information is  fit for any particular purpose. The user thereof uses the information at its sole risk and liability.  The document reflects only the author’s views and the Community is not liable for any use that may be made of  the information contained therein. |

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**List of abbreviations**

|  |  |
| --- | --- |
| **Abbreviation** | **Meaning** |
| **ISO** | International Standards Organization |
| **ITU** | International Telecommunication Union |
| **CEN** | Comité Européen de Normalisation- European Committee for Standardization |
| **CENELEC** | Comité Européen de Normalisation Electrotechnique- European Committee for Electrotechnical Standardization |
| **ETSI** | European Telecommunications Standards Institute |
| **CITYkeys** | The Project funded by the European Union HORIZON 2020 programme |
| **OOS** | Out of scope |

# Introduction

## Document Objectives and Scope

The objective and scope of this document is to determine key performance indicators (KPIs) that allow cities to measure their progress over time and compare their performance to other cities. These KPIs also allow for the dissemination of best practices and set standards for progress in meeting the Sustainable Development Goals at city-level and provide high-level and holistic view for decision makers.

## Document Structure

This document consists of four sections and one annex. First section gives an introduction. Second section reviews the literature for smart city KPIs and describes the KPI framework and the method for determination of the KPIs. Third section introduces the POLDER domains and links the domains to the KPI framework. The annex section gives the whole list of POLDER high level KPIs.

## Executive Summary

The previous two sections give the required concise information.

### Project Summary

Recent advances in technology, from wireless sensor networks to big data processing and analysis, are radically changing our cities, by introducing new services for the citizens, and improving existing ones both in terms of efficiency and reduced costs. Urban policy making is a fundamental aspect of such transformation and can benefit from such emerging technologies with new supporting tools and optimized processes. However, now, policymaking does not take advantage of these developments. This is addressed in the POLDER project.

The ITEA POLDER project proposes a hybrid policy-making model, where policy is made data-driven, model-driven and society-driven. The ITEA POLDER project will create optimal combinations of these sources. This means that the resulting outcome is

* Cost-effective: collecting data for all types of decisions is usually very costly, even in a smart city, even in a context where sensors are cheap, and connections are abundant. Actual data can be a very strong basis for evidence-based policy, but the associated costs are not always feasible or even acceptable.
* Explainable: the outcome of an algorithm will not automatically be understood by decision-makers, especially when state-of-the-art deep learning is used. Incorporating known models or actual experience from policymakers will help them to understand.
* Acceptable: when citizens’ opinions are included in the policy making, it is much easier to show how citizens have actually influenced the policy and how and where this has taken place. Stakeholders will recognize the points they raised, making the outcome acceptable.

To achieve this goal, the consortium is formed with partners having a track record and established exploitation goals in the smart cities domain: research partners (universities and applied research institutes), ICT companies (both corporate and SMEs), and application domain specific partners. National consortiums provide a use case by deploying the tool-suite or its components in specific cities addressing relevant domains of urban policymaking or another smart city theme.

The project will show that data from different domains can be used to support policies. The project addresses a multitude of urban domains (traffic, air quality, noise, tourism, …) and combines data from those domains. The concept to relate such different domains to each other in an urban environment is not new; the innovation is to make such a model viable: meaning that it can be created in a cost-effective way, that multiple viewpoints can be incorporated including citizens’ opinions, and that the outcomes of the model can be explained in understandable terms. Only then can urban policies become really evidence based.

# POLDER KPI Framework

This section reviews the literature to determine the smart sustainable city KPIs which will enable cities to measure their progress over time, compare their performance to other cities and through analysis and sharing allow for the dissemination of best practices and set standards for progress in meeting the Sustainable Development Goals at the city level.

A large variety of existing indicators assess the sustainability and smartness of the cities. All these indicators and international standardization have been presented by three bodies: (1) **ISO** (International Standards Organization), (2) **ITU** (International Telecommunication Union), and (3) the coalition of the European standardization organizations such as **CEN** (Comité Européen de Normalisation- European Committee for Standardization), **CENELEC** (Comité Européen de Normalisation Electrotechnique- European Committee for Electrotechnical Standardization) and **ETSI** (European Telecommunications Standards Institute) in Europe. Currently, there are six international city indicator standards relevant for Smart sustainable city evaluation and reporting. This study focuses on existing indicator frameworks for smart sustainable cities in the following published standards related to Smart City activities.

* Standards developed **by** **ISO Technical Committee 268 (ISO/TC 268)**
  + “**ISO 37120:2018** Sustainable Development of Communities- Indicators for City Services and Quality of Life” and
  + “**ISO/DIS 37122:2018** Sustainable Development in Communities - Indicators for Smart Cities”. *(DIS: Draft international standard)*
* Standards developed **by** **ITU-T Study Group 5 – Focus Group on Smart Sustainable Cities**
  + **ITU-T Y.4901/L.1601** Key Performance Indicators Related to the Use of Information and Communication Technology in Smart Sustainable Cities,
  + **ITU-TY.4902/L.1602** Key Performance Indicators Related to the Sustainability Impacts of Information and Communication Technology in Smart Sustainable Cities and
  + **ITU-T Y.4903/L.1603** Key Performance Indicators for Smart Sustainable Cities to Assess the Achievement of Sustainable Development Goals
* **ETSI TS 103 463** Key Performance Indicators for “Sustainable Digital Multiservice Cities”. ***Note:*** *These indicators were originally deﬁned* ***by the European CITYkeys****[[1]](#footnote-1)* *initiative (CITYkeys deliverable D1.4: CITYkeys indicators for smart city projects and smart cities- 24-01-2017), together with European cities, based on analysis of 20 cities' needs, 43 existing indicator frameworks and feasibility testing by around 50 cities and other stakeholders.*

The KPI frameworks already developed in these standards are assessed and the POLDER KPI framework is determined. The KPIs are listed in the POLDER framework, resulting in a list of 567 KPIs in total.

In the POLDER project, following FPP, five domains are determined: (1) **Safety & Security**, (2) **Smart Traffic**, (3) **Smart Tourism**, (4) **Energy Efficiency (EE) & Renewable Energy (RE) & CO2 Reduction**, and (5) **Smart City Services & City Planning**. In total, 360 KPIs are selected based on the domains covered by POLDER as high-level KPIs and listed in Annex section.

**POLDER KPI Framework**

Among the already developed frameworks and the standards mentioned above, the CITYkeys indicator framework is selected as the base for POLDER KPIs. It is based on the concept of sustainability and has been generally accepted in the development of indicator systems for national and regional urban development, similar to the ETSI standard. (Figure 1)

|  |  |
| --- | --- |
|  |  |
| Classic dimension of sustainable development | The Triple Bottom Line  *(Source: CITYkeys “Deliverable 1.2 Overview of the Current State of the Art”)* |

Figure 1: Sustainable development

By adding two sub-themes into existing CITYkeys indicator framework shown in Figure 2 (Population and social conditions and Wastewater) POLDER KPIs framework is built. Table 1 and Figure 2 indicate the details of the framework.

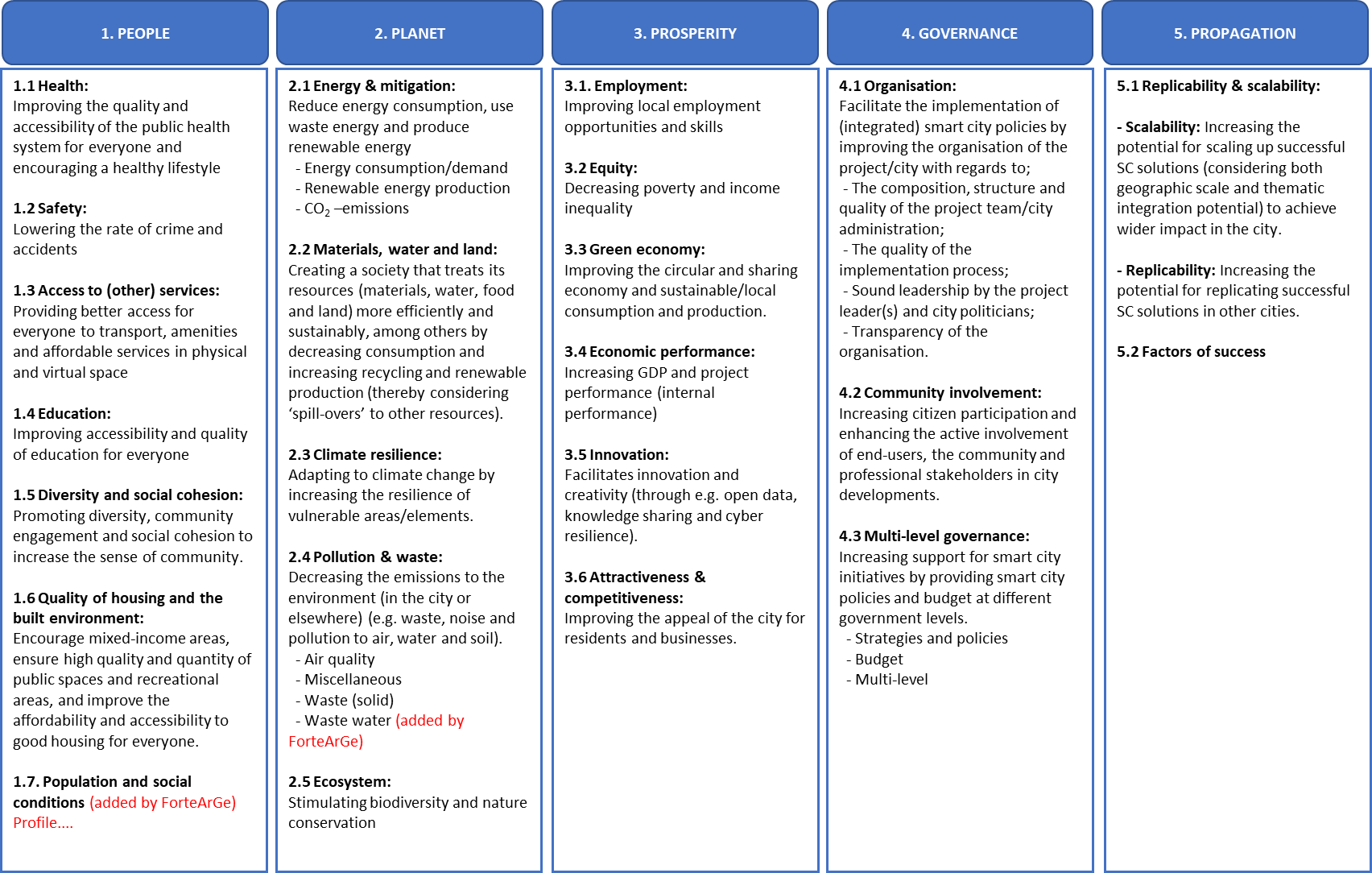


Figure 2: POLDER KPIs Framework

|  |  |  |
| --- | --- | --- |
| **Theme** | **Sub-theme 1** | **Sub-theme 2** |
| **1. People** Definition of People:The People side of sustainability refers to the long-term attractiveness of cities for a wide range of inhabitants and users. Aspects include quality of living for everyone, especially for the most vulnerable citizens, education, health care, social inclusion, etc. | **1.1 Health: I**mproving the quality and accessibility of the public health system for everyone and encouraging a healthy lifestyle |  |
| **1.2 Safety:** Lowering the rate of crime and accidents |  |
| **1.3 Access to (other) services: (\*)** Providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** |
| **1.3.2 (piped) Water** |
| **1.3.3. Electricity & Gas** |
| **1.3.4. Networks and access** |
| **1.3.5 Miscellaneous** |
| **1.4 Education:** Improving accessibility and quality of education for everyone |  |
| **1.5 Diversity and social cohesion:** Promoting diversity, community engagement and social cohesion to increase the sense of community. |  |
| **1.6 Quality of housing and the built environment:** Encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  |
| **1.7. Population and social conditions (\*\*)** |  |
| **2. Planet** Definition of Planet: The "Planet" aspect of sustainability in the first place refers to contributing to a ‘cleaner’ city with a higher resource efficiency and biodiversity and being better adapted to impacts of future climate change such as (in Europe) increased flooding risk, more frequent heat waves and droughts. Included in this theme are thus less consumption of fossil fuels and more generation and use of renewable energy, lower waste generation and less air pollution. As our planet extends beyond the city boundary, impacts of urban consumption in other parts of the world, are explicitly included. | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** |
| **2.1.2 Renewable energy production** |
| **2.1.3 CO2- emissions** |
| **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.1 Materials** |
| **2.2.2 Water** |
| **2.2.3 Land** |
| **2.3 Climate resilience:** Adapting to climate change by increasing the resilience of vulnerable areas/elements. |  |
| **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** |
| **2.4.2 Miscellaneous** |
| **2.4.3 Waste (solid)** |
| **2.4.4 Wastewater (\*\*)** |
| **2.5 Ecosystem:** Stimulating biodiversity and nature conservation |  |
| **3. Prosperity** Definition of Prosperity: Contributing to a prosperous and equal society and supporting affordable, green and smart solutions. On the project level Prosperity stands for economic viability and the value of a smart city project for a neighborhood, for its users and its stakeholders, and even its indirect economic effect on other entities. Economic or financial indicators often need to be accompanied with an in-depth description of the business case, as single indicators are insufficient to evaluate e.g. the distribution of costs and investments. | **3.1. Employment:** Improving local employment opportunities and skills |  |
| **3.2 Equity:** Decreasing poverty and income inequality |  |
| **3.3 Green economy:** Improving the circular and sharing economy and sustainable/local consumption and production. |  |
| **3.4 Economic performance:** increasing GDP and project performance (internal performance) |  |
| **3.5 Innovation:** Facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  |
| **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  |
| **4. Governance** Definition of Governance: Contributes to a successful process of project implementation as well as to a city with an efficient administration and a well-developed local democracy, thereby engaging citizens proactively in innovative ways. | **4.1 Organization:** Facilitate the implementation of (integrated) smart city policies by improving the organization of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organization. |  |
| **4.2 Community involvement:** increasing citizen participation and enhancing the active involvement of end-users, the community and professional stakeholders in city developments. |  |
| **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.1 Strategies and policies** |
| **4.3.2 Budget** |
| **4.3.3 Multi-level** |
| **5. Propagation** Definition of Propagation**:** Improving the replicability and scalability of smart city project solutions at wider city scale. Propagation is about the potential for dissemination to other locations, other contexts and other cities. Propagation (both transfer to other locations and countries, and up-scaling from small single projects) depends in the first place on inherent characteristics of the (innovative) smart city project. In practice propagation also depends on external factors such as market conditions. | **5.1 Replicability & scalability:** - Scalability: Increasing the potential for scaling up successful SC solutions (considering both geographic scale and thematic integration potential) to achieve wider impact in the city.  - Replicability: Increasing the potential for replicating successful SC solutions in other cities. |  |
| **5.2 Factors of success** |  |
| **(\*)** organized in POLDER through 5 sub-themes | |  |
| **(\*\*) additional sub-themes in the POLDER framework** |  |  |

Table 1: The Themes of POLDER KPIs Framework

Finally, out of **567 indicators** from the six international standards, we have defined the POLDER framework by grouping them into themes and sub-themes.

# POLDER KPI Selection

The KPIs are selected based on the domains covered by POLDER and the use cases presented in FPP.) Tables 2 and 3 show the domains covered by POLDER and the use cases, respectively. Based on this information, the POLDER KPIs framework is associated with the domains and use cases.

|  |  |  |
| --- | --- | --- |
| **Acronym** | **The domains covered by POLDER** | **Relevant part of FPP** |
| **I** | **SAFETY & SECURITY** | ● **by creating better insight in locations in the city that are too busy** POLDER will be able to reduce annoyance and unsafe situations for citizens which will aid to the increase in wellbeing; |
| **II** | **SMART TRAFFIC** | ● **by understanding the physical conditions in a city on aspects like temperature, noise and air pollution by means of sensors and modelling and relating these conditions to the local traffic situation**, POLDER will through its visualizations aid in the selection of policy measures that will reduce traffic externalities and thus improving health and wellbeing; |
| **III** | **SMART TOURISM** | **● by improving insight in tourist’s needs and managing their impact on a city, both the experience from tourists improves as well as the impact on the local citizens** by adapting and managing tourists in such a way that externalities coming from tourists visiting cities are reduced; |
| **IV** | **ENERGY EFFICIENCY & RE & CO2 REDUCTION** | ● **by both optimizing and reducing energy usage cross domain (e.g. buildings, lighting and electric vehicles) within an urban area and combining the gained insights to verify effectiveness of measures** the overall energy consumption within an urban area will reduce, thus supporting the general climate goal to **reduce CO2 emissions;** |
| **V** | **SMART CITY SERVICES & CITY PLANNING** | ● **by expanding the smart city services development into other domains such as water, wastewater or waste management** and thus making government services more efficient and effective, taxpayers’ money will be used more efficiently. SMART CITY SERVICES (Air quality, water quality, waste management, open data, big data, GIS etc.) |
| **OOS** | **“out of scope” of the POLDER** | There is a relationship with the domains are not covered by POLDER. |

Table 2: The domains covered by POLDER

POLDER use cases and their relation to the domains are given in the table below:

|  |  |
| --- | --- |
| **The use cases are described in Section 2.3 of FPP (in page 67).** | **Relationship with POLDER domains** |
| Smart tourist destinations.  Improve visiting experience of tourists while also improving living standards of citizens. Forecasting busy areas, and usage of city resources as a result. | III V |
| Traffic security.  Visualization of traffic on dashboard, using IoT, with a focus on security. Using data from many different sources; enabling decision support for events (e.g. with crowd simulation) and other situations. | II  I |
| Smart city planning.  Create 3D models of (planned) developments and study the effects on traffic and waste management. | VI |
| Urban smart services.  The aim of these use cases is to evaluate technologies, reference architectures, data analysis methods and decision-making in services that companies provide to their customers. Themes will be Indoor localization, event management, smart workforce. | V |
| Air quality, temperature and noise monitoring in Cities. Also, water quality and quantity monitoring in the city. | V |
| Traffic visualization, nudging users to take more sustainable routes and transport modes. Combination with social media data to get better insights. | II V |

Table 3: Use cases and related domains covered by POLDER

From Figure 2, KPIs under sub-themes “1.1 Health”, “1.4 Education”, “1.5 Diversity and social cohesion”, “2.2.1 Materials”, “3.1. Employment”, “3.2 Equity”, “3.3 Green economy”, “3.4 Economic performance”, “4.3.3 Multi-level”, “5.1 Replicability & scalability” and “5.2 Factors of success” are considered out of scope (**OOS**) in the POLDER framework. Also, some indicators under the rest of the sub-themes are considered OOS such as “Number of firefighters per 100 000 population”, “Number of smartphones and tablets per 100 inhabitants”, “Number of new patents per 100 000 population per year” etc.

