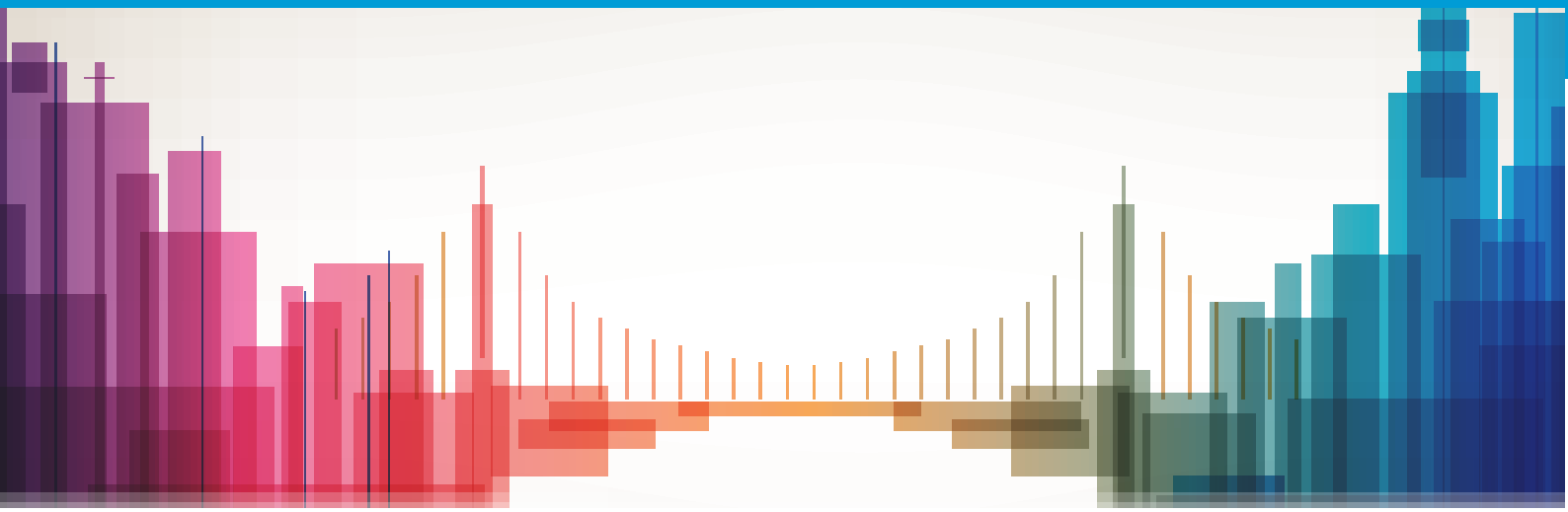
Details of 100 Key Performance Indicators

Digital Transformation Assessment of People-Centred Cities Performance and Impact Assessment Guide



Convention on Biological Diversity

United Nations ECLAC

Food and Agriculture Organization of the United Nations

ITU

UN-HABITAT

UNDP

United Nations Economic Commission for Africa

UNECE

UNIDO

unesco

UN environment programme

UNEP FINANCE INITIATIVE

United Nations Framework Convention on Climate Change

unitar United Nations Institute for Training and Research

UNFPA

United Nations Department of Economic and Social Affairs

UNJSPF United Nations Joint Staff Pension Fund

UN Office 4 PARTNERSHIPS

UNU EGOV

UN Tourism

WORLD METEOROLOGICAL ORGANIZATION



Details of 100 Key Performance Indicators

Digital Transformation Assessment of People-Centred Cities Performance and Impact Assessment Guide

Foreword

This publication was developed within the framework of the United for Smart Sustainable Cities (U4SSC) initiative.

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Disclaimer

The opinions expressed in this publication are those of the authors and do not necessarily represent the views of their respective organizations or U4SSC members. In line with the U4SSC principles, this report does not promote the adoption and use of Smart City technology. It advocates for policies encouraging responsible use of information and communications technologies (ICTs) that contribute to the economic, environmental and social sustainability as well as the advancement of the 2030 Agenda for Sustainable Development and the Pact for the Future and its Global Digital Compact.

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Executive Summary

This document is the technical companion to the Digital Transformation Assessment of People-Centred Cities Performance and Impact Assessment Guide (the Guide). The Guide sets out the purpose, structure and methodology of the Performance and Impact Assessment Framework; this document provides the full specification of each of the 100 Key Performance Indicators (KPIs) on which that Framework is built. It is intended as a working reference for city officials, analysts and data owners responsible for collecting data and for calculating and reporting the KPIs.

How this document relates to the Guide

The two publications are designed to be used together:

- **The Guide** explains why and how cities should assess digital transformation: the people-centred approach (Section 2); the three dimensions and twelve subdimensions and the three-stage structure of Digital Enablement, Output/Usage and Outcome/Impact (Section 3); the distinction between Core and Advanced KPIs (Section 4); the KPI template (Section 5); the summary Key Performance Indicator Table (Section 6); and the four-step Digital Transformation Impact Assessment methodology (Section 9).
- **This document** sets out what to measure and how to measure it, with one completed KPI template for each of the 100 KPIs listed in the Key Performance Indicator Table of the Guide.

The KPI numbers, names, dimensions, subdimensions, stages and categories used in this document are identical to those in the Key Performance Indicator Table (Section 6 of the Guide), so each KPI can be traced directly between the two publications by its KPI number. Each KPI sheet follows the template described in Section 5 of the Guide and reproduced as a blank form in its Appendix 1.

How this document is organized

The KPIs are presented in numerical order, grouped by dimension and subdimension:

- **Society and Culture (KPIs 1–40)**: Culture and Heritage (1–3); Public Services and Engagement (4–19); Health (20–32); Education (33–40).
- **Environment (KPIs 41–65):** City Resilience (41–44); Urban Planning (45); Environment and Sustainability (46–54); Energy and Utilities (55–65).
- **Economy (KPIs 66–100):** Digital Economy (66–77); Digital Skills (78–82); Infrastructure and Connectivity (83–92); Transport and Mobility (93–100).

Of the 100 KPIs, 66 are Core KPIs, applicable to all cities regardless of size or capacity, and 34 are Advanced KPIs, intended for cities with more mature digital ecosystems. Every KPI sheet contains the same fields:

- **Identification**: dimension, subdimension, KPI number and KPI name.
- **Classification**: category (Core or Advanced) and stage (Digital Enablement, Output/Usage or Outcome/Impact).
- **Definition/Description**: what the KPI measures.
- **Rationale/Interpretation**: why the KPI matters for people-centred digital transformation and how a result should be read.
- **Methodology and Unit**: how the KPI is calculated, typically as a numerator and a denominator expressed as a percentage, ratio or rate, and the unit in which it is reported.
- **Benchmarking**: a reference point against which performance can be judged.
- **Source(s)/References and Data Sources/Relevant Databases**: the standards, frameworks and indices the KPI draws on, and where the underlying data can typically be obtained.

How to use this document

Cities are recommended to apply the two publications in the following sequence:

1) **Start with the Guide.** Use the Guide to understand the Framework, the people-centred approach and the meaning of the three stages, and to define the objectives and scope of the assessment.
2) **Select the KPIs.** Use the Key Performance Indicator Table (Section 6 of the Guide) to choose KPIs that reflect local priorities, data availability and level of digital maturity. Cities are not required to apply all 100 KPIs: they may begin with a focused set of 10–20 Core KPIs to establish a baseline and add Advanced KPIs progressively as capacity grows, or focus on selected dimensions, subdimensions or stages.
3) **Consult the KPI sheets.** Look up each selected KPI in this document by its KPI number and review its definition, rationale and methodology to confirm that it is relevant and measurable in the local context.
4) **Identify data sources.** Use the Data Sources/Relevant Databases field to locate existing data, such as municipal, national or regional administrative records, monitoring systems, surveys and publicly available sources. Cities are not required to establish new data-collection systems solely for reporting on the KPIs.
5) **Calculate and record results.** Apply the specified methodology and unit, and record the value, reference period, data source and any limitations, for example using the sample data collection template in Appendix 2 of the Guide.

6) **Interpret and benchmark.** Use the Rationale/Interpretation and Benchmarking fields to interpret results and to track progress over time or compare with peer cities. As the Guide emphasizes, the stage assigned to a KPI reflects its measurement scope; the absence of a stage does not indicate a deficiency or a lower level of digital maturity.

7) **Assess impact (optional).** Cities wishing to go further can use the selected KPIs as inputs to the four-step Digital Transformation Impact Assessment described in Section 9 of the Guide, which is aligned with Recommendation ITU-T Y.4905 - Smart sustainable city impact assessment.

Where local circumstances require it, cities may adapt a KPI's methodology or data sources, provided that any adaptation is documented transparently so that results remain consistent and comparable over time and across cities.

1 Society and Culture Dimension

Dimension	**Society and Culture**		
Subdimension	**Culture and Heritage**		
KPI No	1		
KPI Name	**Availability of Digital Cultural Content**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of a city's cultural and heritage assets that have been digitally documented and made available in digital formats. Cultural assets include museums, monuments, archives, libraries, historic sites, collections, and intangible cultural heritage. Digitalization may include high-resolution imaging, 3D scanning, digital archiving, virtual exhibitions, and online public access. Where applicable, digital cultural assets may also include born-digital works and authenticated digital art (e.g., Non-Fungible Tokens (NFTs)).		
Rationale / Interpretation	Digitalization improves the preservation, accessibility, and discoverability of cultural heritage while expanding opportunities for public participation, education, research, and tourism. A higher percentage indicates that the city is effectively leveraging digital technologies to safeguard cultural assets and broaden access to cultural content. This KPI supports SDG 11.4 and smart city strategies that promote inclusive and sustainable cultural governance.		
Methodology	Calculate as Numerator: Number of cultural and heritage assets available in digital form Denominator: Total number of cultural and heritage assets Multiply by 100		
Unit	Percentage (%)		
Benchmarking	A substantial majority of registered cultural and heritage assets should be digitally accessible through publicly available or institutionally managed digital platforms.		
Source (s) / References	UNESCO/PERSIST Guidelines for the Selection of Digital Heritage for Long-Term Preservation U4SSC Key Performance Indicators for Smart Sustainable Cities (Society and Culture) SDG 11.4 – Protecting the World's Cultural and Natural Heritage National cultural heritage digitalization strategies		

Dimension	Society and Culture
Subdimension	**Culture and Heritage**
Data Sources / Relevant Databases	Municipal cultural heritage departments. Museums, libraries, archives and monument registries National cultural heritage authorities Digital asset management systems Online digital heritage portals UNESCO World Heritage databases. National heritage databases