Although “3.2 Equity”, “3.3 Green economy” and “3.4 Economic performance” are considered OOS, some of indicators under these sub-themes such as “Annual Inflation Rate based on the average of the past five years”, “Saving Rate”, “Share of Green Public Procurement”, “Freight Movement”, “Median Disposable Income” are selected as POLDER KPIs. (Table 4)

|  |  |  |  |
| --- | --- | --- | --- |
| **Theme** | **Sub-theme 1** | **Sub-theme 2** | **Relationship with POLDER domains** |
| **1. People** | 1.1 Health: |  | OOS |
| 1.2 Safety: |  | I, II |
| 1.3 Access to (other) services: | 1.3.1 Transport | II, IV, V |
| 1.3.2 (piped) Water | V |
| 1.3.3. Electricity & Gas | IV, V |
| 1.3.4. Networks and access | V |
| 1.3.5 Miscellaneous | II, V |
| 1.4 Education: |  | OOS |
| 1.5 Diversity and social cohesion: |  | OOS |
| 1.6 Quality of housing and the built environment: |  | IV, V |
| 1.7. Population and social conditions |  | II, V |
| **2. Planet** | 2.1 Energy & mitigation: | 2.1.1 Energy consumption/demand | IV, V |
| 2.1.2 Renewable energy production | IV |
| 2.1.3 CO2- emissions | IV |
| 2.2 Materials, water and land: | 2.2.1 Materials | OOS |
| 2.2.2 Water | V |
| 2.2.3 Land | V |
| 2.3 Climate resilience: |  | V |
| 2.4 Pollution & waste: | 2.4.1 Air quality | V |
| 2.4.2 Miscellaneous | V |
| 2.4.3 Waste (solid) | IV, V |
| 2.4.4 Wastewater | IV, V |
| 2.5 Ecosystem: |  | V |
| **3. Prosperity** | 3.1. Employment |  | OOS |
| 3.2 Equity: |  | OOS **(\*)** |
| 3.3 Green economy: |  | OOS **(\*)** |
| 3.4 Economic performance: |  | OOS **(\*)** |
| 3.5 Innovation: |  | V |
| 3.6 Attractiveness & competitiveness: |  | II, III, V |
| **4. Governance** | 4.1 Organization: |  | II, III, V |
| 4.2 Community involvement: |  | V |
| 4.3 Multi-level governance: | 4.3.1 Strategies and policies | V |
| 4.3.2 Budget | V |
| 4.3.3 Multi-level | OOS |
| **5. Propagation** | 5.1 Replicability & scalability: |  | OOS |
| 5.2 Factors of success |  | OOS |
| ***NOTE:*** *The sub-themes marked by* ***(\*)*** *were considered OOS but some of indicators under these sub-themes were selected as POLDER KPIs.* | | | |

Table 4: The relationship of the Sub-themes with POLDER domains.

The list of POLDER’s KPIs which have reached to around 360 in total are given in annex section.

# Conclusion

This document determined the high-level key performance indicators (KPIs) enabling cities to measure their progress over time and compare their performance to other cities. For this purpose, six international standards were examined to form the POLDER KPI framework. Then the framework is linked to the POLDER domains. Finally, POLDER KPIs are selected from the framework according to the relevant domains. The selection is given the annex section.