Dimension	Society and Culture		
Subdimension	**Culture and Heritage**		
KPI No	2		
KPI Name	**Engagement with Digital Cultural Content**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of a city's population that actively accesses, interacts with, or uses digital cultural and heritage content, including online exhibitions, virtual tours, digital archives, museum and library websites, mobile applications, and other digital platforms providing cultural content.		
Rationale / Interpretation	High levels of engagement indicate that digital cultural initiatives are effectively reaching residents, increasing cultural participation, supporting education and lifelong learning, enhancing public awareness, and strengthening social cohesion. This KPI evaluates the effectiveness and public uptake of digital cultural strategies and aligns with SDG 11.4, which promotes the protection and safeguarding of cultural heritage.		
Methodology	Calculate as Numerator: Number of users engaging with digital cultural content Denominator: Total number of city inhabitants Multiply by 100		
Unit	Percentage (%)		
Benchmarking	High level of city inhabitants' engagement with digital cultural content annually, supporting inclusive access to digital cultural services. Consistent with the objectives of UNESCO, U4SSC, UN-Habitat GUMF, and the Global Digital Compact in promoting digital inclusion, cultural participation, and access to digital public services.		
Source (s) / References	UNESCO/PERSIST Guidelines U4SSC Key Performance Indicators for Smart Sustainable Cities (Society and Culture Dimension) SDG 11.4 indicators. National cultural heritage and digitalization authorities UN-Habitat Global Urban Monitoring Framework (GUMF), where applicable		
Data Sources / Relevant Databases	Website and mobile application analytics from museums, libraries, archives, and cultural institutions. Municipal digital cultural platforms and content management systems Public engagement surveys and cultural participation reports National statistical offices. Cultural heritage authorities		

Dimension	Society and Culture		
Subdimension	**Culture and Heritage**		
KPI No	3		
KPI Name	**Satisfaction with Digital Cultural Content**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of the city's population that reports being satisfied with digital cultural and heritage content and services, including online exhibitions, virtual tours, digital archives, museum and library websites, mobile applications, and other digital platforms providing cultural content. Satisfaction is assessed through user surveys, feedback forms, ratings, or other participatory evaluation methods.		
Rationale / Interpretation	High levels of satisfaction indicate that digital cultural initiatives effectively meet user needs, provide valuable and accessible cultural experiences, and enhance citizen engagement and participation. This KPI enables cities to evaluate the quality, inclusiveness, and impact of their digital cultural strategies, supporting continuous service improvement and evidence-based cultural governance. It aligns with SDG 11.4, which promotes the protection and safeguarding of cultural heritage.		
Methodology	Calculate as Numerator: Number of survey respondents or users reporting satisfaction (e.g., rating "Satisfied" or higher) with digital cultural and heritage content. Denominator: Total number of respondents in the survey or feedback collection period Multiply by 100		
Unit	Percentage (%)		
Benchmarking	A strong majority of respondents report satisfaction with the quality, accessibility, and usability of digital cultural content and services. Consistent with the objectives of UNESCO, U4SSC, UN-Habitat GUMF, and the Global Digital Compact in promoting citizen-centred digital services, cultural participation, and continuous quality improvement.		
Source (s) / References	UNESCO Cultural Participation and Digital Heritage Guidelines U4SSC Key Performance Indicators for Smart Sustainable Cities (Society and Culture Dimension) SDG 11.4 indicators National cultural heritage and digitalization authorities UN-Habitat Global Urban Monitoring Framework (GUMF), where applicable		

Dimension	Society and Culture
Subdimension	**Culture and Heritage**
Data Sources / Relevant Databases	Public surveys and citizen feedback on digital cultural content and services User ratings and analytics from digital cultural platforms (web, mobile applications, virtual reality platforms). Municipal cultural departments and heritage institutions National statistics on cultural participation and citizen satisfaction

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	4		
KPI Name	**Digital Public Services Availability**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of a city's public services that are available through digital channels, including official government websites, mobile applications, self-service kiosks, and integrated e-government platforms. Public services may include health care, education, transportation, licensing and permits, taxation, utilities, social services, and other municipal services.		
Rationale / Interpretation	A high level of digital public service availability indicates that the city is leveraging information and communication technologies (ICTs) to improve service accessibility, efficiency, transparency, and administrative effectiveness. This KPI measures the city's progress toward digital government, smart governance, and digital inclusion by expanding citizens' access to public services through digital channels. It supports SDG 16, which promotes effective, accountable, and inclusive institutions, and SDG 11, which promotes inclusive, safe, resilient, and sustainable cities.		
Methodology	Calculate as Numerator: Number of public services available through official digital channels Denominator: Total number of public services offered by the city Multiply by 100		
Unit	Percentage (%)		
Benchmarking	A strong majority of public services can be accessed and completed through official digital channels.		
Source (s) / References	U4SSC Key Performance Indicators for Smart Sustainable Cities United Nations E-Government Survey SDG 16 and SDG 11 indicators National digital government and e-governance authorities IMD Smart City Index (where applicable)		
Data Sources / Relevant Databases	Municipal digital service registries Official e-government portals Online public service inventories. National digital government authorities Smart city dashboards. Online service analytics and administrative records Citizen feedback and public service monitoring platforms		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	5		
KPI Name	**Digital Inclusion and Accessibility**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of public sector digital channels (websites, portals, mobile apps) that meet international digital accessibility standards, such as WCAG 2.1 Level AA.		
Rationale / Interpretation	Reflects city efforts to ensure inclusive digital services for persons with disabilities and all other vulnerable groups.		
Methodology	Calculate as Numerator: Number of compliant platforms Denominator: Total digital platforms Multiply by 100		
Unit	Percentage (%)		
Benchmarking	WCAG compliance targets, accessibility of municipal digital platforms, and digital inclusion indexes Proportion of population with access to digital public services, including marginalized groups Availability of affordable internet and device access for all residents Number of accessibility compliance. Websites and services should be accessible following WCAG 2.0 and EN301549. Representation of vulnerable populations in e-participation and digital decision-making. Aligned with UN-Habitat's Global Urban Monitoring Framework, urban digital services aim to be accessible to vulnerable populations, with platforms monitored against global standards and with the Global Digital Compact and ICT inclusion initiatives.		
Source (s) / References	Municipal reports on digital inclusion and social equity initiatives Surveys on ICT access and digital literacy Academic research on digital divides and accessibility International guidelines and frameworks on inclusive digital governance (UN, ITU, OECD) ITU-T Recommendations such as Y.4903 includes KPIs for society and culture, and digital inclusion. Reports from community organizations supporting digital empowerment		

Dimension	Society and Culture
Subdimension	**Public Services and Engagement**
Data Sources / Relevant Databases	Government Accessibility Compliance Databases WCAG Audit Tools (e.g., Axe, WAVE) City open-data portals tracking ICT access and usage Household and demographic surveys with digital access indicators Municipal dashboards monitoring accessibility compliance. Reports from international organizations like UN, ITU, and community organizations focused on digital empowerment.

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	6		
KPI Name	**Open Data and Civic Engagement**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of all eligible public sector datasets that are made available to the public in open, machine-readable formats without restrictions, in line with national or international open data standards. Percentage of eligible public sector data provided as open data.		
Rationale / Interpretation	Assesses the transparency and openness of government data-sharing practices. A higher percentage supports innovation, accountability, and public participation in governance by enabling access to information.		
Methodology	Calculate as Numerator: Number of eligible datasets released as open data Denominator: Total number of eligible datasets Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Open Data Barometer, Open Knowledge Foundation Global Open Data Index, OECD Digital Government Index.		
Source (s) / References	Open Data Barometer Open Government Partnership Guidelines OECD Digital Government Toolkit		
Data Sources / Relevant Databases	Government open data portals National statistics agencies Public sector repositories City open-data portals and APIs		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	7		
KPI Name	**Digital Civic Participation**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of the population that participates in official digital public sector engagement activities such as online policy consultations, surveys, participatory budgeting, or other e-participation platforms.		
Rationale / Interpretation	Measures the extent of civic involvement through digital channels, reflecting the effectiveness of online tools in enabling public input and fostering inclusive decision-making. Higher participation rates indicate stronger democratic engagement, greater inclusivity, and higher levels of trust in public institutions.		
Methodology	Calculate as Numerator: Number of individuals participating in digital public sector engagements Denominator: Total eligible population Multiply by 100		
Unit	Percentage (%)		
Benchmarking	UN E-Participation Index, OECD Digital Government Index, leading city-level civic engagement benchmarks.		
Source (s) / References	UN E-Government Survey – E-Participation Index OECD Digital Government Toolkit National Civic Engagement Strategies		
Data Sources / Relevant Databases	Official e-participation portals and platforms Ministry of Digital Government or civic engagement departments National statistics agencies City-level public engagement records		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	8		
KPI Name	**Digital Service Delivery and Adoption**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the proportion of total public service transactions (e.g., applications, renewals, payments) that are completed through digital channels. Percentage of public services transactions conducted digitally.		
Rationale / Interpretation	Measures the extent to which digital public services are being adopted, reflecting convenience, accessibility, and modernization of public service delivery.		
Methodology	Calculate as Numerator: Number of public service transactions conducted digitally Denominator: Total number of public service transactions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Target levels vary according to the city's digital readiness, sectoral context, and jurisdiction.		
Source (s) / References	E-government service portals, service usage statistics		
Data Sources / Relevant Databases	Government digital service records, public administration transaction logs The Global Urban Monitoring Framework (UN Habitat) and UN Global Digital Compact promote the use of such KPIs to measure modernization, accessibility, and convenience in digital public services, but specific numeric benchmarks may vary by local context and sector.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	9		
KPI Name	Open Data Usage		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the proportion of available open data sets that are accessed or downloaded by users over a defined time period. Percentage of open data sets downloaded.		
Rationale / Interpretation	Indicates the usefulness, accessibility, and public awareness of open data resources, supporting transparency and data-driven innovation.		
Methodology	Calculate as Numerator: Number of open data sets downloaded at least once during the period Denominator: Total number of open data sets available Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Varies depending on open data maturity.		
Source (s) / References	Open data portal analytics, open government data guidelines ITU / U4SSC, "Collection Methodology for Key Performance Indicators for Smart Sustainable Cities" and U4SSC verification reports/dashboards. Open Knowledge Foundation, Global Open Data Index		
Data Sources / Relevant Databases	National or city open data platforms, usage tracking tools UN Global Digital Compact supports commitments to open data, data governance and measurable targets that can inform national/city benchmarks. UN-Habitat: Global Urban Monitoring Framework (framework, indicators database and guidance) recommends use of open data and provides a harmonized urban monitoring approach that cities can map KPI targets against.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	10		
KPI Name	**Digital Participation in Policymaking**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the proportion of policies, strategies, or legislative proposals that integrate feedback or contributions received via digital engagement platforms. Percentage of public sector policies enhanced through digital public engagement.		
Rationale / Interpretation	Measures the integration of city inhabitants' input into policy development using digital tools, enhancing inclusivity, transparency, and responsiveness. Websites and digital services shall be developed and maintained in compliance with internationally recognized accessibility standards, specifically WCAG 2.0 and EN 301 549, ensuring inclusive access for all users, including persons with disabilities.		
Methodology	Calculate as Numerator: Number of policies informed or modified by digital public engagement Denominator: Total number of policies developed during the period Multiply by 100		
Unit	Percentage (%)		
Benchmarking	The UN E-government Survey and UN Habitat's Global Urban Monitoring Framework advocate increasing online participation and transparent policymaking, setting benchmarks based on inclusiveness and digital penetration. U4SSC KPIs for Smart Sustainable Cities include citizen engagement and e-government indicators that measure integration of ICT in public services and policy development, with references to international standards (ITU-T Y.4903).		
Source (s) / References	Government policy records, digital engagement reports. UN E-Government Survey. OECD: Implementing E-government in OECD Countries UN Habitat Global Urban Monitoring Framework U4SSC KPIs for Society and Culture (ITU-T Y.4903). Global Digital Compact (UN discussions on digital inclusion and participation).		
Data Sources / Relevant Databases	City e-consultation platforms, municipality policy tracking systems. UN databases: UN e-Government Development Index, SDG monitoring for inclusive institutions and participatory decision-making. E- Participation Index (EPI) (derived as a supplementary index to the United Nations E-Government Survey). UN Sustainable Development Goal (SDG) 16.7: "Ensure responsive, inclusive, participatory and representative decision-making at all levels".		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	11		
KPI Name	**Equity and Inclusivity in Digital Engagement**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of the total population, disaggregated by relevant demographic characteristics, including identified vulnerable groups (e.g., Age, Gender, Persons with Disabilities), who have participated in relevant public consultations through digital platforms. Participation is measured in alignment with principles of inclusivity, accessibility, and non-discrimination, ensuring that all stakeholders, particularly those at risk of marginalization, are meaningfully engaged in decision-making processes.		