# Annex

List of POLDER KPIs.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Theme** | **Sub-theme 1** | **Sub-theme 2** | **Indicator title** | **Indicator unit** | **POLDER domains** | **Definition** | **Calculation/Explanations** | **Source** |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Traffic accidents (CITYkeys) Transportation deaths per 100 000 population (ISO 37120) | #/100 000 | I II | Number of transportation fatalities per 100 000 population | This indicator shall be calculated as the number of fatalities related to transportation of any kind (numerator), divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of transportation fatalities per 100 000 population. The city shall include in this indicator deaths due to any transportation related proximate causes in any mode of travel (automobile, public transport, walking, bicycling, etc.). The city shall count any death directly related to a transportation incident within city limits, even if death does not occur at the site of the incident, but is directly attributable to the accident. | CITYkeys,  ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Reduction of traffic accidents | % of fatalities | I II | Percentage reduction of transportation fatalities due to the project | ((transportation fatalities after project/transportation fatalities before project)\*100)-100 | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Crime rate | #/100 000 | I | Number of violence, annoyances and crimes per 100 000 population | This indicator shall be calculated as the total number of all crimes reported  (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of crimes per 100 000 population. | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Reduction in crime rate | % of crimes | I | Percentage reduction in number of violences, annoyances and crimes due to the project | ((crimes after project/crimes before project)\*100)-100 | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Cybersecurity | Likert | I | The level of cybersecurity of the cities’ systems | Likert scale: Low level of cybersecurity –– 1 — 2 — 3 — 4 — 5 — High level of cybersecurity  1.Maximum one of the following conditions is met.  2.Two of the following conditions are met  3.Three of the following conditions are met.  4.Four of the following conditions are met.  5.All the five following conditions are met.  1.There has been no serious information leakage or cyberattack with significant negative impact on the organisation, its employees or citizens during the past two years. Serious means that it results in disclosure of information (e.g. confidential or sensitive personally identifiable information) or financial lost, due to illegal system access, unauthorized data storage or transmission, unauthorized hardware and software modifications or personnel’s lack of compliance with security procedures.  2.The city makes annually a risk assessment on risks of cybersecurity and has a contingency plan against the identified risks.  3.All city personnel receive basic security training when they are employed to conduct adequately to security incidents.  4.The city has recruited personnel dedicated to cybersecurity and they have signed a security pledge.  5.Employees’ devices deploy an antivirus program for mitigating malware including viruses residing in them and remote access protected, i.e. controlled with security function for intrusion prevention or intrusion detection. | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Improved cybersecurity | Likert | I | The extent to which the project ensures cybersecurity | Likert scale: Not at all –– 1 — 2 — 3 — 4 — 5 — Very high  1.Not at all: Cybersecurity hasn’t received any attention in the project planning, even though the project involves the use of ICT.  2.Low: A risk assessment on cybersecurity has been made for the project but there is either no contingency plan or high risks remain present.  3.Moderate: A risk assessment on cybersecurity has been made for the project and there is a contingency plan for it.  4.High: A risk assessment on cybersecurity has been made for the project and there is a contingency plan for it. Risks on cyber security are low.  5.Very high A risk assessment on cybersecurity has been made for the project and there is a contingency plan for it. Risks on cyber security are low. The project uses only information systems with security assessment approvals (certified and accredited prior to deployment). | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Data privacy | Likert | I | The level of data protection by the city | Likert scale: Not at all –– 1 — 2 — 3 — 4 — 5 — Very high  1.City doesn’t follow national regulations/laws on protection of personal data.  2.City follows national regulations/laws on protection of personal data.  3.City follows relevant national regulations on protection of personal data and the EU Directive on the Protection of Personal Data (95/46/EG).  4.City follows all the relevant national and European regulations/laws related to data privacy and protection. If personal/private data is collected from citizens, proper authorisations with written agreements are made.  5.Relevant national and European regulations on data protection and privacy are followed and written agreements are made for use of citizens’ private/personal data. All the collected personal/private data, especially sensitive personal data, is accessed only by agreed persons and is heavily protected from others (e.g. locked or database on internal server with firewalls and restricted access). | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Improved data privacy | Likert | I | The extent to which data collected by the project is protected | Likert scale: Not at all –– 1 — 2 — 3 — 4 — 5 — Very high  1.Project involves use of personal or private data but national regulations/laws on its protection are not followed.  2.National regulations/laws on protection of personal data are followed.  3.National regulations on protection of personal data and EU Directive on the Protection of Personal Data (95/46/EG) are followed.  4.Relevant national and European regulations on data protection are followed and written agreements are made for use of end-users’ private/personal data.  5.Relevant national and European regulations on data protection are followed and written agreements are made for use of end-users’ private/personal data. Possibly collected personal/private data is accessed only by agreed persons and is heavily protected from others (e.g. locked or database on internal server with firewalls and restricted access). | CITYkeys |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Information security of public services and systems | % of incidents | I | Proportion of incidents, due to illegal system access, unauthorized data storage or transmission, unauthorized hardware and software modifications, which lead to information disclosure or financial loss. | NY | ITU 4901 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Existence of systems, rules and regulations to ensure Child Online Protection (COP) (ITU 4901) Child online protection (COP) (ITU 4903) | Checklist | I | Existence of rules and regulations to ensure COP. This also includes proportion of public web services and devices that ensure COP. NOTE – The city could work against cyber bullying by ensuring safety in online public services (for the use of ICT in schools etc.). | **ITU 4903:** NOTE1 – The city could work against cyber bullying by ensuring safety in online public services (for the use of ICTs in schools, etc.).  NOTE 2 – The verification contains examination in four aspects, including i) COP legislation; ii) COP regulations enforced in public service and facilities; iii) COP regulations properly enforced for web services; and iv) the coverage rate of qualified COP systems.  NOTE 3 – This indicator is determined by the sum of the YES answers. | ITU 4901,  ITU 4903 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Existence of systems, rules and regulations to ensure Privacy protection in public service (ITU 4901) Information security and privacy protection (ITU 4903) | Checklist | I | Existence of rules and regulations to ensure privacy protection in public service. This should also include proportion of public services and devices that ensure privacy protection. NOTE – This indicator evaluates the adoption of K-anonymity privacy preserving scheme, and other systems to ensure privacy of the city inhabitants. In addition, the rules, and regulations also require that institutions which offer consumers financial products or services like loans, financial advice, investment advice, or insurance; to safeguard sensitive and confidential information by explaining their information-sharing practices to their customers. | NOTE 1 – The verification contains examination in four aspects, including a) legislation; b) regulations enforced in public service and facilities; c) regulations properly enforced for web services; and d) the coverage rate of qualified systems.  NOTE 2 – This indicator is determined by the sum of YES answers reported. | ITU 4901,  ITU 4903 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Response time for emergency response services from initial call (supporting indicator) (ISO 37120) Emergency Service Response Time (ITU 4903) | in minutes and seconds | I | Average response time for emergency services | **ISO 37120:** The response time for the emergency and rescue department from the initial call shall be calculated as the sum of all initial distress calls to the on-site arrival of the emergency personnel and equipment in minutes and seconds for the year (numerator) divided by the number of emergency responses in the same year (denominator). The result shall be expressed as the response time for emergency response services from initial call in minutes and seconds. The total number of minutes and seconds taken to respond to all emergency rescue calls shall include the time elapsed from receiving the initial call for assistance to arrival on-site of emergency personnel and equipment is calculated for the preceding 12 months. **ITU 4903:** NOTE 1 – Emergency services include police, fire control and others.  NOTE 2 – Expressed as the average number of minutes and seconds taken to respond to emergency calls from initial call to arrival on-site. | ISO 37120,  ITU 4903 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Response time for fire department from initial call (supporting indicator) Emergency Service Response Time (ITU 4903) | in minutes and seconds | I | Average response time for emergency services | **ISO 37120:** The response time for a fire department from the initial call shall be calculated as the sum of all initial distress calls to the on-site arrival of the fire department personnel and equipment in minutes and seconds for the year (numerator) divided by the number of fire department responses in the same year (denominator). The result shall be expressed as the response time for fire department from initial call in minutes and seconds. The total number of minutes and seconds taken to respond to all emergency calls shall include the time elapsed from receiving the initial call for assistance to the on-site arrival of fire department personnel and equipment and is calculated for the preceding 12 months. **ITU 4903:** NOTE 1 – Emergency services include police, fire control and others.  NOTE 2 – Expressed as the average number of minutes and seconds taken to respond to emergency calls from initial call to arrival on-site. | ISO 37120,  ITU 4903 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Crimes against property per 100 000 population (supporting indicator) | #/100 000 | I | NY | The number of crimes against property shall be calculated as the total number of all property crimes reported (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of property crimes per 100 000 population. Crimes against property shall be defined as all offences involving the unlawful taking or destruction of property, but without the threat of use of force against a person. Crime against property should include: burglary; larceny-theft; motor vehicle theft; and, arson. | ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Number of deaths caused by industrial accidents per 100 000 population (supporting indicator) | #/100 000 | I | NY | NY | ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Number of violent crimes against women per 100 000 population (supporting indicator) | #/100 000 | I | NY | NY | ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Response time for police department from initial call (ISO 37120) Emergency Service Response Time (ITU 4903) | in minutes and seconds | I | Average response time for emergency services | **ISO 37120:** The response time for police department from initial call shall be calculated as the sum of number of all initial distress calls to the on-site arrival of the police department personnel for the year in minutes and seconds (numerator) divided by the number of police department responses in the same year (denominator). The result shall be expressed as the response time for police department from initial call in minutes and seconds. The total number of minutes and seconds taken to respond to all emergency calls shall include the time elapsed from receiving the initial call for assistance to arrival on-site of police department personnel is calculated for the preceding 12 months. **ITU 4903:** NOTE 1 – Emergency services include police, fire control and others.  NOTE 2 – Expressed as the average number of minutes and seconds taken to respond to emergency calls from initial call to arrival on-site. | ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Violent crime rate per 100 000 population | #/100 000 | I | NY | The violent crime rate per 100 000 population shall be calculated as the total number of all violent crimes reported (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of violent crimes per 100 000 population. Violent crimes shall include offences that involve force or the threat of force to a person. Total violent crimes reported shall be calculated as the total sum of the number of murders and non-negligent manslaughters, the number of rapes, the number of robberies and the number of aggravated assaults. Furthermore, a violent crime should be classified as one of the following four offences (in order of severity): murder and non-negligent manslaughter; rape; robbery; and, aggravated assault. For a multiple-offence, only the most serious/severe offence shall be counted. | ISO 37120 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Percentage of the city area covered by digital surveillance cameras | % of city area | I | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Percentage of city population registered with a public safety alert system | % of people | I | NY | NY | ISO/CD 37122 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Annual number of social media posts by municipal public safety officials per 100 000 population | #/100 000 | I | NY | NY | ISO/CD 37122 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Resilience plans | checklist | ı | Presence of vulnerability assessment, financial (capital and operating) plans and technical systems for disaster mitigation | NOTE 1 – Checklist: a) city infrastructures available for resilience; b) vulnerability assessment; c) financial (capital and operation) plans to mitigate vulnerabilities; d) technical systems to implement the plans.  NOTE 2 – This indicator shall be determined by the sum of YES answers reported.  NOTE 3 – Vulnerability to heat, drought, flooding, earthquakes, typhoon, tsunami and other natural hazards are investigated, and adoption of disaster management.  NOTE 4 – Data of vulnerability assessment can be derived from historical data (expert interviews) and global maps regarding heat, drought, flooding, earthquakes, typhoon, tsunami, etc.  NOTE 5 – reference: the United Nations Office for Disaster Risk Reduction http://www.unisdr.org/  NOTE 6 – SDG indicator 11.b.1 is "Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030a". [b-UN SDG] | ITU 4903 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Adoption of ICT for disaster management | ??? | I | Adoption of an ICT based disaster management system including disaster preparedness, prevention, mitigation, and response as applicable to the city.  NOTE – Disasters may be natural or man-made. | NY | ITU 4901 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Availability of ICT based safety systems | ??? | I | Availability of ICT based systems that increase the perceived safety.  NOTE – This may include solutions such as video surveillance system, online information published by the police, online support for protection of women and children, community incident mapping etc. | NY | ITU 4901 |
| **1. People** | **1.2 Safety:** lowering the rate of crime and accidents |  | Disaster and emergencies alert accuracy (ITU 4902) Disaster and emergency alert (ITU 4903) | % | I | Proportion of disasters and emergencies with timely alerts. (\*\*) NOTE – Disasters may be natural or man-made. Emergencies concern incidents like kidnapping and missing people etc. | **ITU 4903:** NOTE 1 – Civil protection agencies are called to provide the list of events with the related alerting/risk level and also the quantifications of the misleading/worn alarms. NOTE 2 – Calculate as:  Numerator: Number of disasters and emergencies with timely alerts.  Denominator: Number of disasters and emergencies. | ITU 4902,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to public transport (CITYkeys) Percentage of population living within 0,5 km of public transit running at least every 20 min during peak periods (supporting indicator)(ISO 37120) | % of people | II | Share of population with access to a public transport stop within 500m | (Number of inhabitants with a transportation stop <500m/total population)\*100%  NB. It can be calculated as the sum of buildings with a point of access within 500m, multiplied by its inhabitants. A point of access is defined as the location where a mode of transportation can be accessed. | CITYkeys,  ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to public transport | Likert scale | II | The extent to which public transport stops are available within 500m | Likert scale: No stops – 1 — 2 — 3 — 4 — 5 — Many stops  1.No stops  2.Relatively few stops  3.A relatively reasonable number of stops  4.A relatively sufficient number of stops  5.Relatively many stops of public transport  NB. As local circumstances vary, no absolute benchmark is attached to this indicator. The evaluator is asked to provide an indication of the extent to which public transportation stops are present. A building is considered to have access to a transport network if a point of access is located within 500m of said building. A point of access is defined as the location where a mode of transportation can be accessed. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Use of public transport | % of people | II | Proportion of travellers utilizing public transportation compared to overall city population. (\*\*) | NY | ITU 4902 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Quality of public transport | Likert scale | II | The perception of users on the quality of the public transport service | Likert scale:Dissatisfied – 1 – 2 – 3 – 4 – 5 – Very satisfied  1.Very dissatisfied  2.Somewhat dissatisfied  3.Neither dissatisfied nor satisfied  4.Somewhat satisfied  5.Very satisfied  Note: The answer depends very much on the formulation of the question adopted. The question to be asked could be for instance "How do you rate the quality of public transport in your city?" Each target group must be represented by the survey. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Road traffic efficiency | Ratio | II | Freedom from traffic congestion exposure. (\*\*) NOTE – Traffic congestion is measured in accordance with relevant international/national standards. For example, in terms of average speed of vehicle or average delay. Travel time index (ITU 4903) | NOTE 1 – Travel time index (TTI) is a measure of congestion that focuses on each trip and each distance of travel and relates to traffic efficiency.  NOTE 2 – Ratio of the travel time during the peak period to the time required to make the same trip at free-flow speeds.  NOTE 3 – Calculate as:  Numerator: Travel time in the peak period.  Denominator: Travel time in free-flow.  Expressed as a ratio. | ITU 4902,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Kilometres of public transport system per 100 000 population (core indicator) Public transport network (ITU 4903) | km/100 000 inhabitants | II | Length of public transport systems per 100 000 inhabitants | NOTE 1 – Public transport should include both high capacity (e.g., heavy rail, metro, subway systems and commuter rail systems) and light capacity (e.g., light rail streetcars and trams, buses, trolleybuses).  NOTE 2 – Calculate as:  Numerator: km (one way length).  Denominator: One 100 000th of the city's population.  Express as km / 100 000 inhabitants.  NOTE 3 – One way length is defined as a transit line that is 10 km long (back and forth) is counted as 10km (one way length) vs 20 km (two way length). | ISO 37120,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Kilometres of high capacity public transport system per 100 000 population | #/100 000 | II | NY | The kilometres of high capacity public transport system per 100 000 population shall be calculated by adding the kilometres of high capacity public transport systems operating within the city (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the kilometres of high capacity public transport system per 100 000 population. High capacity public transport may include heavy rail metro, subway systems and commuter rail systems. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Kilometres of light passenger public transport system per 100 000 population | #/100 000 | II | NY | The kilometres of light passenger public transport system per 100 000 population shall be calculated by adding the kilometres of light passenger transport systems provided within the city (numerator), divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the kilometres of light passenger transport system per 100 000 population. Expressed as per 100 000 population. Light passenger transport may include light rail streetcars and tramways, bus, trolleybus and other light passenger transport services. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Average commute time (supporting indicator) | ??? | II | NY | NY | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of commuters using a travel mode to work other than a personal vehicle (supporting indicator) | % | II | NY | Percent of commuters using a travel mode to work other than a personal vehicle shall be calculated as the number of commuters working in the city who use a mode of transportation other than a private Single Occupancy Vehicle (SOV) as their primary way to travel to work (numerator) divided by all trips to work, regardless of mode (denominator). The result shall then be multiplied by 100 and expressed as a percentage of commuters using a travel mode other than a personal vehicle. Modes other than non-SOV may include carpools, bus, mini-bus, train, tram, light rail, ferry, motorcycle and non-motorized two-wheel vehicles such as bicycles, and walking, and other modes. For cases where multiple modes are used, the indicator shall reflect the primary travel mode, either by length of trip on that mode or by distance travelled on that mode. For example, if a person drives a SOV from home to a suburban train station (5 minutes), takes a 30-minute train ride to the central city, and then takes a 5- minute bus ride to their office, the primary travel mode is the passenger train. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Number of personal automobiles per capita (profile indicator) | #/cap | II | NY | The number of personal automobiles per capita shall be calculated as the total number of registered personal automobiles in a city (numerator) divided by the total city population (denominator). The result shall be expressed as the number of personal automobiles per capita. The total number of registered personal automobiles shall include automobiles used for personal use by commercial enterprises. This number shall not include automobiles, trucks and vans that are used for the delivery of goods and services by commercial enterprises. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Number of two-wheeled motorized vehicles per capita (profile indicator) | #/cap | II | NY | The number of two-wheel motorized vehicles per capita shall be calculated as the total number of two-wheel motorized vehicles in the city (numerator) divided by the total city population (denominator). The result shall be expressed as the number of two-wheel motorized vehicles per capita. Two-wheel motorized vehicles shall include scooters and motorcycles. This shall not include non motorized vehicles such as bicycles. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to vehicle sharing solutions for city travel | #/100 000 | II | Number of vehicles available for sharing per 100 000 inhabitants | Number of vehicles per 100 000 | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Improved access to vehicle sharing solutions | Likert scale | II | Improved accessibility to vehicle sharing solutions | Likert scale: No improvement – 1 — 2 — 3 — 4 — 5 — Very high improvement.  1.Not at all: the possibilities for vehicle sharing were not improved.  2.Poor: there was little improvement in the possibilities for vehicle sharing.  3.Somewhat: the possibilities for vehicle sharing were somewhat improved.  4.Good: the possibilities for vehicle sharing were sufficiently improved.  5.Excellent: the prossibilities for vehicle sharing were very much improved. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Availability of online bike/car sharing system | % of km2 | II | Proportion of city area covered by an online bike/car sharing system | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Length of bike route network (CITYkeys) Kilometres of bicycle paths and lanes per 100 000 population (ISO 37120) | % in km | II | % of bicycle paths and lanes in relation to the length of streets (excluding motorways) | The indicator shall be calculated as the total kilometres of bicycle paths and lanes (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the kilometres of bicycle paths and lanes per 100 000 population. | CITYkeys,  ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Extending the bike route network | % in km | II | Percentage increase of the length of cycling roads | ((km’s cycling roads after the project/km’s cycling roads before the project)\*100)-100 | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Commercial air connectivity (number of non-stop commercial air destinations) (supporting indicator) | # of flights | II | NY | Commercial air connectivity shall be expressed as the sum of all non-stop commercial (i.e. scheduled) flights departing from all airports serving the city. Airports serving the city shall include all airports within a two hour travel distance from the subject city. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of city streets and thoroughfares covered by real-time online traffic alerts and information | % of streets | II | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Availability of traffic monitoring using ICT (ITU 4901) Traffic monitoring (ITU 4903) | % of streets | II | Proportion of streets with traffic monitoring using ICT (e.g., using sensors to produce traffic volume maps etc). (ITU 4901) Proportion of major streets monitored by ICT (ITU 4903) | NOTE 1 – Refer to major and arterial roads and highways.  NOTE 2 – Calculate as:  Numerator: Length of major streets monitored by ICT.  Denominator: Total major streets. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Availability of real-time traffic information (ITU 4901) Real-time public transport information (ITU 4903) | % of stops | II | Proportion of public transport stops and stations with real-time traffic information available (via electronic bus bulletin boards, smartphone apps etc.) NOTE – Public transportation includes e.g., metro, bus, tram, train and ferry. | ITU 4903: NOTE 1 – Calculate as:  Numerator: Number of stops and stations with real time information.  Denominator: Total number of stops and stations.  NOTE 2 – Via electronic bus bulletin boards, smartphone apps, etc. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of vehicles registered in the city that are low-emission vehicles | % of vehicles | II IV | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Share of EVs | % of vehicles | II IV | Proportion of EVs (BEV, PHEV, REEV/REX, FCEV) in public fleets  EV: Electric Vehicle, BEV: battery-electric vehicle, PHEV: plug-in hybrid electric vehicle, REEV: Range Extended Electric Vehicle, REX: Range Extender (Vehicle) FCEV: fuel cell electric vehicle | NOTE 1 – Calculate as:  Numerator: Number of EVs.  Denominator: Total number of vehicles. | ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Number of bicycles available through municipally provided bicycle sharing services per 100 000 population | #/100 000 | II IV | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of public transport lines equipped with a real-time system | % of lines | II | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of the city public transport network covered by a unified payment system | % of lines | II | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of public parking spaces equipped with e-payment systems | % of public parking | II | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of public parking spaces equipped with real-time availability systems (ISO/DIS 37122) Availability of parking guidance systems. (ITU 4901) | % of public parking | II IV | NY (ISO 37122) Proportion of parking lots and street parking spaces with ICT based parking guidance systems. (ITU 4901) | NY | ISO/DIS 37122,  ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of traffic lights that are intelligent/smart | % of traffic lights | II IV | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Street lighting management using ICT | % of street lamps | I II IV V | Proportion of street lamps under automatic management using ICT (e.g., light/sound control and solar power charging). NOTE – Management covers both inspection and regulation. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of street lighting remotely managed by a light management system | ??? | I II IV V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of marked pedestrian crosswalks equipped with accessible pedestrian signals | % of crosswalks | II V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | City area mapped by real-time interactive street maps as a percentage of city’s total land area | % of km2 | II IV V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of vehicles registered in the city that are autonomous vehicles | % of vehicles | I II V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of public transport routes with municipally provided and/or managed internet connectivity for commuters | % of road | I II V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of roads compliant with autonomous driving systems | % of road | I II V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of vehicles fined for traffic violations making a payment through an online e-fine system | % of vehicles | I II | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to public amenities | % of people | II V | Share of population with access to at least one type of public amenity within 500m | (Number of inhabitants with a public amenity <500m/total population)\*100%  NB. It can be calculated as the sum of buildings with a public amenity within 500m, multiplied by its inhabitants. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to public amenities | Likert scale | II V | The extent to which public amenities are available within 500m | Likert scale: No public amenities – 1 — 2 — 3 — 4 — 5 — Relatively many public amenities.  1.No amenities: no public amenities whatsoever are available (e.g. no basic nor additional).  2.Relatively few amenities: only few basic public amenities are available (e.g. a small park).  3.A reasonable number of amenities: basic public amenities are available including a few important amenities such as a park and a community center.  4.A sufficient number of amenities: basic public amenities are widely available (e.g. open green spaces, public recreation) as well as many important public amenities (theatres).  5.Relatively many amenities: the area surrounding the project’s central living area includes a wide variety of public amenities including numerous basic amenities (e.g. green spaces, public recreation facilities) as well as numerous important public amenities (e.g. theatres, zoos).  The evaluator may also take into account the type of amenities, i.e. the availability of public recreation is more important than the availability of drinking fountains. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Percentage of public buildings that are accessible by persons with special needs | % of public buildings | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Number of persons with special needs that have real-time ICT-based interactive mapping applications per 100 000 population | #/100 000 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to commercial amenities | % of people | II V | Share of population with access to at least six types of commercial amenities providing goods for daily use within 500m | NY | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.1 Transport** | Access to commercial amenities | Likert scale | II V | The extent to which commercial amenities are available within 500m | Likert scale:  1.No amenities: not even the day to day basic amenities are present (e.g. no supermarkets, shops). Residents will need to leave the area for all other.  2.Relatively few amenities: A few of the day to day basic amenities are present (small grocery store, kiosk). Residents will need to leave the area to find most other amenities (e.g.  sports, restaurants etc.).  3.A relatively reasonable number of amenities: day to day basics are reasonably present including a few additional (e.g. restaurants/bars and services).  4.A relatively sufficient number of amenities: day to day basics are sufficiently present, including many additional (e.g.  shopping malls, variety of shops, restaurants etc.).  5.Relatively many amenities: the area includes a wide variety of commercial amenities, making it a vibrant center of the region where there is little need to leave the area.  NB. The evaluator may also take into account the type of amenities and their relative importance. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Percentage of city population with potable water supply service (core indicator) | % of people | V | NY | The percentage of city population with potable water supply service shall be calculated as the total number of people with potable water supply service (numerator) divided by total city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage of city population serviced by a potable water supply service. The total number of people with potable water supply service shall be calculated as the total number of households in the city connected to a potable water supply service multiplied by the current average household size for the city. Potable water shall refer to water that is treated or confirmed safe for human consumption. A potable water supply service shall refer to a service that delivers potable water through a pipe or similar duct that is connected to a network, the supply of which is relatively continuous given that it includes a deposit built for its storage. If a house or group of houses has a ‘mother’ pipe connected either provisionally or permanently; it shall be considered to have access to potable water. A house shall not be considered to have access to potable water when an individual house or group is served by a conduit system built with for example wood, bamboo, or rubber hose, connected directly to a river, well, or to another house. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Percentage of city population with sustainable access to an improved water source (core indicator)  Access to improved water source (ITU 4903) | % of people | V | ITU 4903: Proportion of city population with sustainable access to improved water sources | The percentage of city population with sustainable access to an improved water source shall be calculated as the total population with access to an improved water source (numerator) divided by the total city population. The result shall then be multiplied by 100 and expressed as a percentage. An improved water source shall refer to piped water, public tap, borehole or pump, protected well, protected spring or rainwater. The percentage of city population with sustainable access to an improved water source represents the percentage of the population with reasonable access to an adequate supply of safe water in their dwelling or within a convenient distance of their dwelling. Reasonable access to water is defined as the availability of at least 20 litres of water per person a day from a source within one kilometer of the dwelling. | ISO 37120,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Quality of drinking water | % | V | Index of compliance with standards relating to water quality parameters for drinking water | NOTE 1 – For this indicator to be implemented there will be a need to define what is considered to be an acceptable standard for water quality and a definition as to the minimum sampling required. Preferable reference: World Health Organisation (WHO) Guidelines for drinking-water quality. [b-WHO water] As an alternative a national reference can be used.  NOTE 2 – SDG indicator 6.3.2 is "Proportion of bodies of water with good ambient water quality".  NOTE 3 – SDG indicator 6.4.2\* is "Level of water stress: freshwater withdrawal as a proportion of available freshwater resources [b-UN SDG ] | ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Compliance rate of drinking water quality (core indicator) | # | V | NY | NY | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Average annual hours of water service interruptions per household (supporting indicator) | hours/household/year | V | Data interpretation Cities with older infrastructure, in areas with electric power interruptions, in areas of war or civil unrest, or in areas that are more susceptible to natural hazards such as earthquakes and extensive flooding will tend to report more incidents of service interruptions. A physically larger service area is likely to have more kilometres of pipes and mains in the distribution system vulnerable to service interruptions. This indicator may need to be compared differently among large (greater than 25 000 connections or bulk water providers), medium (1 000 to 25 000 connections) and small (1 000 or fewer connections) service providers. To facilitate comparison among cities, the number of interruptions can also be related to the hectares of water service area within the city. | The average annual hours of water service interruption per household shall be calculated by taking the total sum of hours of interruption multiplied by the number of households impacted (numerator), divided by the number of households (denominator). The result shall be expressed as the average annual hours of water service interruption per household. Incidents of complete shutoff, low flow restriction, boil water advisory, water main flushing, planned and unplanned interruptions shall be counted equally. This indicator shall exclude: — incidents where there is some reduction to the level of service but where normal activities (shower, washing machine, toilet flushing etc.) are still possible, and — breaks in house connection branches. An “unplanned interruption” is an interruption caused by a fault in the utility’s system. A “planned interruption” is an interruption for which the utility has provided at least 24 h advanced notification (or as otherwise prescribed by regulatory requirements). | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Number of real-time ICT-based drinking water quality monitoring stations per 100 000 population | #/100 000 | V | NY | NY | ISO/CD 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Number of real-time ICT-based environmental water quality monitoring stations per 100 000 population | #/100 000 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Percentage drinking water under water quality monitoring by real-time water quality monitoring station | % of … | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Percentage of the city’s water distribution network monitored by a smart water system | % of … | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Percentage of buildings in the city with smart water meters | % of buildings | *V* | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Application of city water monitoring through ICT | % of the city water resources | V | Proportion of the city water resources (rivers, lakes etc) monitored by ICT with respect to water pollution and quality. NOTE – Quality of drinking water forms part of Physical infrastructure. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Water supply system management using ICT (ITU 4901) Water Supply ICT Monitoring (ITU 4903) | % of the water supply systems | V | Proportion of the water supply systems under automatic monitoring using ICT so as to ensure water quality and reduce leakage. (ITU 4901) Proportion of the water distribution system monitored by ICT (ITU 4903) | **ITU 4903:** NOTE 1 – Calculate as:  Numerator: length of water distribution system monitored by ICT.  Denominator: length of water distribution system. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Availability of visualised real-time information regarding water use | % of the water supply systems | V | Proportion of users with real-time information on quantum of water usage and water use pattern. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | City fresh water sources monitored using ICT | % of the water supply systems | V | Proportion of the city fresh water sources monitored using ICT with respect to availability. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.2 (piped) Water** | Availability of smart water meters | % of meters | V | Proportion of the water consumers (including households, companies, etc) with ICT based water meters. | NOTE 1 – Calculate as:  Numerator: Number of smart water meters.  Denominator: Total number of water meters. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Access to Electricity | % | IV | Proportion of households with access to electricity | NOTE 1 – Calculate as:  Numerator: Number of households in the city with a connection to the electrical system.  Denominator: Total number of households.  NOTE 2 – SDG indicator 7.1.1 is "Proportion of population with access to electricity". [b-UN SDG] | ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Availability of smart electricity meters | % of meters | IV | Proportion of the electricity consumers (including households, companies, etc.) with ICT based electricity meters. | NOTE 1 – Calculate as:  Numerator: Number of smart electricity meters.  Denominator: Total number of electricity meters. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Percentage of buildings in the city with smart electricity meters | % of meters | IV | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Electricity supply system management using ICT (ITU 4901) Electricity supply system management using ICT (ITU 4903) | % of the electricity supply systems | IV V | Proportion of power substation and user points under automatic inspection using ICT. NOTE – Management of electricity supply is an important ICT task, but data may not be available to cities. | **ITU 4903:** NOTE 1 – Calculate as:  Numerator: Number of power substation and user points under automatic inspection using ICT.  Denominator: Total number of power substation and user points. | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Availability of visualised real-time information regarding electricity use | % of the electricity supply systems | IV V | Proportion of users with real-time information on quantum of electricity usage and electricity use pattern. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Availability of visualised real-time information regarding gas use | % of the gas supply systems | IV V | Proportion of users with real-time information on quantum of gas usage and gas use pattern. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.3. Electricity & Gas** | Gas system management using ICT | % of the gas supply systems | IV V | Proportion of gas supply systems under automatic monitoring using ICT. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Fixed broadband subscriptions | % | V | Households with fixed (wired) broadband | NOTE 1 – Fixed (wired) broadband subscriptions refer to subscriptions for high-speed access to the public Internet (a TCP/IP connection). High-speed access is defined as downstream speed equal to, or greater than, 256 kbits/s.  NOTE 2 – Fixed (wired) broadband includes broadband through cable modem, DSL, fibre and other fixed (wired) broadband technologies (such as Ethernet LAN, and broadband-over-power line (BPL) communications).  NOTE 3 – Calculated as:  Numerator: Households with fixed (wired) broadband.  Denominator: Total households.  NOTE 4 – Mobile cellular network subscriptions are not included.  NOTE 5 – The data may be collected from local statistics department, or may need to be extrapolated from national data. | ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Use of Internet by city inhabitants | % of people | V | Proportion of inhabitants using internet. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Availability of wireless broadband subscriptions | #/100 inhabitants | V | Wireless-broadband subscriptions per 100 inhabitants (\*)  NOTE – Wireless broadband subscriptions include wireless broadband through satellite broadband, terrestrial fixed wireless broadband and mobile cellular network subscriptions. | **ITU 4903:**  NOTE 1 – Wireless broadband subscriptions include wireless broadband through satellite broadband, terrestrial fixed wireless broadband and mobile cellular network subscriptions. NOTE 2 – The data may be collected from local statistics department, or may need to be extrapolated from national data.  NOTE 3 – SDG indicator 9.c.1 is "Proportion of population covered by a mobile network, by technology". [b-UN SDG]  NOTE 4 – SDG indicator 5.b.1 is "Proportion of individuals who own a mobile telephone, by sex". [b-UN SDG] | ITU 4901,  ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Availability of WiFi in public areas | # in the city center | V | Number of WiFi hotspots at certain points in the city center. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Use of social media by the public sector | # | V | Use of social media by the public sector, to share information about regulations and to get feedback.  NOTE – Social media refers to a group of Internet-based applications that allow the creation and exchange of user-generated content. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Availability of electronic and mobile payment platforms | # | V | Existence of electronic and mobile payment platforms to facilitate access to city services for city inhabitants. | NY | ITU 4901 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Increase in online government services | Likert scale | V | The extent to which access to online services provided by the city was improved by the project | Likert scale: No improvement – 1 — 2 — 3 — 4 — 5 — Very much improved.  1.Not at all: access to online services was not at all improved.  2.Poor: there was little improvement of access to online services, such as a basic municipal web site.  3.Somewhat: there was some improvement of access to  online services, such as the possibility to schedule appointments online  4.Good: a sufficient improvement of access to online services, such as reporting minor issues to the police (i.e.  passport loss, stolen goods).  5.Excellent: access to online services were extensively improved, including open data platforms. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Access to public free WiFi | % of m2 | V | Public space Wi-Fi coverage | (Sum of wifi node's coverage / Total city urban surface)\*100%  (City protocol 2015) | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Percentage of the city population with access to computers or other electronic devices with internet access in libraries and other public buildings | % of people | V | NY | NY | ISO/CD 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Percentage of city area under a white zone/dead spot/not covered by telecommunication connectivity | % of km2 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Percentage of city area covered by municipally provided internet connectivity | % of km2 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Number of municipal smart stations installed per 100 000 population | #/100 000 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.4. Networks and access** | Number of internet connections per 100 000 population (supporting indicator) | #/100 000 | V | NY | The number of internet connections per 100 000 population shall be calculated as the number of internet connections in the city (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of internet connections per 100 000 population. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.5 Miscellaneous** | Flexibility in delivery services | Likert | II V | The extent to which there is flexibility in delivery services | Likert scale: None – 1 — 2 — 3 — 4 — 5 — Very much.  1.Not at all: there is no flexibility in delivery services at all. Receiving a package requires the consumer to be home during regular business hours (the default).  2.Poor: there is little flexibility in delivery services, providing one additional option to the default.  3.Somewhat: there is some flexibility in delivery services, providing two additional options to the default.  4.Good: there is sufficient flexibility in delivery services, providing three additional options to the default.  5.Excellent: there is extensive flexibility in delivery services, providing more than three additional options to the default. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.5 Miscellaneous** | Improved flexibility in delivery services | Likert scale | II V | The extent to which flexibility in delivery services was improved by the project. | Likert scale: No improvement – 1 — 2 — 3 — 4 — 5 — Very much improved.  1.Not at all: flexibility in delivery services was not at all improved. Receiving a package requires the consumer to be home during regular business hours (the default).  2.Poor: there was little improvement of flexibility in delivery services, providing one additional option to the default.  3.Somewhat: there was some improvement of flexibility in delivery services, providing two additional options to the default.  4.Good: a sufficient improvement of flexibility in delivery services, providing three additional options to the default.  5.Excellent: flexibility in delivery services was extensively improved, providing more than three additional options to the default. | CITYkeys |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.5 Miscellaneous** | Household sanitation | % | V | Proportion of the households with access to improved sanitation facilities | NOTE 1 – Calculate as :  Numerator: Total number of households using improved sanitation and facilities.  Denominator: Total number of households.  NOTE 2 – Improved facilities include:  • Flush or pour-flush to piped sewer system, septic tank or pit latrine,  • Ventilated improved pit latrine,  • Pit latrine with slab,  • Composting toilet. http://www.unwater.org/downloads/TFIMR\_Annex\_FinalReport.pdf NOTE 3 – SDG indicator 6.2.1 is "Proportion of population using safely managed sanitation services, including a hand-washing facility with soap and water". [b-UN SDG] | ITU 4903 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.5 Miscellaneous** | Percentage of population with access to improved sanitation | % of people | V | NY | The percentage of population with access to improved sanitation shall be calculated as the total number of people using improved sanitation facilities (numerator) divided by the total city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage. | ISO 37120 |
| **1. People** | **1.3 Access to (other) services:** providing better access for everyone to transport, amenities and affordable services in physical and virtual space | **1.3.5 Miscellaneous** | Opportunities for people with special needs | Checklist | V | Existence of public services and benefits for people with special needs. | NOTE 1 – Public services and benefits checklist: a) Public buildings: infrastructure available; b) Education: higher education possible; c) Jobs: availability; d) ICT: availability of customized services and information. NOTE 2 – People with special needs here indicate indigenous people, and persons with disabilities including age related disabilities.  NOTE 3 – SDG indicator 11.2.1 is "Proportion of the population that has convenient access to public transport, disaggregated by age group, sex and persons with disabilities". [b-UN SDG] | ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Diversity of housing | Simpson Diversity Index/Social housing | V | Simpson Diversity Index of total housing stock in the project area OR Percentage of social dwellings as share of total housing stock in the project area | Below, two options to calculate the diversity in housing types are listed and explained. Because of the direct and coherent calculation, the Simpson Diversity Index is the preferred method. However, this Index is perceived as difficult to calculate. As an alternative, this diversity in housing can be approached by assessing the variety in ownership.  Simpson Diversity Index  The Simpson Diversity Index calculates the probability that any two randomly selected dwelling units in a city will be of a different type. An index score greater than 0,5 is considered preferable (LEED, 2014).  **For more explanation see Page 227 to 229 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Diversity of housing | Simpson Diversity Index/Social Housing | V | Simpson Diversity Index of total housing stock in the project area OR Percentage of social dwellings as share of total housing stock in the project area | Below, two options to calculate the diversity in housing types are listed and explained. Because of the direct and coherent calculation, the Simpson Diversity Index is the preferred method. However, this Index is perceived as difficult to calculate. As an alternative, this diversity in housing can be approached by assessing the variety in ownership. Simpson Diversity Index The Simpson Diversity Index calculates the probability that any two randomly selected dwelling units in a project will be of a different type. (LEED, 2014).   Score = 1- Σ (n/N)2 Where n = the total number of dwelling units in a single category, and N = the total number of dwelling units in all categories. The housing categories are defined in the table below (LEED, 2014).  **For more explanation see Page 82 to 85 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of city population living in inadequate housing (core indicator) (ISO 37120) Informal settlements (ITU 4903) | % of people | V | Proportion of urban population living in slums, informal settlements or inadequate housing (ITU 4903) | **ITU 4903:** NOTE 1 – Same as SDG indicator 11.1.1. [b-UN SDG]  NOTE 2 – Informal settlements include slums, informal settlements and inadequate housing as defined by UN-Habitat [b-UN-habitat sett.] | ISO 37120,  ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of population living in affordable housing (core indicator) | % of people | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of city population living in slums (ISO 37120) Informal settlements (ITU 4903) | % of people | V | Proportion of urban population living in slums, informal settlements or inadequate housing (ITU 4903) | The percentage of city population living in slums shall be calculated as the number of people living in slums (numerator) divided by the city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage. The number of people living in slums shall be calculated as the number of slum households multiplied by current average household size. **ITU 4903:** NOTE 1 – Same as SDG indicator 11.1.1. [b-UN SDG]  NOTE 2 – Informal settlements include slums, informal settlements and inadequate housing as defined by UN-Habitat [b-UN-habitat sett.] | ISO 37120,  ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Number of homeless per 100 000 population (supporting indicator) | #/100 000 | V | NY | The number of homeless per 100 000 population shall be calculated as the total number of homeless people (numerator), divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of homeless per 100 000 population. The following definition is used by the United Nations[41] to define homelessness: Absolute homelessness refers to those without any physical shelter, for example, those living outside, in parks, in doorways, in parked vehicles, or parking garages, as well as those in emergency shelters or in transition houses for women fleeing abuse. | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of households that exist without registered legal titles (supporting indicator) | % of households | V | NY | The percentage of households that exist without registered legal titles shall be calculated as the number of households that exist without registered legal titles (numerator) divided by the total number of households (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Unregistered legal title includes the following tenure types: unregistered lease or leaseholds, rental, occupancy right, use right (including sub-lease, sub-rental and co-tenancy, and co-occupancy right). | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Total number of households (profile indicator) | # of households | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Persons per unit (profile indicator) | #/household | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Total number of occupied dwelling units (owned & rented) | # of households | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Dwelling density (per square kilometre) | #/km2 | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Vacancy rate (residential) (profile indicator) | # | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Living space (square metres) per person (profile indicator) | m2/person | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Secondary residence rate (profile indicator) | # | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Residential rental dwelling units as a percentage of total dwelling units  (profile indicator) | % of … | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Preservation of cultural heritage | Likert | V | The extent to which preservation of cultural heritage of the city is considered in urban planning | The indicator provides a qualitative measure and is rated on a fivepoint Likert scale:  Not at all – 1 — 2 — 3 — 4 — 5 — Very much  1.Not at all: no attention has been paid to existing cultural heritage in urban planning.  2.Fair: heritage places have received some attention in urban planning, but not as an important element.  3.Moderate: some attention has been given to the conservation of heritage places.  4.Much: heritage places are reflected in urban planning  5.Very much: preservation of cultural heritage and connections to existing heritage places are a key element of urban planning. | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Connection to the existing cultural heritage | Likert scale | V | The extent to which making a connection to the existing cultural heritage was considered in the design of the project | The indicator provides a qualitative measure and is rated on a five-point Likert scale:  Not at all – 1 — 2 — 3 — 4 — 5 — Very much  1.Not at all: no attention has been paid to existing cultural heritage.  2.Fair: heritage places have received some attention in the project, but not as an important element.  3.Moderate: some attention has been given to the conservation of heritage places.  4.Much: heritage places are reflected in the project design  5.Very much: heritage places are included in the project as clear and recognizable landmarks. | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Protected cultural heritage sites | % | V | Proportion of city area related to protected cultural heritage sites | NOTE 1 – Calculate as:  Numerator: City area related to protected cultural heritage sites.  Denominator: Total city surface area. | ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Design for a sense of place | Likert scale | V | The extent to which a ‘sense of place’ was included in the design of the project | The indicator is qualitative and rated on a five-point Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very much  1.Poor: no attention has been paid to the idea of creating a “sense of place” in the design of the project, even residents are not able identify any elements.  2.Fair: the idea of creating a “sense of place” has received some attention in the project, but not as an important element.  3.Average: some attention has been given in the design to the idea of creating a “sense of place”.  4.Good: Much attention has been given to the idea of creating a “sense of place” in the project design.  5.Very good: The attention paid to the aim of creating a “sense of place” in the design is clearly and recognizably present in the project, even for outsiders. | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Ground floor usage | % of m2 | V | Percentage of ground floor surface of buildings that is used for commercial or public purposes as percentage of total ground floor surface | (ground floor space used commercially/publically (in m2)/total ground floor space (in m2) \*100%.  Depending on the city, this indicator maybe limited to certain (central) parts of the urban area. | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Increased use of groundfloors | % in m2 | V | Increase in ground floor space for commercial or public use due to the project as percentage of total ground floor surface | (extra ground floor space used commercially/publically created by the project (in m2)/current total ground floor space (in m2) \*100%  Strengths: Absolute and objective value for ground floor usage.  Weaknesses: Data are scattered. Definitions of public and commercial spaces can vary between cities.  Alternative: Are there strategies to activate vacant ground floor space? | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Public outdoor recreation space (CITYkeys) Square metres of public outdoor recreation space per capita (ISO 37120) | m2/cap | V | Square meters of public outdoor recreation space per capita | Square meters of public outdoor recreation space per capita shall be calculated as square meters of outdoor public recreation space (numerator) divided by the population of the city (denominator), and shall be expressed as the number of square meters of outdoor recreation space per capita (ISO/DIS 37120, 2013). | CITYkeys,  ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Increased access to urban public outdoor recreation space | m2 | V | Increase in public outdoor recreation space (m2) within 500m | (Public outdoor recreation space (m2) within 500 m after the project/ Public outdoor recreation space (m2) within 500 m before the project)\*100% | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Square metres of public indoor recreation space per capita (supporting indicator) | m2 | V | NY | Square meters of public indoor recreation space per capita shall be calculated as the square meters of indoor public recreation space (numerator) divided by the population of the city (denominator), and shall be expressed as the number of square meters of indoor recreation space per capita. | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Green space (CITYkeys) Green area (hectares) per 100 000 population (ISO 37120) | hectares/100 000 | V | Green area (hectares) per 100 000 population | Green space shall be calculated as the total area (in hectares) of green in the city (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed in hectares of green area per 100 000 population.  ISO 37120: This indicator reflects green area that is “publicly accessible” as opposed to whether or not the green area is protected. | CITYkeys,  ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Green areas surface | ??? (hectares) | V | Proportion of municipal territory allocated to publicly accessible green areas. (\*\*) | NY | ITU 4902 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Green areas and public spaces | m2/100 000 inhabitants | V | Publically accessible green areas and public spaces per 100 000 inhabitants. | NOTE 1 – Green space includes parks and nature areas that are publically accessible.  NOTE 2 – Calculate as:  Numerator: Total area of green space in the city.  Denominator: One 100,000th of the city's population.  Express as: m2 / 100 000 inhabitants.  NOTE 3 – SDG indicator 11.7.1 is "The average share of the built-up area of cities that is open space for public use for all, disaggregated by age group, sex and persons with disabilities". [b-UN SDG] | ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Increased access to green space | m2 | V | Increase in green space (m2) within 500m | (Green space (m2) within 500 m after the project/ Green space (m2) within 500 m before the project)\*100% | CITYkeys |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Pedestrian infrastructure | km/km2 | V | Portion of city with pedestrian, car free and traffic calming streets | NOTE 1 – Calculate as:  Numerator: Total length of pedestrian, car free and traffic calming streets.  Denominator: Total city area. | ITU 4903 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Areal size of informal settlements as a percentage of city area (supporting indicator) | % of km2 | V | NY | The areal size of informal settlements as a percentage of city area shall be calculated as the area of informal settlements in square kilometres (numerator) divided by the city area in square kilometres (denominator). The result shall then be multiplied by 100 and expressed as a percentage. To simplify the measure of informal settlements, those smaller than 2 km2 should not be included. Informal settlements are known by many different names around the world including shantytowns, favelas (Brazil), squatter camps (South Africa), and bidonvilles in French-speaking areas. The UN Statistics Division has developed the following definition which is used here: a) Areas where groups of housing units have been constructed on land that the occupants have no formal legal claim to; b) Unplanned settlements and areas where housing is not in compliance with current planning and building regulations (unauthorized housing). | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Number of trees per 100 000 population (profile indicator) | #/100 000 | V | Data interpretation A city’s tree planting strategy should reflect not only the number of new trees planted but also attention to indigenous species. | The annual number of trees planted per 100 000 shall be calculated as the total number of trees planted in a given year (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the annual number of trees planted per 100 000 population. The number of trees planted shall include trees planted and/or funded by government (or by a third party under government oversight). This shall include trees planted by private businesses and non-governmental organizations under the purview of government greening and reforestation initiatives. | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Built-up density (profile indicator) | ??? | V | NY | NY | ISO 37120 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Average time for building permit approval (days) | ??? (minutes, hours) | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of building permits submitted through an electronic submission system | % of … | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of households with smart electricity meters | % of households | IV V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of total land area that is a mixed use zone | % of km2 | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of households with smart water meters | % of households | IV V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Percentage of public recreation services that can be booked online | % of … | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Number of municipal smart kiosks installed per 100 000 population | #/100 000 | V | NY | NY | ISO/CD 37122 |
| **1. People** | **1.6 Quality of housing and the built environment:** encourage mixed-income areas, ensure high quality and quantity of public spaces and recreational areas, and improve the affordability and accessibility to good housing for everyone. |  | Perception on environmental quality | % of people | V | Proportion of city inhabitants satisfied with the urban environment. (\*\*) | NY | ITU 4902 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Annual population change (profile indicator) | ??? | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Population demographics (profile indicator) | ??? | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of population that are new immigrants (profile indicator) | % of people | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of city population that are non-citizens (profile indicator) | % of people | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Number of university students per 100 000 population (profile indicator) | #/100 000 | II V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Total city population | # | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of the city population living at medium-to-high population densities | % of people | V | NY | NY | ISO/DIS 37122 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of country’s population | % of people | V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of population that are children (0-14) | % of people | II V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of population that are youth (15-24) | % of people | II V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of population that are adult (25-64) | % of people | II V | NY | NY | ISO 37120 |
| **1. People** | **1.7. Population and social conditions (added by FORTEARGE)** |  | Percentage of population that are senior citizens (65+) | % of people | II V | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Annual final energy consumption (CITYkeys) Total end-use energy consumption per capita (GJ/year) (ISO 37120) | MWh/cap/yr; GJ/cap/yr (ISO 37120) | IV | Annual final energy consumption for all uses and forms of energy | Energy consumption shall be calculated per year as the total use of final energy (MWh) within a city (numerator) divided by the amount of residents in city (denominator). The result indicates the total energy consumption per year in megawatt hours per capita.  To facilitate the calculation of the total energy consumption, the indicator can be broken down into energy consumption of various sectors: buildings, transport, industry, public services, ICT, etc.. This can, of course, be further subdivided, for example for ’buildings’, in residential buildings, commercial buildings and public buildings, or for ’transport’ in public and private transport.  All forms of energy need to be taken into account, including electricity consumption, natural gas or thermal energy for heating and cooling and fuels. These will be given in different units of energy  (kWh, GJ, m3), but they all have to be calculated or converted to MWh of energy in order to be able to sum up the separately calculated energy consumptions and achieve the total energy consumption of the city.  Relevant unit conversions are 1 W = 1 kg m2 s–3; 1 J = 1 Ws; 1 kWh= 3,600,000 J; and 1 TOE = 41.868 GJ, 11,630 kWh, or 11.63 MWh (ITUT L.1430: 2013)  Note: All calculations need to be thoroughly recorded for transparency. | CITYkeys,  ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Reduction in annual final energy consumption | % in kWh | IV | Percentage change in annual final energy consumption due to the project for all uses and forms of energy | The percentage of the decrease in energy consumption caused by the project is calculated as the difference between the total use of energy per year (kWh) on-site or within the project boundaries before and after the project (numerator) divided by the total use of energy per year (kWh) on-site before the project (denominator). The result (numerator/denominator) is multiplied by 100 in order to present the outcome as a percentage. The indicator expresses the percentual reduction of energy consumption due to actions taken within the project.  To facilitate the calculation of the total energy consumption, the indicator can be broken down into energy consumption of various sectors: buildings, transport, industry, public services, etc.. This can, of course, be further subdivided, for example for ’buildings’, in residential buildings, commercial buildings and public buildings, or for ’transport’ in public and private transport.  All forms of energy need to be taken into account, including electricity consumption, natural gas or thermal energy for heating and cooling and fuels. These will be given in different units of energy (kWh, GJ, m3), but they all have to be calculated or converted to kWh of energy in order to be able to sum up the separately calculated energy consumptions and achieve the total energy consumption of the project.  Relevant unit conversions are 1 J = 1 Ws; 1 kWh= 3,600,000 J; and 1 TOE = 41.868 GJ; 11,630 kWh; or 11.63 MWh (ITU 4901 & 4902 L.1430: 2013).  Note: All calculations need to be thoroughly recorded for transparency.  Note for Residential building consumption: As total energy consumption may vary considerably per household (or per user of the building) in some cases this indicator may be restricted to energy for heating, cooling, and hot water provision. These data can be more easily gathered, also in a planning stage (Eurbanlab: 2014). | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Reduction in lifcycle energy use | % in kWh | IV | Reduction in life cycle energy use achieved by the project (%) | The percentual reduction in life-cycle energy use is calculated as: the difference between the life cycle energy use of the reference scenario (business-as-usual measures) and life cycle energy use when the project is applied. Then the result is divided by the life cycle energy use of the reference scenario and multiplied by 100 to express it as a percentage. The indicator should express the difference between comparing project development to a state-ofthe-art or business-as-usual option.  Boundaries of the life cycle analysis need to be clearly stated, as well as the used LCA method (process-LCA, industry/commodity level input/output (I/O) modelling or hybrid-LCA). [Rebitzer et al, 2004] | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Total residential electrical energy use per capita (kWh/ year) | kWh/cap/yr; | IV | NY | Total residential electrical energy use per capita shall be calculated as the total residential electrical usage of a city in kilowatt hours (numerator) divided by the total population of the city (denominator). The result shall be expressed as the total residential electrical use per capita in kilowatt hours/year. | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Energy saving in households | #/year | IV | Energy saving in households compared to a baseline. (\*\*) NOTE – The baseline may be either a previous measurement or a reference value.NOTE – It would be preferred to distinguish between households with and without smart meters, and with and without home automation systems. | NY | ITU 4902 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Energy saving in households | % | IV | Proportion of households with energy saving installations | NOTE 1 – Calculate as:  Numerator: Number of households with energy saving installations.  Denominator: Total number of households. | ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Percentage of total end-use energy derived from renewable sources (core indicator) | % of total energy consumption | IV | Data interpretation Renewable energy shall include both combustible and non-combustible renewables. Non-combustible renewables include geothermal, solar, wind, hydro, tide and wave energy. For geothermal energy, the energy quantity is the enthalpy of the geothermal heat entering the process. For solar, wind, hydro, tide and wave energy, the quantities entering electricity generation are equal to the electrical energy generated. The combustible renewables and waste (CRW) consist of biomass (fuelwood, vegetal waste, ethanol) and animal products (animal materials/waste and sulphite lyes), municipal waste (waste produced by the residential, commercial and public service sectors that are collected by local authorities for disposal in a central location for the production of heat and/or power) and industrial waste.NY | The share of a city’s total energy consumption derived from renewable sources shall be calculated as the total consumption of electricity generated from renewable sources (numerator) divided by total energy consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Consumption of renewable sources should include geothermal, solar, wind, hydro, tide and wave energy, and combustibles, such as biomass. | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Use of alternative and renewable energy (ITU 4902) Renewable energy consumption (ITU 4903) | % of total electricity consumption | IV | Proportion of renewable energy consumed in the city. (\*)  NOTE – Renewable energy sources include geothermal, solar thermal, solar voltaic, hydro, wind, and combustible renewable sources and waste (composed of solid biomass, liquid biomass, bio-gas, industrial waste and municipal waste) (ITU 4902) | **ITU 4903:**  NOTE 1 – Calculate as :  Numerator: Total consumption of electricity from renewable sources.  Denominator: Total electricity consumption.  NOTE 2 – Renewable sources include geothermal, solar, wind, hydro, tide, wave energy, and biomass, etc.  NOTE 3 – SDG indicator 7.2.1 is "Renewable energy share in the total final energy consumption". [b-UN SDG] | ITU 4902,  ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Percentage of city population with authorized electrical service (residential) (core indicator) | % of people | IV V | NY | The percentage of city population with authorized electrical service shall be calculated as the number of persons in the city with lawful connection to the electrical supply system (numerator) divided by the total population of the city (denominator). The result shall then be multiplied by 100 and expressed as a percentage. The number of city households lawfully connected to the electricity grid shall be multiplied by the current average city household size to determine the number of city residents with lawful connection to the electricity supply system (the electricity grid). | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Number of gas distribution service connections per 100 000 population (residential) (core indicator) | #/100 000 | IV V | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Final energy consumption of public buildings per year (GJ/m2) (core indicator) | (GJ/m2/yr) | IV | NY | Energy consumption of public buildings shall be calculated per year as the total use of electricity at final consumption stage by public buildings (kWh) within a city (numerator) divided by total floor space of these buildings in square meters (m²) (denominator). The result shall be expressed as the total energy consumption of public buildings per year in kilowatt hours per square meter. | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Public buildings energy consumption | kWh/m2/year | IV | Annual energy consumption of public buildings | NOTE 1 – Calculate as:  Numerator: Total electricity consumption by public buildings.  Denominator: Total floor space.  Calculate as kWh / m2 / year. | ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Total electrical energy use per capita (kWh/year) Electricity consumption (ITU 4903) | (kWh/cap/year) kWh/day/capita (ITU 4903) | IV | Data interpretation Compilation of the sources used to generate energy based on fossil and renewable energy sources; types of renewable energy already in use; identification of locally existing renewable energy sources; compilation of the energy required for heating and cooling processes; completed and planned measures to save energy and to improve energy efficiency; completed and planned activities for the environmentally friendly insulation and cooling of buildings, if available should be noted. Electricity consumption per capita (ITU 4903) | Total electrical energy use per capita shall be calculated as the total electrical usage of a city in kilowatt hours including residential and non-residential use (numerator) divided by the total population of the city (denominator). The result shall be expressed as the total electrical use per capita in kilowatt hours/year.  **ITU 4903:**  NOTE 1 – Calculate as:  Numerator: Total consumption of electricity. Denominator: Number of city inhabitants.  Express as kWh / day / capita. | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Electricity consumption of public street lighting per kilometre of lighted street (kWh/year) (supporting indicator) | (kWh/km/year) | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Energy consumption of public street lighting as a percentage of total annual municipal energy consumption | % of total energy consumption | IV | NY | NY | ISO/CD 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Electricity use for street lighting | #/cap/year | IV | Electricity used for street lighting per capita. (\*\*) | NY | ITU 4902 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Percentage of street lighting that has been refurbished | % of … | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Percentage of public buildings requiring renovation/refurbishment (by floor area) | % of … | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Automatic energy management in buildings | % of buildings | IV | Proportion of public and private sector buildings using ICT based systems to automatically regulate and reduce their energy needs. | NY | ITU 4901 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Integrated management in public buildings | % of public buildings | IV | *Proportion of public buildings using integrated ICT systems to automate building management and create flexible, effective, comfortable and secure environment. NOTE – ICT systems include building management, communication and control systems, etc.* | NY | ITU 4901 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Public building sustainability | % | IV | Proportion of public buildings with sustainability certifications | NOTE 1 – Calculate as:  Numerator: Area of public buildings with certification to a recognized standard for ongoing building operations.  Denominator: Total area of public buildings.  NOTE 2 – Standards include but are not limited to: BREEAM, LEED, CASBEE, BOAM BEST, BCA, Green Mark, etc. | ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Average number of electrical interruptions per customer per year (ISO 37120) Electricity system outage frequency (ITU 4903) | #/customer/year | IV | Average number of electrical interruptions per customer per year | The average number of electrical interruptions per customer per year shall be calculated as the total number of customer interruptions (numerator) divided by the total number of customers served (denominator). The result shall be expressed as the average number of electrical interruptions per customer per year. Electrical interruptions shall include both residential and non-residential. It is normal to expect interruptions in service for a number of reasons including scheduled maintenance and equipment breakdown. To establish the opportunity to have a reasonable comparison between energy providers, major storms and weather events should be excluded due to their unpredictability and randomness since they are difficult to predict, prevent or mitigate against. ITU 4903: NOTE 1 – This is also known as SAIFI – System Average Interruption Frequency Index ( dimensionless number ) NOTE 2 – Calculate as:  Numerator: Total number of customer interruptions.  