Rationale / Interpretation	Measures inclusivity and fairness in digital public engagement, ensuring all community segments have a voice in policy development. Websites and digital services shall be developed and maintained in compliance with internationally recognized accessibility standards, specifically WCAG 2.0 and EN 301 549, ensuring inclusive access for all users, including persons with disabilities.		
Methodology	Calculate as Numerator: Number of participants from total population and vulnerable groups in consultations Denominator: Total number of city inhabitants and vulnerable groups invited Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks depend on context but aim for proportional representation aligned with population demographics. International sources tracking Internet/ digital usage, inclusivity statistics, and data on vulnerable group participation in policy consultations (e.g., UNDP, ITU).		
Source (s) / References	Public consultation records, demographic statistics. UN E-Government Survey UN Habitat Global Urban Monitoring Framework U4SSC Key Performance Indicator reporting guidance (ITU-T Y.4903) National, city, or municipal digital consultation participation records, with demographic data referenced.		
Data Sources / Relevant Databases	City and municipal statistics offices, public consultation records and population demographic data. U4SSC and UN databases for monitoring digital equity, accessibility, and nondiscrimination in public engagement. UN Habitat's Global Urban Monitoring Framework and UN Sustainable Development Goals advocate for proportional and representative participation, especially of vulnerable groups, during public consultations via digital platforms.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	12		
KPI Name	**Satisfaction with Digital Public Services**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/impact
Definition / Description	Measures the proportion of surveyed users who report satisfaction with the quality, accessibility, and usability of digital public services. Percentage satisfaction of public with digital public services.		
Rationale / Interpretation	Reflects user experience and trust in digital public services, guiding service improvements. Websites and digital services shall be developed and maintained in compliance with internationally recognized accessibility standards, specifically WCAG 2.0 and EN 301 549, ensuring inclusive access for all users, including persons with disabilities.		
Methodology	Calculate as Numerator: Number of satisfied respondents Denominator: Total respondents surveyed Multiply by 100		
Unit	Percentage (%)		
Benchmarking	High-performing digital services typically target very high levels of user satisfaction. This depends on the city's readiness level. Benchmarks are grounded in measuring satisfaction regarding accessibility, usability, and quality, with feedback used internationally to refine services and align with Sustainable Development Goals (SDGs).		
Source (s) / References	User satisfaction surveys, feedback platforms. UN E-Government Survey 2024 (United Nations DESA) U4SSC KPIs for Smart Sustainable Cities (ITU-T Y.4903 supported by 17+ UN agencies) Global and local government user satisfaction survey results, as compiled and benchmarked by international case studies.		
Data Sources / Relevant Databases	National and citywide digital public service user satisfaction surveys Feedback collection platforms operated by public sector agencies U4SSC monitoring and reporting hubs, and local government smart city assessment portals		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	13		
KPI Name	**Sustainability Benefits**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the observed change in greenhouse gas (GHG) emissions associated with the shift from physical to digital delivery of public services. The indicator provides a correlational assessment of potential environmental benefits associated with digital service delivery, rather than attributing all observed changes in emissions to digitalization.		
Rationale / Interpretation	Assesses the potential environmental benefits associated with digital transformation by examining changes in GHG emissions linked to the delivery of public services. Results should be interpreted as correlational unless a robust attribution methodology is applied. Changes in emissions may also be influenced by external factors such as economic activity, population changes, energy sources, transport patterns, weather conditions, and changes in service demand. Note: An observed reduction in GHG emissions should not be interpreted as being caused solely by digitalization. Economic conditions, weather patterns, energy mix, transport behaviour, population changes, and other external factors may contribute to changes in emissions.		
Methodology	Calculate as Numerator: Total GHG emissions prior to the shift to digital service delivery – Total GHG emissions after the shift to digital service delivery (metric tons CO_2 equivalent (tCO_2e)). Denominator: Total GHG emissions prior to the shift to digital service delivery (metric tons CO_2 equivalent (tCO_2e)). Multiply by 100 Compare GHG emissions associated with the delivery of the relevant public service before and after the shift to digital delivery, using comparable periods, service volumes and system boundaries where possible. Document material external factors that may have influenced the observed change. Where sufficient data are available, adjustments or comparisons should be made to account for major external influences.		
Unit	Percentage (%)		
Benchmarking	Targets vary by context and should align with national or local climate and sustainability commitments. Results should be compared across comparable periods and service volumes where possible.		
Source (s) / References	Environmental impact assessments, sustainability reports, GHG accounting guidance, and studies assessing the environmental effects of digital public service delivery.		
Data Sources / Relevant Databases	Transport data, public service delivery statistics, service usage data, energy consumption data where available, and recognized emissions-factor databases.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	14		
KPI Name	**Inclusive Access to Digital Public Services**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the share of surveyed individuals from general and vulnerable populations satisfied with how accessible digital public services are to them. Percentage satisfaction of population / vulnerable groups (e.g., Age, Gender, Persons with Disabilities) with the accessibility of digital public services.		
Rationale / Interpretation	Assesses if digital services meet diverse needs and comply with accessibility standards. Websites and digital services shall be developed and maintained in compliance with internationally recognized accessibility standards, specifically WCAG 2.0 and EN 301 549, ensuring inclusive access for all users, including persons with disabilities.		
Methodology	Calculate as Numerator: Number of satisfied respondents Denominator: Total respondents surveyed Multiply by 100 Websites and services should be accessible following WCAG 2.0 and EN301549		
Unit	Percentage (%)		
Benchmarking	Higher satisfaction rates indicate better inclusivity; targets should strive for parity with general population satisfaction. Global frameworks such as U4SSC's KPI Collection Methodology use similar indexes to evaluate inclusivity and accessibility of digital public services in smart sustainable cities. UN Habitat's Global Urban Monitoring Framework emphasizes inclusive digital access as critical for urban development and societal inclusion. The Global Digital Compact highlights access and inclusivity as fundamental digital rights and benchmarks. All digital services and products should follow EN301549. https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.02.01_60/en_301549v030201p.pdf		
Source (s) / References	Accessibility audits from specialized organizations or according to (WCAG) and other standards. User satisfaction surveys segmented by demographics and vulnerabilities. Reports and methodologies from U4SSC on smart city KPIs. UN Habitat reports on urban inclusiveness and digital public service accessibility Global Digital Compact documents outlining digital equity and inclusion goals International accessibility evaluation frameworks and indexes like the Government Services Index or digital inclusion indices linking satisfaction and accessibility.		

Dimension	Society and Culture
Subdimension	**Public Services and Engagement**
Data Sources / Relevant Databases	Survey responses specifically gathered from both general and vulnerable populations measuring satisfaction with digital services. Accessibility compliance reports from audits checking adherence to accessibility standards.

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	15		
KPI Name	**Open Data Usage in Policy and Research**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the share of open data sets officially accessed and used in government decision-making processes and academic studies. Percentage of open data sets used in decision making and academic research.		
Rationale / Interpretation	Measures the practical impact and integration of open data into policy and research activities.		
Methodology	Calculate as Numerator: Number of open data sets cited or used in decisions and research Denominator: Total open data sets published Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Higher usage indicates stronger open data ecosystem maturity. Municipality or government reports on open data usage and reuse.		
Source (s) / References	Municipality reports, academic publications, data platform usage logs. Academic publications and research studies citing open data sets. Usage logs from open data platforms and repositories. Notable references include data.europa.eu reports, OECD Government at a Glance 2025 reports, and UNDP reports on open government data. The OECD's OURdata Index provides indicators of open data availability, accessibility, and government support for data reuse, which reflect ecosystem maturity and practical usage.		
Data Sources / Relevant Databases	Open data repositories from governments and municipalities Research databases and citation indexes tracking usage of datasets Platform usage logs and audit reports from open data portals		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	16		
KPI Name	**Satisfaction with Open Data**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the proportion of users expressing satisfaction regarding the availability, quality, and usefulness of open data. Percentage satisfaction of users with open data.		
Rationale / Interpretation	Reflects how well open data services meet user needs, influencing ongoing improvements		
Methodology	Calculate as Numerator: Number of users who report being satisfied or very satisfied with the availability, quality and usefulness of open data. Denominator: Total number of users providing a valid satisfaction response Multiply by 100		
Unit	Percentage (%)		
Benchmarking	International studies, such as those compared in academic reviews (OECD, Open Data Barometer, Global Open Data Index, ODIN), note the variance but typically highlight benchmarks above 80% for open data satisfaction as a sign of robustness in meeting user needs.		
Source (s) / References	Open data user surveys, platform feedback mechanisms, and stakeholder interviews are core methods for evaluating satisfaction. Reports and methodologies from organizations like U4SSC, ITU, UNECE, OECD, and UN Habitat provide authoritative references for both data collection and establishing benchmarks for satisfaction with open data services.		
Data Sources / Relevant Databases	Survey tools, open data platform feedback Survey tools (e.g., Open Data Kit, online self-filling, face-to-face, and telephone interviews) and open data platform feedback channels are commonly cited as best practices in major reports and frameworks.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	17		
KPI Name	**Involvement in Public Sector Investment Decisions**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of digital transformation investment expenditure that was subject to documented public engagement or participatory decision-making. The KPI captures the extent to which public input is incorporated into decisions concerning investments in digital transformation and public digital services.		
Rationale / Interpretation	Indicates the level of transparency, openness and public participation in digital investment decisions. Higher levels of participation demonstrate stronger mechanisms for incorporating citizen and stakeholder perspectives into public-sector digital investment planning.		
Methodology	Calculate as Numerator: Amount of the digital transformation investment budget allocated to initiatives or investments that were subject to a documented public engagement or participatory decision-making process. Denominator: Total digital transformation investment budget for the reporting period Multiply by 100		
Unit	Percentage (%)		
Benchmarking	No universal target is prescribed. Higher and increasing proportions indicate stronger public participation in digital investment decisions. Cities should benchmark performance against comparable cities, national practices and their own performance over time, supported by documented engagement and financial records.		
Source (s) / References	City budget reports, digital transformation investment plans, public consultation records, participatory budgeting records, stakeholder engagement reports and documented investment decision processes. Relevant international frameworks and guidance from organizations such as the World Bank, OECD, European Commission, UN-Habitat, UN and U4SSC can provide supporting principles and approaches for assessing public participation and digital governance.		
Data Sources / Relevant Databases	City budget documents, digital transformation investment records, public consultation summaries, participatory budgeting records, stakeholder engagement reports and municipal financial management systems. Cities may use existing budgetary and engagement records, avoiding the need for a separate data collection system. Regular monitoring can support progressive improvement in the breadth and effectiveness of public participation. The duration and accessibility of consultation periods may be considered as supporting contextual information, but should not by themselves constitute evidence of participation in an investment decision.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	18		
KPI Name	**Public Trust in Digital Governance**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of surveyed residents who express trust in digital public services and digital government systems, based on a defined and representative survey.		
Rationale / Interpretation	Trust is a key enabler of adoption and effective use of digital government services. Higher trust indicates stronger legitimacy, usability, and confidence in digital governance systems.		
Methodology	Calculate as Numerator: Number of valid respondents expressing trust in digital public services and digital government systems. Denominator: Total number of valid respondents providing a trust response. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarking should use national or regional reference values, comparable cities and trends over time. International survey frameworks from organizations such as the OECD, European Commission and UN may support comparative assessment. Higher levels of trust and sustained improvement indicate stronger performance.		
Source (s) / References	Public opinion surveys, trust barometers The main references for tracking trust benchmarks are national surveys (such as Eurobarometer, World Values Survey), public opinion polling, and specialized digital trust barometers maintained by governments and international bodies. Comparative studies like the eGovernment Benchmark (EU) and OECD reports monitor trust levels and include periodic cross-national surveys as their core data source. UN frameworks (e.g., UN Habitat, Global Urban Monitoring) also advocate using large-scale national or city-level polling results and ongoing feedback mechanisms.		
Data Sources / Relevant Databases	National surveys, polling data. National or city polling data and public opinion surveys are the primary databases; regional and international benchmarking projects (like OECD, UN, EU) often aggregate these results for global comparisons.		