Denominator: Total number of customers served. | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Average annual hours of electrical service interruptions per household (supporting indicator) | in hours | IV |  | The average length of electrical interruptions shall be calculated as the sum of the duration of all customer interruptions in hours (numerator) divided by the total number of customer interruptions (denominator). The result shall be expressed as the average length of electrical interruptions in hours. Electrical interruptions shall include both residential and non-residential. It is normal to expect interruptions in service for a number of reasons including scheduled maintenance and equipment breakdown. To establish the opportunity to have a reasonable comparison between energy providers, major storms and weather events shall be excluded due to their unpredictability as they are difficult to prevent or mitigate against. | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Electricity system outrage time | Minutes | IV | Average length of electrical interruptions | NOTE 1 – This is also known as CAIDI – Customer Average Interruption Duration Index (in minutes) NOTE 2 – Calculate as :  Numerator: Sum of all customer interruption durations  Denominator: Total number of customers' interruptions. | ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Reliability of electricity supply system | % | IV | Proportion of time during which electricity supply system works without outages. (\*) | NY | ITU 4902 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Heating degree days (profile indicator) | # | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Cooling degree days (profile indicator) | # | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Region | # | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Climate type | # | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Annual average temperature (Celsius) | °C | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Average annual rain (mm) | mm | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.1 Energy consumption/demand** | Average annual snowfall (cm) | cm | IV | NY | NY | ISO 37120 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Renewable energy generated within the city | % of MWh | IV | The percentage of total energy derived from renewable sources, as a share of the city's total energy consumption | The share of renewable energy produced within the city is calculated as the total consumption of electricity generated from renewable sources (numerator) divided by total energy consumption (denominator). The result shall then be multiplied by 100 and  expressed as a percentage. Consumption of renewable sources includes geothermal, solar, wind, hydro, tide and wave energy, and combustibles, such as biomass. (ISO/DIS 37120, 2013). | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Increase in local renewable energy production | % in kWh | IV | Percentage increase in the share of local renewable energy due to the project | The percentage of the increase in local renewable energy production caused by the project is calculated as the difference between the annual renewable energy generation related to the project before and after project completion (or as the difference between the annual renewable energy generation related to the project compared to BAU). The result will be divided by the annual total energy consumption related to the project, and then it is multiplied by 100 to express the result as a percentage.  Relevant unit conversions are 1 J = 1 Ws; 1 kWh= 3,600,000 J; and 1  TOE = 41.868 GJ, 11,630 kWh, or 11.63 MWh (ITU 4901 & 4902 L.1430: 2013) | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Electrical and thermal energy (kWh) produced from waste water treatment, solid waste treatment and other waste heat resources, as part of the city’s energy mix (%) | % | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Electrical and thermal energy (KWh) produced from wastewater treatment per capita per year | kWh/cap/yr; | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Electrical and thermal energy (KWh) produced from solid waste treatment per capita per year | kWh/cap/yr; | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Percentage of the city’s energy that is produced using decentralized energy production systems | % of … | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.2 Renewable energy production** | Storage capacity of the city’s energy grid per capita (GJ/person) | (GJ/person) | IV | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.3 CO2 –emissions** | CO2 emissions  Greenhouse gas emissions measured in tonnes per capita (ISO 37120) GHG emissions per sector per capita (ITU 4902) GHG emissions (ITU 4903) | t CO2/cap/yr | IV | CO2 emissions in tonnes per capita per year  ITU 4902: GHG emissions per capita per sector including industrial (manufacturing, construction), commercial, household, transport, and waste disposal etc. (\*) | The CO2 emissions measured in tonnes per capita shall be measured as the total amount of direct CO2 emisissions in tonnes (equivalent carbon dioxide units) generated over a calendar year by all activities within the city, including indirect emissions outside city boundaries (numerator) divided by the current city population (denominator). The result shall be expressed as the total direct CO2 emissions per capita in tonnes.The Global Protocol for Community-Scale GHG Emissions (GPC), (2012 Accounting and Reporting Standard) refers to a multi-stakeholder consensus-based protocol for developing international recognized and accepted community-scale greenhouse gas accounting and reporting. This protocol defines the basic emissions sources and categories within sectors for a community-scale GHG inventory, in order to standardize GHG inventories between communities and within a community over time. The protocol provides accounting methodologies and step-by-step guidance on data collection, quantification, and reporting recommendations for each source of emissions.  Both emissions sources and sector categorizations reflect the unique nature of cities and their primary emissions sources. These include emissions from: 1) Stationary Units, 2) Mobile Units, 3) Waste, and 4) Industrial Process and Product Use sectors. For further specifications, refer to the full GPC methodology. Local governments shall be expected to provide information (i.e., quantified emissions) for each of these emission sources.  In order to address the issue of inter-city sources of emissions that transcend more than one jurisdictional body, the GPC integrates the GHG Protocol Scope definitions, as follows:  1.Scope 1 emissions: All direct emission sources from activities taking place within the community’s geopolitical boundary.  2.Scope 2 emissions: Energy-related indirect emissions that result as a consequence of consumption of grid-supplied electricity, heating and/or cooling, within the community’s geopolitical boundary.  3.Scope 3 emissions: All other indirect emissions that occur as a result of activities within the community’s geopolitical boundary.  For step-by-step guidance on data and accounting collection, see Section 3 of the GPC.  http://www.ghgprotocol.org/files/ghgp/GPC%20v9%2020120320.pdf  ITU 4903: NOTE 1 – Methodologies for determining GHG emissions include but are not limited to: The global protocol for community-scale greenhouse gas emission inventories (GPC). BSI Norm: PAS 2070 on Specification for the assessment of greenhouse gas emissions of a city. Intergovernmental Panel on Climate Change (IPCC) Guidelines for national greenhouse gas inventories. Global protocol for community-scale GHG emissions' (GPC), (2012 Accounting and Reporting Standard).  NOTE 2 – This indicator can be either in total or partially subdivided into major city sectors (transportation, industry, commercial buildings, residential buildings, etc.)  NOTE 3 – In CO2e, "e" means "equivalent" and every other greenhouse gas is converted into CO2. | CITYkeys,  ISO 37120,  ITU 4902,  ITU 4903 |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.3 CO2 –emissions** | Carbon dioxide emission reduction | % in tonnes | IV | Percentage reduction in direct (operational) CO2 emissions achieved by the project. | The indicator is calculated as the direct (operational) reduction of the CO2 emissions over a calender year: before the project and after the project. The result will be divided by the CO2 emissions before the project, and then it is multiplied by 100 to express the result as a percentage.  To calculate the direct CO2 emissions, the total energy reduced, as reflected in the indicator ‘reduction in annual final energy’, can be translated to CO2 emission figures by using conversion factors for different energy forms as described in below tables.  **For more explanation see Page 102 to 104 of "CITYkeys indicators for smart city projects and smart cities"** **(CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.3 CO2 –emissions** | Reduction in lifecycle CO2 emissions | % in tonnes | IV | Percentage peduction in lifecycle CO2 emissions achieved by the project | The percentual reduction in life-cycle CO2 emissions is calculated as: the difference between the life cycle CO2 emissions before the project (or reference scenario) and life cycle CO2 emissions when the project is applied. Then the result is divided by the life cycle CO2 emissions before the project (or the reference scenario) and multiplied by 100 to express it as a percentage.  Detailed guidelines for the calculation are provided in ITU 4901 & 4902 L1430: (2013). | CITYkeys |
| **2. Planet** | **2.1 Energy & mitigation:** Reduce energy consumption, use waste energy and produce renewable energy | **2.1.3 CO2 –emissions** | Local freight transport fuel mix | % in kms | IV | The ratio of renewable fuels in the local freight transport fuel mix in the project. | (ton kilometres transported by renewable fuels in the project/total ton kilometers in the project)\*100%  Please indicate which fuels/energy carriers have been considered. Renewable fuels include: bio-fuels, hydrogen and electricity. Other fuels include: petrol, diesel, liquefied petroleum gas, compressed natural gas, alcohol mixtures. | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Water consumption  Total water consumption per capita (litres/day) (ISO 37120) | liters/cap/year l / day / capita | V | Total water consumption per capita per day | The indicator shall be calculated as the total amount of the city’s water consumption in litres per day (numerator) divided by the total city population (denominator). The result shall be expressed as the total water consumption per capita in litres/days. ITU 4903: NOTE 1 – Calculate as:  Numerator: Total amount of water consumption (l /day)  Denominator: Total number of city inhabitants.  Express as: l / day / capita.  http://www.unwater.org/downloads/TFIMR\_Annex\_FinalReport.pdf NOTE 2 – SDG indicator 6.1.1 is "Proportion of population using safely managed drinking water services". [b-UN SDG] | CITYkeys,  ISO 37120,  ITU 4903 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Reduction in water consumption | % in m3 | V | Percentage reduction in water consumption brought about by the project | (decrease in the volume of the water used due to project / volume of total water consumption of the city)\*100 % Note: From a smart/sustainable cities perspective, the indicator should include everything that is relevant to water loss. This includes pipe losses, firefighting etc. However, that information may be difficult to obtain or to allocate since the distribution area of the water company is not necessarily the same as the geographic borders of the city under evaluation. So if this information is not available or otherwise difficult, the consumption billed can be used as a proxy. | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Grey and rain water use | % of houses | V | Percentage of houses equipped to reuse grey and rain water | NY | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Increase in water re-used | % in m3 | V | Increase in percentage of rain and grey water re-used to replace potable water | The increase in water re-used on site is calculated as the percentage of the overall water demand of the project in the operation phase covered by grey water and storm water retained on site. | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Water Exploitation Index | % of m3 | V | Annual total water abstraction as a percentage of available long-term freshwater resources in the geographically relevant area (basin) from which the city gets its water | (volume of water abstraction in the geographically relevant area/volume of long term freshwater resources in the geographically relevant area)\*100% (EEA) | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Self-sufficiency - Water | % in m3 | V | Increased share of local water resources | (increased volume of the water used from local resources / volume of total water consumption of the city)\*100 % | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Water losses (CITYkeys) Percentage of water loss (unaccounted for water) (ISO 37120) Leakage in water supply system (ITU 4902) Water Supply loss (ITU 4903) | % of m3 | V | Percentage of water loss of the total water consumption (CITYkeys) Proportion of water leakage in the water supply system. (\*) (ITU 4902) Proportion of water leak in the water distribution system. (ITU 4903) | **CITYkeys:** This indicator shall be calculated as the volume of water supplied minus the volume of customer billed water (numerator) divided by the total volume of water supplied (denominator). The result shall then be multiplied by 100 and expressed as a percentage.  **ITU 4903:** NOTE 1 – Calculate as:  Numerator: Volume of water supplied minus the volume of utilized water.  Denominator: Total volume of water supplied. | CITYkeys,  ISO 37120,  ITU 4903 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Total domestic water consumption per capita (litres/day) (core indicator) | litres/day/cap | V | Data interpretation In interpreting this indicator, water consumption per capita should fall within a range that is sustainable for the climate of the city. A minimum benchmark should be established to meet public health and safety needs. Higher rates of per capita water consumption should show reductions approaching the minimum or sustainable consumption rates. | The total domestic water consumption per capita shall be calculated as the total amount of the city’s water consumption in litres per day for domestic use (numerator) divided by the total city population (denominator). The result shall be expressed as the total domestic water consumption per capita in litres per day. Only water consumed for domestic purpose shall be taken into account. Water consumed for industrial and commercial purposes shall be excluded. | ISO 37120 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Quality of city water resources | ??? | V | Quality of water resources (rivers, lakes etc.). (\*\*) NOTE – Pollution of water resources includes (but is not limited to) acidity, organic, floatables, alga, chemical substances and bacteria etc. | NY | ITU 4902 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Quality of piped water | ??? | V | Quality of water as supplied to end users. (\*\*) NOTE – Quality is impacted by both water treatments and distribution systems. | NY | ITU 4902 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.2 Water** | Water saving in households | % | V | Proportion of households with water saving installations | NOTE 1 – Calculate as:  Numerator: number of households with water saving installations.  Denominator: Total number of households.  NOTE 3 – SDG indicator 6.4.1\* is "Change in water-use efficiency over time". [b-UN SDG] | ITU 4903 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.3 Land** | Land area (Square kilometres) | km2 | V | NY | NY | ISO 37120 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.3 Land** | Percentage of non-residential area (square kilometres) | % in km2 | V | NY | NY | ISO 37120 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.3 Land** | Population density | #/km2 | V | Number of people per km2 | Population density is calculated as the ratio of number of inhabitants (numerator) divided by the overall area of the city (km²) (denominator). | CITYkeys,  ISO 37120 |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.3 Land** | Increase in compactness | % of people or workplaces | V | Percentage increase in the number of people or workplaces situated in the project area | Compactness shall be calculated as the increase in the number of inhabitants (#) or the number of work places (#) divided by the project area [ha]. The evaluator should indicate clearly which measure is used. The indicator is expressed as the percentage change comparing before and after the project. ((# of inhabitants or work places after project completion - # of inhabitants or work places before project completion/# of inhabitants or work places before project completion)\*100%))-100 | CITYkeys |
| **2. Planet** | **2.2 Materials, water and land:** Creating a society that treats its resources (materials, water, food and land) more efficiently and sustainably, among others by decreasing consumption and increasing recycling and renewable production (thereby considering ‘spill-overs’ to other resources). | **2.2.3 Land** | Soil pollution avoidance | % of incidents | V | Proportion of soil pollution incidents with successful early warning and emergency detection of heavy metal, chemicals and acid etc. through ICT. | NY | ITU 4902 |
| **2. Planet** | **2.3 Climate resilience:** Adapting to climate change by increasing the resilience of vulnerable areas/elements. |  | Urban Heat Island | °C UHImax | V | Maximum difference in air temperature within the city compared to the countryside during the summer months | Whether there is one or several measurement stations in the built environment, compare the air temperature measurements of these stations with a station outside the city which functions as a reference station, and look for the largest temperature difference (hourly average) during the summer months. | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Nitrogen oxide emissions (NOx) | g/cap | V | Annual nitrogen oxide emissions (NO and NO2) per capita | **See Page 252 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Decreased emissions of Nitrogen oxides (NOx) | % in tonnes | V | Percentage reduction in NOx emissions (NO and NO2) achieved by the project | **See Page 128 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Fine particulate matter emissions (PM2.5) | g/cap | V | Annual particulate matter emissions (PM 2,5) per capita | **See Page 254 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** According to ISO 37120: Fine particulate matter (PM2.5) concentration shall be calculated as the total mass of collected particles that are 2.5 microns or less in diameter (numerator) divided by the volume of air sampled (denominator). The result shall be expressed as the concentration of PM2.5 in micrograms per standard cubic meter (μg/m3). The method for measurement shall involve the use of an air sampler which draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM2.5 size range. The 24-hour (daily) measurements of PM2.5 concentrations are forwarded to a database where yearly summaries for each monitoring stations are computed. NOTE Since data for PM2.5 is not readily available, levels are often calculated on the basis of PM10 emission and this is reported as a separate indicator. | CITYkeys,  ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Decreased emissions of Particulate matter (PM2,5) | % in tonnes | V | Percentage reduction in PM2,5 emissions achieved by the project | **See Page 129 and 130 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Particulate matter (PM10) concentration (core indicator) | μg/m3 | V | NOTE: Those implementing this International Standard shall report on this indicator (unless reporting on PM2.5) in accordance with the following requirements. | Particulate Matter (PM10) concentration shall be calculated as the total mass of collected particles in the PM10 size range (numerator) divided by the volume of air sampled (denominator). The result shall be expressed as the concentration of PM10 in micrograms per standard cubic meter (μg/m3). The method for measurement shall involve the use of an air sampler which draws ambient air at a constant flow rate into a specially shaped inlet where the suspended particulate matter is inertially separated into one or more size fractions within the PM10 size range. The 24-hour (daily) measurements of PM10 concentrations are forwarded to a database where yearly summaries for each monitoring stations are computed. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Air quality index (CITYkeys) Air pollution intensity (ITU 4902) Air pollution (ITU 4903) | Index | V | Annual concentration of relevant air pollutants  **ITU 4903:** Air quality index (AQI) based on :  Particulate matter (PM10, and PM2.5), NO2 (nitrogen dioxide), SO2 (sulphur dioxide), O3 (ozone) and CO (carbon monoxide) | **See Page 255 and 256 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf) ITU 4903:** NOTE 1 – This indicator should be measured as annual mean levels of AQI. NOTE 2 – Average concentrations can demonstrate long term exposure (chronic) while days exceeding demonstrates short term (acute) exposure each of which have different impacts on the population. Concentration can be expressed as: PM 2.5 (μg/m3), PM 10 (μg/m3), NO2 (nitrogen dioxide) (μg/m3), SO2 (sulphur dioxide) (μg/m3), O3 (ozone) (μg/m3), and CO (carbon monoxide) (μg/m3). NOTE 3 – SDG indicator 11.6.2 is "Annual mean levels of fine particulate matter (e.g., PM2.5 and PM10) in cities (population weighted)" [b-UN SDG] | CITYkeys,  ITU 4902,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Number of real-time remote air quality monitoring stations per square kilometre (km2) | #/km2 | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Percentage of public buildings equipped for monitoring indoor air quality | ??? | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Application of ICT based monitoring system for particles and toxic substances | % | V | Proportion of city area covered by outdoor ICT based monitoring system for particles and toxic substances  NOTE – This indicator captures to what extent ICT monitors the air pollution (PM10, PM2.5, toxic substances etc.). | NY | ITU 4901 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | Air pollution monitoring system | #/km2 | V | Number of outdoor installations of ICT based air quality monitoring systems per km2 | NOTE 1 – ICT based systems refer to air quality monitoring systems with sensors, which transmit measurements to a database where daily alerts and information are available and yearly summaries for each monitoring stations are computed.  NOTE 2 – Calculate as:  Numerator: Total number of outdoor installations of ICT based monitoring systems.  Denominator: Total city surface area. | ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | NO2 (nitrogen dioxide) concentration (supporting indicator) | µg/m3 | V | NY | NO2 concentration shall be calculated as the sum of daily concentrations for whole year (numerator) divided by 365 days (denominator). The result shall be expressed as the annual average for daily NO2 concentration in µg/m3. The daily concentrations shall be determined by averaging the hourly concentrations throughout a 24 hour period from all monitoring stations within the city. NOTE If the local air quality monitoring station measures NO2 in parts per billion, the following conversion ratio to μg/m3 can be used: 1 ppb = 1.88 μg/m3. The conversion assumes an ambient pressure of 1 atmosphere and a temperature of 25 degrees °C. The general equation is μg/m3 = (ppb)\*(12.187)\*(M) / (273.15 + °C) where M is the molecular weight of the gaseous pollutant. An atmospheric pressure of 1 atmosphere is assumed. Users of this standard should also note the frequency of NO2 exposures. Peak exposure is determined by calculating the number of times the hourly mean exceeded 200 µg/m3 of NO2 in a calendar year. Long-term exposure is determined by calculating the number of times the daily mean exceeded 40 µg/m3 of NO2 in a calendar year. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | SO2 (sulfur dioxide) concentration (supporting indicator) | µg/m3 | V | NY | SO2 concentration shall be calculated as the sum of daily concentrations for the whole year (numerator) divided by 365 days. The result shall be expressed as the annual average for daily SO2 concentration in µg/m3. The daily concentration shall be determined by averaging the hourly concentrations throughout a 24 hour period from all monitoring stations within the city. Users of this standard should also note the frequency of SO2 exposures. Peak exposure is determined by calculating the number of times the 10 minute mean exceeded 500 µg/m3 of SO2 in a calendar year. Long-term exposure is determined by calculating the number of times the daily mean exceeded 20 µg/m3 of SO2 in a calendar year. NOTE If the local air quality monitoring stations measure SO2 in parts per billion the following conversion ratio to μg/m3: 1 ppb = 2.62 μg/m3 shall be used. The conversion assumes an ambient pressure of 1 atmosphere and a temperature of 25 degrees Celsius. The general equation is μg/m3 = (ppb)\*(12.187)\*(M) / (273.15 + °C) where M is the molecular weight of the gaseous pollutant. An atmospheric pressure of 1 atmosphere is assumed. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.1 Air quality** | O3 (ozone) concentration (supporting indicator) | µg/m3 | V | NY | O3(ozone) concentration shall be calculated as the sum of daily concentrations for the whole year (numerator) divided by 365 days (denominator). The result shall be expressed as the annual average for daily O3 (ozone) concentration in μg/m3. O3 is normally monitored at 8- hour intervals. To determine the 24 hour average daily concentration, the three 8 hour concentrations shall be determined and averaged over a 24 hour period at all monitoring stations within the city’s boundaries. NOTE If local stations monitor O3 in parts per billion, the following conversion ratio to μg/m3 shall be used: 1 ppb = 2.00 μg /m3. The conversion assumes an ambient pressure of 1 atmosphere and a temperature of 25 degrees Celsius. The general equation is μg/m3 = (ppb)\*(12.187)\*(M) / (273.15 + °C) where M is the molecular weight of the gaseous pollutant. An atmospheric pressure of 1 atmosphere is assumed. Long-term exposure shall be determined by the number of days when the daily average concentration over an 8 hour exposure exceeds 100 μg/m3. Long-term exposure shall be noted. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Noise pollution  Exposure to noise (ITU 4902 & 4903) | % of people | V | Share of the population affected by noise >55 dB(a) at night time  Proportion of the city inhabitants exposed to noise levels above international/national exposure limits (ITU 4902 & 4903)  NOTE – Noise is measured as sound pressure in accordance with relevant international/national standards. (ITU 4902) | **See Page 256 and 257 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** According to ISO 37120: Noise pollution shall be calculated by mapping the noise level Lden (day-eveningnight) likely to cause annoyance as given in ISO 1996-2:1987, identifying the areas of the city where Lden is greater than 55 dB(A) and estimating the population of those areas as a percentage of the total city population. The result shall be expressed as the percentage of the population affected by noise pollution. Users of this standard should note that noise pollution can also be recorded as Ln (night) and when exceeding 50 dB(A) is likely to cause sleep deprivation.ITU 4903: NOTE 1 – Relevant standards include but are not limited to: [b-ISO 1996-2] [b-ISO/TS 15666] | CITYkeys,  ISO 37120,  ITU 4902,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Reduced exposure to noise pollution | % in dB | V | Percentage reduction of noise level at night measured at the receiver | **See Page 130 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Application of ICT based noise monitoring | % of km2 | V | Proportion of the city area with applied ICT based noise monitoring NOTE – This indicator measures how ICT is used to monitor how the city inhabitants are exposed to acoustical noise within city areas, especially focusing on noise sensitive areas. | NY | ITU 4901 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | ICT Noise monitoring | #/km2 | V | Number of outdoor installations with applied ICT based noise monitoring per km2 | NOTE 1 – ICT based systems refer to noise monitoring systems with sensors, which transmit measurements to a database where daily alerts and information are available and yearly summaries for each monitoring station are computed.  NOTE 2 – Calculate as:  Numerator: Total number of outdoor installations of ICT based monitoring system.  Denominator: Total city surface area. | ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Compliance with WHO endorsed exposure guidelines | YES/NO | V | Application of WHO endorsed exposure guidelines for ICT installations in the city | NOTE 1 – WHO endorsed exposure guidelines are referred to in [ITU-T K-Sup.4]. NOTE 2 – ICT devices are regulated nationally and are not included. | ITU 4901,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Adoption of a consistent planning approval process with respect to EMF (Electromagnetic field) | YES/NO | V | Application of a consistent planning approval process with respect to EMF to enable efficient deployment of ICT systems | NOTE 1 – A consistent planning approval process between cities is preferred to individual city requirements to ensure efficient deployment [ITU-T K-Sup.4]. | ITU 4901,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.2 Miscellaneous** | Availability of EMF information | YES/NO | V | Availability of information for the public and other stakeholders and referencing WHO and ITU resources regarding compliance, health and installation issues | NOTE 1 – EMF-related information is referred to in [ITU-T K-Sup.4]. | ITU 4901,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Municipal solid waste | t/cap/yr | V | The amount of municipal solid waste generated per capita annually | **See Page 258 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Recycling rate (CITYkeys) Recycling of waste (ITU 4902) | % of tonnes | V | Percentage of city's solid waste that is recycled (CITYkeys) Proportion of waste recycled compared to total collected waste. (\*) (ITU 4902) | CITYkeys: The percentage of city's solid waste that is recycled shall be calculated as the total amount of the city’s solid waste that is recycled in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage (ISO/DIS 37120, 2013).  