Dimension	Society and Culture		
Subdimension	**Public Services and Engagement**		
KPI No	19		
KPI Name	**Evidence-Based Policymaking**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of city-level policies that are supported by or explicitly cite publicly available data sources in their development.		
Rationale / Interpretation	Indicates the extent to which policymaking is data-driven and transparent. A higher percentage reflects stronger integration of evidence in decision-making processes and improved policy quality and accountability.		
Methodology	Calculate as Numerator: Number of policies supported by or citing publicly available data sources Denominator: Total number of policies developed Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Continuous improvement is expected. Cities are encouraged to increase the percentage of policies citing or using public data sources continuously. Best practice aims at integrating evidence in the majority of city policies, recognizing incremental progress due to challenges in data availability and capacity. The UNECE Guidelines on Evidence-Based Policies highlight the importance of rigorous data collection, coordinated data use, and integrating evidence through all policy stages.		
Source (s) / References	The primary data sources are policy documents citing publicly available data, city transparency reports, open data platforms, and policy databases that track documented evidence use in policymaking.		
Data Sources / Relevant Databases	Policy databases, open data platforms		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	20		
KPI Name	**Digital Health Services Availability**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of defined healthcare services that are available through digital channels within the healthcare system. Digital services may include teleconsultations, digital diagnostics, electronic prescriptions, online appointment booking, and access to health information.		
Rationale / Interpretation	Indicates the extent to which healthcare systems have modernized service delivery through digital channels. Higher values reflect improved accessibility, efficiency, and patient-centered care, aligned with WHO Digital Health Strategy and SDG 3.8.		
Methodology	Calculate as Numerator: Number of defined digitally applicable healthcare services available through digital channels. Denominator: Total number of defined digitally applicable healthcare services within the established service catalogue. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary by national digital health maturity and infrastructure capacity. Countries typically adopt progressive targets based on national digital health strategies rather than fixed global thresholds.		
Source (s) / References	Healthcare system reports, digital health registries United for Smart Sustainable Cities (U4SSC) and the UN Habitat Global Urban Monitoring Framework reference KPIs under society and culture for health, including electronic health records and other digital health infrastructure as advanced or core indicators.		
Data Sources / Relevant Databases	WHO Global Digital Health Monitor WHO Guideline Recommendations on Digital Interventions for Health System Strengthening Service Availability and Readiness Assessment (SARA) reports U4SSC KPI Collection Methodology National Health Information Systems Digital Health Strategy Documents		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	21		
KPI Name	**Electronic Health Records**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of healthcare institutions (hospitals and clinics) that have implemented and actively use electronic health record (EHR) systems to store, manage, and share patient information. EHR systems support recording of patient visits, diagnoses, prescriptions, and enable interoperability with other health information systems.		
Rationale / Interpretation	Indicates the level of digital infrastructure adoption in the healthcare system. Higher EHR adoption improves care coordination, data quality, efficiency, and supports better patient outcomes in line with the WHO Global Strategy on Digital Health.		
Methodology	Calculate as Numerator: Number of healthcare institutions with operational EHR systems Denominator: Total number of healthcare institutions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary by national digital health maturity and healthcare infrastructure. Countries typically adopt phased targets for EHR rollout across hospitals and primary care facilities.		
Source (s) / References	National Health Information Systems (HIS), WHO Service Availability and Readiness Assessment (SARA), health facility surveys and audits, OECD health IT reports, and digital health infrastructure assessments.		
Data Sources / Relevant Databases	WHO Service Availability and Readiness Assessment (SARA) National Health Information Systems (HIS) Health facility surveys and audits		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	22		
KPI Name	**Tele-Health Adoption and Utilization**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of healthcare institutions that provide and actively use telehealth services as part of routine healthcare delivery. Telehealth includes virtual consultations, remote monitoring, tele-radiology, and tele-mental health services.		
Rationale / Interpretation	Telehealth improves access to healthcare services, particularly for remote, underserved, and vulnerable populations. It enhances system resilience, service continuity, and efficiency, supporting WHO Digital Health Strategy and SDG 3.8 (Universal Health Coverage). Reflects a health system's digital readiness, resilience, and ability to maintain continuity of care during disruptions (e.g., pandemics).		
Methodology	Calculate as Numerator: Number of healthcare institutions that offer and actively use telehealth services Denominator: Total number of healthcare institutions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary depending on national infrastructure, regulation, and digital maturity. Countries typically set progressive targets for telehealth expansion, with higher adoption expected in urban and tertiary healthcare facilities.		