Recycled materials shall denote those materials diverted from the waste stream, recovered, and processed into new products following local government permits and regulations (International Solid Waste Association, ISWA).  Hazardous waste that is produced in the city and is recycled shall be reported separately. | CITYkeys,  ITU 4902 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Solid waste collection (ITU 4903) | % | V | Proportion of households with regular solid waste collection (ITU 4903) | ITU 4903: NOTE 1 – Calculate as:  Numerator: Number of households that are served by solid waste collection.  Denominator: Total number of households.  NOTE 2 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated, by cities". [b-UN SDG]  NOTE 3 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Reduction in the amount of solid waste collected | % in tonnes | V | Percentage reduction in the amount of waste collected due to the project | **See Page 133 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of city population with regular solid waste collection (residential) (core indicator) | % of people | V | Data interpretation Results will only indicate how much of the city population has access to solid waste collection systems, not the quality of the system: the quality of the service (street level), the levels of recycling (and of land fill misuse), or the capacity of the land fill to meet the demand. Some of these issues will be addressed in the supporting indicators. The proper discharge, transportation and treatment of solid waste is one of the most important components of life in a city and one of the first areas in which governments and institutions should focus. Solid waste systems contribute in many ways to public health, the local economy, the environment, and the social understanding and education about the latter. A proper solid waste system can foster recycling practices that maximize the life cycle of landfills and create recycling micro-economies; and it provides alternative sources of energy that help reduce the consumption of electricity and/or petroleum based fuels. | The percentage of city population with regular solid waste collection shall be calculated as the number of people within the city that are served by solid waste collection (numerator) divided by the total city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Total collected municipal solid waste per capita (core indicator) | tonnes/cap | V | Data interpretation The proper discharge, transportation and treatment of solid waste is one of the most important components of life in a city and one of the first areas in which governments and institutions should focus. Solid waste systems contribute in many ways to public health, the local economy, the environment, and the social understanding and education about the latter. A proper solid waste system can foster recycling practices that maximize the life cycle of landfills and create recycling micro-economies; and it provides alternative sources of energy that help reduce the consumption of electricity and/or petroleum based fuels. | The total collected municipal solid waste per capita shall be expressed as the total municipal solid waste produced in the municipality per person. This indicator shall be calculated as the total amount of solid waste (household and commercial) generated in tonnes (numerator) divided by the total city population (denominator). The result shall be expressed as total municipal solid waste collected per capita in tonnes. Municipal waste shall refer to waste collected by or on behalf of municipalities. The data shall only refer to the waste flows managed under the responsibility of the local administration including waste collected on behalf of the local authority by private companies or regional associations founded for that purpose. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is recycled (core indicator) (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) disposed to sanitary landfills; b) burnt in an open area; c) incinerated; d) disposed to an open dump; e) **recycled**; f) other with regard to total amount of solid waste produced (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is recycled shall be calculated as the total amount of the city’s solid waste that is recycled in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Recycled materials shall denote those materials diverted from the waste stream, recovered, and processed into new products following local government permits and regulations (International Solid Waste Association, ISWA[23]). Hazardous waste that is produced in the city and is recycled shall be reported separately. **ITU 4903:** NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is disposed of in a sanitary landfill (core indicator) (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) **disposed to sanitary landfills**; b) burnt in an open area; c) incinerated; d) disposed to an open dump; e) recycled; f) other with regard to total amount of solid waste produced (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is disposed of in a sanitary landfill shall be calculated as the amount of the city’s solid waste that is disposed of in a sanitary landfill in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Sanitary landfill shall refer to a carefully designed structure which uses a clay liner or a synthetic liner in order to isolate solid waste from the surrounding environment. This isolation is accomplished with a bottom liner and daily covering of soil. **ITU 4903:** NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is treated in energy-from-waste plants (core indicator) | % in tonnes | IV V | NY | NY | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is biologically treated and used as compost or biogas (supporting indicator) | % in tonnes | IV V | NY | NY | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city’s solid waste that is disposed of in an incinerator (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) disposed to sanitary landfills; b) burnt in an open area; c) **incinerated**; d) disposed to an open dump; e) recycled; f) other with regard to total amount of solid waste produced (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is disposed of in an incinerator shall be calculated as the total amount of the city’s solid waste that is disposed of in an incinerator in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. An incinerator shall refer to a unit or facility used to burn waste, often referred to as an incineration plant. **ITU 4903:** NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city’s solid waste that is burned openly (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) disposed to sanitary landfills; b) **burnt in an open area**; c) incinerated; d) disposed to an open dump; e) recycled; f) other with regard to total amount of solid waste produced (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is burned openly shall be calculated as the amount of the city’s solid waste that is burned in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Burned openly shall refer to the combustion of solid waste in an open dump or open space. **ITU 4903:** NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is disposed of in an open dump (supporting indicator) (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) disposed to sanitary landfills; b) burnt in an open area; c) incinerated; d) **disposed to an open dump**; e) recycled; f) other with regard to total amount of solid waste produced (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is disposed of in an open dump shall be calculated as the amount of the city’s solid waste that is disposed of in an open dump in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Open dump shall refer to an uncovered space or hole where solid waste is disposed of without further treatment. **ITU 4903:** NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city's solid waste that is disposed of by other means (supporting indicator) (ISO 37120) Solid waste treatment (ITU 4903) | % in tonnes | V | Proportion of solid waste: a) disposed to sanitary landfills; b) burnt in an open area; c) incinerated; d) disposed to an open dump; e) recycled; f) **other with regard to total amount of solid waste produced** (ITU 4903) | **ISO 37120:** The percentage of the city’s solid waste that is disposed of by other means shall be calculated as the total amount of the city’s solid waste that is disposed of by other means in tonnes (numerator) divided by the total amount of solid waste produced in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Other means shall refer to methods of disposal by means other than the ones indicated in 16.3 (recycling), 16.4 (sanitary landfill), 16.5 (incinerator), 16.6 (burned openly), and 16.7 (open dump). **ITU 4903**: NOTE 1 – Each treatment should be reported separately.  NOTE 2 – Calculate as:  Numerator: Total amount of solid waste that is (disposed to landfills / incinerated/ burnt in an open area / disposed in an open dump / recycled / other) (tonnes).  Denominator: Total amount of solid waste produced (tonnes).  NOTE 3 – SDG indicator 11.6.1 is "Proportion of urban solid waste regularly collected and with adequate final discharge with regard to the total waste generated by cities". [b-UN SDG]  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Hazardous waste generation per capita (tonnes) (supporting indicator) | tonnes/cap | V | NY | The hazardous waste generation per capita shall be calculated as the annual total amount of hazardous waste in tonnes (numerator) divided by total city population (denominator). The result shall be expressed as total hazardous waste generated per capita in tonnes. Hazardous waste generated in the city includes hazardous waste collected under national or municipal hazardous waste directives or regulations, and in accordance with the city’s monitoring and information systems. Hazardous waste is usually accepted at landfills, hazardous waste treatment facilities (including incinerators) and wastewater treatment facilities located in the boundaries of the city. This indicator also covers those hazardous wastes exported for disposal. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city’s hazardous waste that is recycled (supporting indicator) | % in tonnes | V | NY | The percentage of the city’s hazardous waste that is recycled shall be calculated as the total amount of hazardous waste that is recycled in tonnes (numerator) divided by the total amount of hazardous waste that is generated in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Recycled hazardous waste (or hazardous recyclables) shall refer to hazardous waste that is used, reused, or reclaimed. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of waste drop-off centres (containers) equipped with telemetering | % of people | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of the city population that has a door-to-door garbage collection with an individual telemetering of household waste quantities | % of people | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of total amount of waste in the city that is used to generate energy | % in tonnes | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of total amount of plastic waste recycled in the city | % of … | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage of public garbage bins that are sensor-enabled public garbage bins | % of … | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Percentage the city’s electronic waste that is recycled | % of … | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.3 Waste (solid)** | Annual total collected municipal food waste sent to a processing facility for composting per capita (in tonnes) | % in tonnes | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of city population served by wastewater collection (core indicator) Wastewater collection (ITU 4903) | % of people | V | roportion of households served by wastewater collection | Percentage of city population served by wastewater collection shall be calculated as the number of people within the city that are served by wastewater collection (numerator) divided by the city population (denominator). The result shall then be multiplied by 100 and expressed as a percentage. The number of households in the city serviced with regular wastewater collection shall first be determined by counting the number of households that are connected as part of a public or community owned system of discharge of served waters and other residues through a pipe or similar duct that is connected to a network that takes it to a facility where it is treated. The number of households being serviced by wastewater connection shall then be multiplied by the then current average household size for that city to determine the number of persons serviced with wastewater collection. ITU 4903: NOTE 1 – Calculate as :  Numerator: Number of households served by wastewater collection.  Denominator: Total number of households. | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of the city’s wastewater that has received no treatment | % | V | NY | Percentage of the city’s wastewater that has received no treatment shall be calculated as the total amount of the city’s wastewater that has undergone no treatment (numerator) divided by the total amount of wastewater produced in the city and collected (denominator). This result shall then be multiplied by 100 and expressed as a percentage. No treatment shall refer to collected wastewater that is discharged to a water body without any treatment, including periods when wastewater volume exceeds treatment plant capacity. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of the city’s wastewater receiving primary treatment | % | V | NY | The percentage of the city’s wastewater receiving primary treatment shall be calculated as the total amount of the city’s wastewater that has undergone primary treatment (numerator) divided by the total amount of wastewater produced in the city and collected (denominator). This result is then multiplied by 100 and expressed as a percentage of the city’s wastewater receiving primary treatment. Primary wastewater treatment shall refer to the physical separation of suspended solids from the wastewater flow using primary clarifiers. This separation reduces total suspended solids as well as the biological oxygen demand (BOD) levels and prepares the waste stream for the next step in the wastewater treatment process. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of the city’s wastewater receiving secondary treatment | % | V | NY | Percentage of the city’s wastewater receiving secondary treatment shall be calculated as the total amount of the city’s wastewater that has undergone secondary treatment (numerator) divided by the total amount of wastewater produced in the city and collected (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Secondary treatment shall refer to the process of removing or reducing contaminants or growths that are left in the wastewater from the primary treatment process. Secondary treatment reduces Biological Oxygen Demand (BOD) by microbial oxidation. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of the city’s wastewater receiving tertiary treatment | % | V | NY | Percentage of the city’s wastewater receiving tertiary treatment shall be calculated as the total amount of the city’s wastewater that has undergone tertiary treatment (numerator) divided by the total amount of wastewater produced in the city and collected (denominator). The result shall then be multiplied by 100 and expressed as a percentage. Tertiary treatment shall refer to the next wastewater treatment process after secondary treatment. This step removes stubborn contaminants that secondary treatment was not able to clean up. Wastewater effluent becomes even cleaner in this treatment process through the use of stronger and more advanced treatment systems. Tertiary treatment technologies can be extensions of conventional secondary biological treatment to reduce Biological Oxygen Demand (BOD) levels and further stabilize oxygen-demanding substances in the wastewater and to remove nitrogen and phosphorus. Tertiary treatment may also involve physical-chemical separation techniques such as carbon adsorption, flocculation/precipitation, membranes for advanced filtration, ion exchange, chlorination, dechlorination and reverse osmosis. | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of city’s wastewater receiving centralized treatment (core indicator) | % of … | V | NY | NY | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Wastewater treated | % | V | Proportion of wastewater receiving treatment | NOTE 1 – Calculate as:  Numerator: Total amount of wastewater that has undergone (primary /secondary / tertiary) treatment.  Denominator: Total amount of wastewater produced in the city and collected.  NOTE 2 – Calculation of this indicator should be made on each level of treatment separately. http://www.un.org/esa/sustdev/natlinfo/indicators/methodology\_sheets/ freshwater/waste\_water\_treatment.pdf  Primary: physical separation of suspended solids using primary clarifiers.  Secondary: After primary treatment to remove or reduce contaminants or growths with a focus on biological oxygen demand (BOD) Tertiary: After secondary treatment for further reductions in BOD levels and other oxygen-demanding substances in the wastewater, remove nitrogen and phosphorus and including other separation techniques such as carbon adsorption, flocculation/precipitation, membranes for advanced filtration, ion exchange, chlorination, dechlorination , reverse osmosis, etc.  NOTE 4 – SDG indicator 12.4.2\* is "Hazardous waste generated per capita and proportion of hazardous waste treated, by type of treatment". [b-UN SDG] | ITU 4903 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of population with access to improved sanitation (core indicator) | % of people | V | NY | NY | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Compliance rate of wastewater treatment (supporting indicator) | ??? | V | NY | NY | ISO 37120 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of treated wastewater being reused | % of … | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of sludge that is reused (dry matter tonnes) | % of dry matter tonnes | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Energy derived from wastewater as a percentage of total energy consumption of the city | % of … | IV V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of total amount of wastewater in the city that is used to generate energy | % of … | IV V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Percentage of the wastewater pipeline network monitored by a real-time data tracking sensor system | % of … | V | NY | NY | ISO/DIS 37122 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Sewage system coverage | % of households | V | Proportion of households connected to the sewage system. (\*\*) | NY | ITU 4902 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Sewage system management using ICT | % of the sewage system | V | Proportion of the sewage system monitored using ICT NOTE – Monitoring includes both inspection and controlling. | NY | ITU 4901 |
| **2. Planet** | **2.4 Pollution & waste:** Decreasing the emissions to the environment (in the city or elsewhere) (e.g. waste, noise and pollution to air, water and soil). | **2.4.4 Wastewater (Added by FORTEARGE)** | Drainage system management using ICT (ITU 4901) Drainage system management (ITU 4903) | % of the drainage system | V | Proportion of the drainage systems monitored in real-time using ICT. NOTE – Monitoring includes both inspection and controlling. | **ITU 4903:** NOTE 1 – Water quantity observation stations are used as a reference for evaluating an index representing the density of the natural and artificial drainage system monitoring network. Each observation node is associated with a drainage area either for natural drainage (rivers, lakes) or for artificial systems (sewers, urban storm drains, etc.).  NOTE 2 – Calculate as:  Numerator: The sum of the total drainage areas that are covered by the monitoring nodes.  Denominator: The total drainage area of the river basin closed to the outlet (lake or ocean).  NOTE 4 – SDG indicator 6.5.1\* is "Degree of integrated water resources management implementation (0-100)". [b-UN SDG] | ITU 4901,  ITU 4903 |
| **2. Planet** | **2.5 Ecosystem:** stimulating biodiversity and nature conservation |  | Share of green and water spaces | % in km2 | V | Share of green and water surface area as percentage of total land area | **See Page 260 and 261 of "CITYkeys indicators for smart city projects and smart cities" (CITYkeysD14Indicatorsforsmartcityprojectsandsmartcities.pdf)** | CITYkeys |
| **2. Planet** | **2.5 Ecosystem:** stimulating biodiversity and nature conservation |  | Increase in green and blue space | % in m2 | V | Percentage increase in green and blue spaces due to the project | ((blue and green space after project (m2)/blue and green space before project(m2))\*100)-100 | CITYkeys |
| **2. Planet** | **2.5 Ecosystem:** stimulating biodiversity and nature conservation |  | Percentage of areas designated for natural protection (supporting indicator) (ISO 37120) Protected natural area (ITU 4903) | % | V | Proportion of city area under environmental protection (ITU 4903) | **ITU 4903:** NOTE 1 – Calculate as:  Numerator: Area of protected areas (hectares) reserved by law or other effective means. Denominator: Total city area (hectares). | ISO 37120,  ITU 4903 |
| **2. Planet** | **2.5 Ecosystem:** stimulating biodiversity and nature conservation |  | Percentage of ecosystems that are mapped by remote sensing monitoring | % of … | V | NY | NY | ISO/CD 37122 |
| **2. Planet** | **2.5 Ecosystem:** stimulating biodiversity and nature conservation |  | Annual frequency of ecosystem remote sensing monitoring | #/year | V | NY | NY | ISO/CD 37122 |
| **3. Prosperity** | **3.2 Equity:** decreasing poverty and income inequality |  | Annual inflation rate based on the average of the past five years (profile indicator) | # | ALL | NY | NY | ISO 37120 |
| **3. Prosperity** | **3.2 Equity:** decreasing poverty and income inequality |  | Saving rate | # | IV V | Proportion of total incomes for each household remaining after deducting consumption and expenditures. (\*\*) | NY | ITU 4902 |
| **3. Prosperity** | **3.2 Equity:** decreasing poverty and income inequality |  | Country’s GDP (USD/EURO) | EURO/year | ALL | NY | NY | ISO 37120 |
| **3. Prosperity** | **3.2 Equity:** decreasing poverty and income inequality |  | Country’s GDP per capita (USD/EURO) | EURO/cap/year | ALL | NY | NY | ISO 37120 |
| **3. Prosperity** | **3.3 Green economy:** improving the circular and sharing economy and sustainable/local consumption and production. |  | Share of Green Public Procurement | % in € | V | Percentage annual procurement using environmental criteria as share of total annual procurement of the city administration | (Millon EUR annual procurement using environmental criteria/Millon EUR total annual procurement of the city administration)\*100 | CITYkeys |
| **3. Prosperity** | **3.3 Green economy:** improving the circular and sharing economy and sustainable/local consumption and production. |  | Green public procurement | Likert scale | V | The extent to which GPP criteria where taken into account for the procurement processes related to the project | Likert scale: Not at all -1 - 2 - 3 – 4 -5-Excellent  1. Not at all: GPP criteria were not taken into account for the procurement processes related to the project  2. Poor: GPP criteria were to a large extent not taken into account for the procurement processes related to the project  3. Somewhat: GPP criteria were somewhat taken into account for the procurement processes related to the project  4. Good: GPP criteria were to a large extent taken into account for the procurement processes related to the project  5. Excellent: GPP criteria were completely taken into account for the procurement processes related to the project, followed to the letter | CITYkeys |
| **3. Prosperity** | **3.3 Green economy:** improving the circular and sharing economy and sustainable/local consumption and production. |  | Freight movement | # of movements | II | Freight movement is defined as the number of freight vehicles moving into an area (e.g. the city) | # of freight vehicle movements | CITYkeys |
| **3. Prosperity** | **3.3 Green economy:** improving the circular and sharing economy and sustainable/local consumption and production. |  | CO2 reduction cost efficiency | €/ton CO2 saved/year | IV | Costs in euro’s per ton of CO2 saved per year | This indicator is calculated on an annual basis, taking the annual reduction in CO2 emissions, and the annual costs of the project (which is the annualised investment plus current expenditures for a year).    Note: Only the additional costs for energy/CO2 related measures (to the extent discernible) are taken into account in the total costs calculation. | CITYkeys |
| **3. Prosperity** | **3.3 Green economy:** improving the circular and sharing economy and sustainable/local consumption and production. |  | Percentage of buildings built or refurbished within the last 5 years in conformity with green building principle | % in buildings | IV V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.4 Economic performance:** increasing GDP and project performance (internal performance) |  | Median disposable lncome | €/household | IV | Median disposable annual household income | In general, individual data are rarely available so income classes are used. Knowing the number of households in each class, the class of the median income is known. The “exact” amount of median income can be approximated by replacing the steps (caused by the classes) in the cumulative frequency curve by a smooth curve of distribution, at least for the class in which the median is situated. | CITYkeys |
| **3. Prosperity** | **3.4 Economic performance:** increasing GDP and project performance (internal performance) |  | Financial benefit for the enduser | €/household/yr | IV | Total cost savings in euros for end-users per household per year | Total (direct) costs before the project- total (direct) costs after the project = cost savings. | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Investments in ICT innovation | % | V | Proportion of private sector expenditures invested in ICT innovation. | NY | ITU 4902 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Open datasets | #/100 000 | V | # of open government datasets per 100 000 inhabitants | (number of open government datasets/total population) x 100 000  Nb. List all open government datasets and the format they are published in. | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Open data | % | V | Proportion of available open data of cities | NOTE 1 – Calculate as:  Numerator: Total number of open data sets published.  Denominator: Total number of open data sets that could be published following national rule. | ITU 4903 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Research intensity | % in euros | V | R&D expenditure as percentage of city’s GDP | (total expenditure on R&D/city GDP)\*100 | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Stimulating an innovative environment | Likert scale | V | The extent to which the project is part of or stimulates an innovative environment | Likert scale:  1. Not at all: the project is not part of and does not stimulate an innovative environment.  2. Poor: the project is somewhat part of an innovative environment.  3. Somewhat: the project is part of and somewhat stimulates an innovative environment.  4. Good: the project is part of and stimulates an innovative environment.  5. Excellent: the project is an essential part of and stimulates an innovative environment. | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Accessibility of open data sets | # stars | V | The extent to which the open city data are easy to use | Total stars of all datasets/total # datasets  Each dataset has to be rated according to below scheme. All the stars of all the datasets are added up and divided by the total number of datasets.  Average stars across all datasets according to the 5 star deployment scheme for Open Data defined by Tim Berners Lee (5stardata.info):  1. Making data online available in whatever format under an open license  2. Making data available as structured data (e.g. Excel instead of image scan of a table)  3. Making data available in a non-proprietary open format (e.g. CSV) 4. Use URIs to denote things, so that people can point at your data  5. Link your data to other data to provide context | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Quality of open data | # stars | V | The extent to which the quality of the open data produced by the project was increased | Likert scale, partly based on the average stars across all datasets generated by the project according to the 5 star deployment scheme for Open Data defined by Tim Berners Lee (5stardata.info):  1. Making data online available in whatever format under an open license  2. Making data available as structured data (e.g. Excel instead of image scan of a table)  3. Making data available in a non-proprietary open format (e.g. CSV)  4. Use URIs to denote things, so that people can point at your data  5. Link your data to other data to provide context | CITYkeys |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Annual number of online visits to the municipal open data portal per 100 000 population | #/100 000 | V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Number of datasets offered on the municipal open data portal per 100 000 population | #/100 000 | V | NY | NY | ISO/CD 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Percentage of municipal datasets available to the public | % of … | V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Percentage of city services accessible online | % of … | V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | e-Public Services adoption | % | V | Proportion adoption of electronic public services | NOTE 1 – Calculate as:  Numerator: Number of public service transactions conducted online.  Denominator: Total number of public service transactions (online and offline). | ITU 4903 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Average response time to relevant inquiries made through the city’s nonemergency inquiry system (days) | days | V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Average downtime of the city’s IT infrastructure | ??? | V | NY | NY | ISO/DIS 37122 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Research and Development intensity in ICT | % of companies | V | Proportion of research and development intensive ICT companies among all companies. NOTE – Research and development intensive ICT companies refer to ICT companies with high focus on research and development efforts. | NY | ITU 4901 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Application of Geographic Information System (GIS) | % of companies | V | Proportion of e-service companies with core business related to GIS serving the public, companies, government and other organizations. | NY | ITU 4901 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Companies providing e‑services Companies providing online services (ITU 4903) | % of companies | V | Proportion of companies which provide network based services (including e‑commerce, e-learning, e-entertainment, cloud computing etc.). NOTE – Data collection may be challenging due to data gaps. (ITU 4901) Proportion of registered companies providing online services (ITU 4903) | **ITU 4903:** NOTE 1 – online services include e-commerce, e-learning, e-entertainment, cloud computing, etc. NOTE 2 – Calculate as:  Numerator: Number of registered companies providing online serviced (including e-commerce, e-learning, e-entertainment, cloud computing, etc.).  Denominator: Total registered companies within the city. | ITU 4901,  ITU 4903 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Application of big data | % of companies | V | Proportion of e-service companies with core business related to big data storage and analysis serving the public, companies, government and other organizations. | NY | ITU 4901 |
| **3. Prosperity** | **3.5 Innovation:** facilitates innovation and creativity (through e.g. open data, knowledge sharing and cyber resilience). |  | Application of computing platforms | % of companies | V | Proportion of companies that offer cloud computing and similar resources serving the public, other companies, government and other organizations. | NY | ITU 4901 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Congestion | % in hours | V | Increase in overall travel times when compared to free flow situation (uncongested situation) | This indicator can be calculated as indicated by tomtom (tomtom.org): ((travel times in peak hours - travel times during non-congested periods (free flow\*))/travel times during non-congested periods)\*100%   NB There are other was to calculate congestion, see below. We would like to hear from the cities what method they use. For the moment, therefore, the calculation method is flexible, as long as it is specified.  2 Decide  - Average delay per vehicle kilometre (congestion), with unit: hour delay/vehicle-km;  - Vehicle kilometres travelled in congestion, with unit: vehiclekm/time unit Travel time (average per traffic unit), with unit: hour;  - Additional travel time caused by incidents, with unit: hour;  EEA  - Average daily km of traffic jams per 1000 inhabitants in city  City Protocol  - Average daily traffic jam in hours | CITYkeys |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Decreased travel time | % in hours | II | Percentage decrease in travel time due to the project | This indicator can be calculated according to the congestion index of tomtom (tomtom.com): (travel times in peak hours after the project - travel times in peak hours before the project/ travel times in peak hours before the project)\*100% Note: other options are also possible, e.g.: h/veh-km before the project – h/veh-km after the project (decrease in %). | CITYkeys |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Public transport use (CITYkeys) Annual number of public transport trips per capita (ISO 37120:2018) | #/cap/year | II | Annual number of public transport trips per capita | This indicator shall be calculated as the total annual number of transport trips originating in the city - “ridership of public transport” - (numerator), divided by the total city population (denominator) (ISO/DIS 31720). Transport trips shall include trips via heavy rail metro or subway, commuter rail, light rail streetcars and tramways, organized bus, trolleybus, and other public transport services. Cities shall only calculate the number of transport trips with origins in the city itself. Note: Transport systems often serve entire metropolitan areas, and not just central cities. The use of number of transport trips with origins in the city itself will still capture many trips whose destination are outside the city, but will generally capture the impact that the city has on the regional transport network. | CITYkeys,  ISO 37120 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Net migration | #/1 000 | V | Rate of population change due to migration per 1000 inhabitants | ((Move-ins – move-outs)/total population)\*1000 (CASBEE, 2012; Telos, 2015) | CITYkeys |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | International Events Hold | #/100 000 | III | The number of international events per 100 000 inhabitants | NY | CITYkeys |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Tourism intensity | #/100 000 | III | Number of tourist nights per year per 100 000 inhabitants | NY | CITYkeys |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Annual number of visitor stays (overnight) per 100 000 population (supporting indicator) | #/100 000 | III | NY | NY | ISO 37120 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Number of cultural institutions and sporting facilities per 100 000 population (core indicator) (ISO 37120) Cultural infrastructure (ITU 4903) | #/100 000 inhabitants | V | Number of the cultural institutions per 100 000 inhabitants (ITU 4903) | **ITU 4903**: NOTE 1 – "Cultural institution" means a public or non-profit institution within this state which engages in the cultural, intellectual, scientific, environmental, educational or artistic enrichment of the people of this state. "Cultural institution" includes, without limitation, aquaria, botanical societies, historical societies, land conservation organizations, libraries, museums, performing arts associations or societies, scientific societies, wildlife conservation organizations and zoological societies. "Cultural institution" does not mean any school or any institution primarily engaged in religious or sectarian activities. http://www.oregonlaws.org/glossary/definition/cultural\_institution | ISO 37120,  ITU 4903 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Sporting facilities | m2/100 000 inhabitants | V | Area of total public sports facilities per 100 000 inhabitants | NOTE 1 – Calculate as:  Numerator: m2 total public sports facilities (free and paid).  Denominator: One 100,000th of the city's population. | ITU 4903 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Availability of sporting facilities | #/cap | V | Number of sports training facilities per capita. (\*) | NY | ITU 4902 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Percentage of municipal budget allocated to cultural and sporting facilities (supporting indicator) | % of budget | V | NY | NY | ISO 37120 |
| **3. Prosperity** | **3.6 Attractiveness & competitiveness:** Improving the appeal of the city for residents and businesses. |  | Annual number of cultural events per 100 000 population (e.g. exhibitions, festivals, concerts) (supporting indicator) | #/100 000 | III V | NY | NY | ISO 37120 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Cross-departmental integration | Likert | V | The extent to which administrative departments contribute to “smart city” initiatives and management | Likert scale (adapted to Transform (2013)): Only one department involved – 1 – 2 – 3 – 4 – 5 – All departments are actively involved  1. There is a silo-ed smart city governance structure, only one department actively contributes to smart city initiatives and decides on the strategy.  2. The local authority is poorly oriented towards crossdepartmental “smart city” management: officially there is no “mainstreaming approach”, some civil servants from a few departments work on this portfolio on the side or provide data for the initiatives, but there is no real strategy and commitment.  3. The local authority is somewhat oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and several departments contribute in human, data or financial resources.  4. The local authority is clearly oriented towards crossdepartmental “smart city” management: there is a strategy for a “mainstreaming approach” and almost all departments provide financial, data and human resources for the smart city themes.  5. The local authority is committed towards crossdepartmental “smart city” management: there is a wellanchored “mainstreaming approach” with shared performance targets and all departments are actively contributing to the smart city themes in financial, data and human resources. | CITYkeys |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Establishment within the administration | Likert | V | The extent to which the smart city strategy has been assigned to one department/director and staff resources have been allocated | Likert scale: Not at all – 1 – 2 – 3 – 4 – 5 – Very much  1. Not at all: The municipal efforts regarding smart city are not at all reflected by the organizational structure and staff resources.  2. Poor: some civil servants manage this portfolio on the side but there is no real commitment to the subject.  3. Moderate: responsibility has been assigned to a director and a small team is working on the topic.  4. Much: responsibility has been assigned to a director and a large team is working on the topic.  5. Very much: the smart city strategy is a well-anchored in the administration reflected by the assigned responsiblity to a large team and the strong commitment to achieve the smart city targets. | CITYkeys |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Monitoring and evaluation | Likert | V | The extent to which the progress towards a smart city and compliance with requirements is being monitored and reported | Likert scale no continued monitoring – 1 — 2 — 3 — 4 — 5 — Extensive monitoring  1. No monitoring & reporting: No monitoring and reporting at all was used to verify the progress of policies/strategies/projects.  2. Little monitoring & reporting: there is a basic monitoring scheme in place: a basic set of indicators assessed at irregular time intervals.  3. Some monitoring & reporting: there is a city-wide monitoring scheme in place with an elaborate set of indicatorsmeasurement intervals, backed by well-defined (SMARTY) goals of the smart city strategy.  4. Very much monitoring & reporting: there is a city-wide monitoring scheme in place with anelaborate set of indicators and measurement intervals, the findings of which are yearly reported upon.  5. Extensive monitoring & reporting: there is a city-wide monitoring scheme in place addressing all stages of the process, the findings of which are yearly reported upon and published transparently online. | CITYkeys |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Continued monitoring and reporting | Likert scale | V | The extent to which the progress towards project goals and compliance with requirements is being monitored and reported | Likert scale: No continued monitoring – 1 — 2 — 3 — 4 — 5 — Extensive monitoring  1. No monitoring & reporting: No monitoring and reporting at all was used to verify that the project was executed according to the sustainability ambitions, rules & regulations.  2. Little monitoring & reporting: there is a basic monitoring scheme in place: a basic set of indicators assessed at irregular time intervals.  3. Some monitoring & reporting: a monitoring scheme is in place with an elaborate set of indicators and measurement intervals, backed by well-defined (SMARTY) goals.The scope of the monitoring activities is limited, including only some facets of the project’s development.  4. Very much monitoring & reporting: a monitoring scheme is in place with an elaborate set of indicators and measurement intervals, the findings of which are yearly reported upon. Most of the project’s facets were monitored.  5. Extensive monitoring & reporting: monitoring and reporting to ensure that the project was executed according to the established sustainability ambitions, rules & regulations was a central and consistent concern during all stages of the project’s development. Monitoring and reporting was frequent, and carried out at set intervals, the findings of which are yearly reported upon and published transparently online.. The scope of the monitoring activities were extensive, including all facets of the project’s development. | CITYkeys |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Availability of government data | Likert | V | The extent to which government information is published | Likert scale Not at all – 1 – 2 – 3 – 4 – 5 – Excellent  1. Not at all: most of the information is not available to the public or only upon appointment with an expert  2. Poorly: most of the information is available to the public, but available in the form of a hard copy which cannot leave city hall  3. Somewhat: most of the information is available to the public, some in the form of a hard copy, some online.  4. Good: most of the information is available online, but structure is lacking  5. Excellent: all government information is available online and neatly structured. | CITYkeys |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Existence of strategy, rules and regulations to enable the use of public data | ??? | V | Existence of a framework to enable the use of public data of cities. | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Provision of online systems for administering public services and facilities | % of public services | V | Proportion of public services and facilities (e.g., choice of schools, booking of public sports facilities, library services, etc.) that could be administered online. NOTE – This includes bookings, payments etc. | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Application of services to support persons with specific needs | % of public services | V | Proportion of public facilities and buildings that provide ICT based services and information to support persons with specific needs, and proportion of online public information customized for these persons. NOTE – Persons with specific needs here indicate indigenous people, and persons with disabilities including age related disabilities. | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Availability of online city information and feedback mechanisms | % of public services | II III V | Proportion of city information available online and existence of ICT systems for easy access and anonymous feedback mechanism that enable cities to improve their governance. NOTE – Online city information include city plans, budget, minutes of city governance meetings etc. | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Availability of cultural resources online (ITU 4902) Cultural resources online (ITU 4903) | % of public services | III V | Proportion of cultural institutions and events in the city for which online participation is offered.  NOTE – The indicator measures how ICT increases the availability of cultural resources, such as museums, galleries etc, to a broader audience. (ITU 4902) Proportion of cultural institutions and events for which online participation is offered. (ITU 4903) | **ITU 4903:** NOTE 1 – Cultural resources online include: events and activities provided online, and watched or listened through electric/virtual media.  NOTE 2 – Calculated as:  Numerator: Number of cultural institutions and events for which online participation is offered.  Denominator: Total number of cultural institutions and events. | ITU 4902,  ITU 4903 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Interest in online access to cultural resources | #/cap/year | V | On-line visits to cultural resources per capita. | NY | ITU 4902 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Online civic engagement | % of people | V | Proportion of city inhabitants using online information and proportion of city inhabitants using ICT based feedback mechanism. | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Online support for new city inhabitants | # | V | Availability of ICT based applications and services to provide establishment support for new city inhabitants. NOTE – New city inhabitants include people moving to the city and visitors | NY | ITU 4901 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Use of online city services | % of people | V | Proportion of city inhabitants using online public services and facilities (e.g., choice of schools, booking of public sports facilities, library services, etc.). NOTE – This includes bookings, payments etc. | NY | ITU 4902 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Perception on social inclusion | % of people | V | Proportion of city inhabitants satisfied with the social inclusion. (\*\*) NOTE – Social inclusion usually refers to members of society feeling valued and important. | NY | ITU 4902 |
| **4. Governance** | **4.1 Organisation:** Facilitate the implementation of (integrated) smart city policies by improving the organisation of the project/city with regards to;  - The composition, structure and quality of the project team/city administration;  - The quality of the implementation process;  - Sound leadership by the project leader(s) and city politicians;  - Transparency of the organisation. |  | Existence of strategies, rules and regulations to enable ICT literacy among inhabitants | # | V | Existence of strategies, regulations, voluntary work or interest organizations to enhance ICT literacy among all city inhabitants. NOTE – This includes mechanisms that enable public knowledge and skill development. | NY | ITU 4901 |
| **4. Governance** | **4.2 Community involvement:** increasing citizen participation and enhancing the active involvement of end-users, the community and professional stakeholders in city developments. |  | Citizen participation | % of projects | V | The number of projects in which citizens actively participated as a percentage of the total projects executed | NY | CITYkeys |
| **4. Governance** | **4.2 Community involvement:** increasing citizen participation and enhancing the active involvement of end-users, the community and professional stakeholders in city developments. |  | Annual number of citizens engaged in the planning process per 100 000 population | #/100 000 | V | NY | NY | ISO/DIS 37122 |
| **4. Governance** | **4.2 Community involvement:** increasing citizen participation and enhancing the active involvement of end-users, the community and professional stakeholders in city developments. |  | Open public participation | #/100 000 | V | Number of public participation processes per 100 000 per year | Calculation: (Total amount of open public participation processes/City population)\*1000 | CITYkeys |
| **4. Governance** | **4.2 Community involvement:** increasing citizen participation and enhancing the active involvement of end-users, the community and professional stakeholders in city developments. |  | Public participation | Checklist | V | Promotion of inhabitants' participation in public affairs | NOTE 1 – Checklist: a) existence of rules and regulations to promote the participation of inhabitants in public affairs; b) existence of systems to promote inhabitants' engagement, such as online information and ICT based feedback mechanism; c) existence of formal participatory process prior to policy making, major public projects etc.; d) existence of public decision-making to ensure gender and aging equity.  NOTE 2 – The value of this indicator is determined by the sum of YES answers relatively to the above checklist. | ITU 4903 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.1 Strategies and policies** | Smart city policy | Likert | V | The extent to which the city has a supportive smart city policy | Likert scale: Not at all – 1 — 2 — 3 — 4 — 5 — Very supportive  1. Not at all: the complete absence of a long-term smart city vision (including and absence of long-term targets & goals) from the side of the government or an opposing vision create a difficult environment for starting smart city initiatives.  2. Poor: The long-term vision of the government does, to some extent, hamper the environment for smart city initiatives.  3. Neutral: The long-term vision of the government has had no significant, positive or negative, impact on the environment for smart city initiatives.  4. Somewhat supportive: The long-term vision of the government has to some extent benefitted the environment for smart city initiatives. The city has created roadmaps and actions to support vision implementation  5. Very supportive: The comprehensive long-term vision on the future of the city stimulates the environment for smart city initiatives to a great extent. | CITYkeys |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.1 Strategies and policies** | Smart city policy | Likert scale | V | The extent to which the project has benefitted from a governmental smart city policy | Likert scale: Very much hampered – 1 — 2 — 3 — 4 — 5 — Very much benefitted  1. Very much hampered: Project development has been hampered by an absence of a long-term smart city vision (including and absence of long-term targets & goals) from the side of the government, or its vision hinders the smart city ambitions of the project.  2. Somewhat hampered: The long-term vision of the government has, to some extent, hampered the development of the project or the achievement of its ambitions.  3. Neutral: The long-term vision of the government on Smart City (domains) has had no significant, positive or negative, effect on the project’s development or in achieving its ambitions.  4. Somewhat benefitted: The long-term vision of the government on Smart City (domains) has to some extent benefitted the project in the development of the project or in achieving its ambitions.  5. Very much benefitted: The comprehensive long-term vision on the future of the city has benefitted the project to a great extent in the development of the project or in achieving its ambitions. | CITYkeys |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.1 Strategies and policies** | Urban development and spatial planning | YES/NO | V | Existence of a strategic city planning documents promoting compact development, mixed urban land use; and avoiding urban sprawl | NOTE 1 – SDG indicator 11.a.1\* is "Proportion of population living in cities that implement urban and regional development plans integrating population projections and resource needs, by size of city". [b-UN SDG] | ITU 4903 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Expenditures by the municipality for a transition towards a smart city | €/capita | V | Annual expenditures by the municipality for a transition towards a smart city | (Total annual expenditures by the municipality for a transition towards a Smart City/total population) | CITYkeys |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Percentage of municipal budget spent on smart city innovations and initiatives per year | % of budget | V | NY | NY | ISO/CD 37122 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Investment intensity in ICT projects enabling SSC (Smart Sustainable City) | # | V | The amount of city investments in programs, initiatives and awards that enhance the smartness and sustainability of the city, expressed as proportion of city GDP.  NOTE – These projects could be sponsored by grant makers, multilateral organisations and/or private sector. | NY | ITU 4901 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Municipal involvement - Financial support | Likert scale | V | The extent to which the local authority provides financial support to the project | Likert scale: Not at all – 1 – 2 – 3 – 4 – 5 – Very much  1. The municipality does not provide financial support to the project  2. The municipality provides little financial support to the project, the administrative burden is high in relation to the amount of aid given  3. The municipality provides some financial support to the project, the administrative burden is reasonable in relation to the amount of aid given.  4. The municipality provides generous financial support to the project, the administrative burden is reasonable in relation to the amount of aid given.  5. The municipality provides very generous financial support to the project, with very low administrative burden in relation to the amount of aid given. | CITYkeys |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Gross operating budget (USD/EURO) | EURO/year | V | NY | NY | ISO 37120 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Gross capital budget (USD/EURO) | EURO/year | V | NY | NY | ISO 37120 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Gross operating budget per capita (USD/EURO) (profile indicator) | EURO/cap/year | V | NY | NY | ISO 37120 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Gross capital budget per capita (USD/EURO) (profile indicator) | EURO/yecaap/r | V | NY | NY | ISO 37120 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Percentage of municipal budget allocated for provision of mobility aids, devices, and assistive technologies to citizens with special needs | % of city budget | V | NY | NY | IS0/DIS 37122 |
| **4. Governance** | **4.3 Multi-level governance:** Increasing support for smart city initiatives by providing smart city policies and budget at different government levels. | **4.3.2 Budget** | Annual percentage of municipal budget spent on urban agriculture initiatives | % of city budget | V |  |  | ISO/DIS 37122 |

1. **CITYkeys Project:** Funded by the European Union HORIZON 2020 programme, CITYkeys developed and validated, with the aid of cities, key performance indicators and data collection procedures for the common and transparent monitoring as well as the comparability of smart city solutions across European cities. The project started in February 2015 and run for two years, until January 2017. <http://www.citykeys-project.eu/citykeys/cities_and_regions/Project-deliverables> [↑](#footnote-ref-1)