Source (s) / References	Healthcare surveys, telemedicine usage reports		
Data Sources / Relevant Databases	National Health Information Systems (HIS), telehealth platform usage logs, facility-level service reports, WHO Global Digital Health Monitor (GDHM), healthcare surveys, and provider/patient engagement studies. Facility-level tele-health usage reports. Surveys on provider and patient tele-health engagement. The World Bank's Living Standards Measurement Study (LSMS) conducted High-Frequency Phone Surveys (HFPS) across multiple low- and middle-income countries to track the socio-economic impacts of COVID-19. Insights on COVID-19 Telemedicine experiences.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	23		
KPI Name	**Public Access to Electronic Health Records**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of individuals with secure online access to their electronic health records (EHR), including medical history, prescriptions, lab results, and immunization records.		
Rationale / Interpretation	Enhances patient empowerment, transparency, and engagement in healthcare decisions. Supports WHO Digital Health Strategy and contributes to SDG 3.8 by improving access to essential health information and services.		
Methodology	Calculate as Numerator: Number of individuals with secure access to their electronic health records Denominator: Total number of registered patients (or total population, if national EHR coverage is defined as universal). Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary by national digital health maturity, privacy regulations, and infrastructure capacity. Countries typically set progressive targets in national digital health strategies.		
Source (s) / References	Population health surveys, health IT infrastructure reports. The KPI can be calculated from anonymized administrative statistics or survey responses.		
Data Sources / Relevant Databases	National Health Information Systems (HIS) Facility-level EHR usage logs Patient surveys and digital health portals analytics WHO Global Digital Health Monitor (GDHM)		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	24		
KPI Name	**Digital Transformation in Healthcare Institutions**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Percentage of healthcare institutions (hospitals and clinics) offering digital services. Measures the extent to which healthcare institutions have adopted and integrated digital technologies across their services, including electronic health records (EHRs), tele-health platforms, digital diagnostics, health information systems, and administrative automation.		
Rationale / Interpretation	Indicates the level of digital adoption in healthcare systems and reflects readiness to deliver more efficient, accessible, and resilient healthcare services. Supports WHO Digital Health Strategy and contributes to SDG 3.8 (Universal Health Coverage).		
Methodology	Calculate as Numerator: Number of healthcare institutions offering at least one digital service Denominator: Total number of healthcare institutions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary according to national healthcare system maturity and digital transformation readiness. Rather than fixed global thresholds, performance should be assessed using progressive improvement targets over time. Cities are encouraged to set incremental targets aligned with national digital health strategies.		
Source (s) / References	Healthcare institution reports, digital transformation assessments		
Data Sources / Relevant Databases	Facility-level Digital Health Assessments. WHO Service Availability and Readiness Assessment (SARA). National Health Information Systems (HIS). Staff training and capacity reports. Information can be collected through facility assessments, health information systems or institutional surveys.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	25		
KPI Name	**Digital Assistive Living**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of households of vulnerable or at-risk individuals equipped with digital infrastructure and assistive technologies that support independent living. Assistive technologies may include smart home systems, remote monitoring devices, emergency alert systems, and accessibility-enabled digital tools.		
Rationale / Interpretation	Supports social inclusion, independence, and quality of life for vulnerable populations, including older persons and persons with disabilities. Aligns with global principles on accessibility, digital inclusion, and equitable access to technology.		
Methodology	Calculate as Numerator: Number of vulnerable or at-risk households equipped with digital assistive technologies. Denominator: Total number of vulnerable or at-risk households Multiply by 100		
Unit	Percentage (%)		
Benchmarking	This is an emerging indicator with no established global benchmarks. Targets vary depending on national social care policies, disability inclusion strategies, and digital accessibility frameworks. Countries typically adopt progressive expansion targets to increase coverage of assistive technologies among vulnerable populations.		
Source (s) / References	Social service and health agency records, assistive technology registries, relevant policy documents. WHO's Rapid Assistive Technology Assessment (rATA) tool is an important validated methodology for assessing needs, usage, and barriers in populations.		
Data Sources / Relevant Databases	Social care databases, assistive device installation logs, national disability registries, ICT household surveys. Information on vulnerable populations on Chapter 2.5: Idenifying and engaging high-risk groups in disaster research in the WHO Guidance on Research Methods for Health Emergency and Disaster Risk Management, revised in 2022.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	26		
KPI Name	**Teleconsultation Utilization Rate**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of total patient consultations conducted through teleconsultation platforms, including video, audio, and text-based consultations across all levels of care.		
Rationale / Interpretation	Indicates the extent to which telehealth services are being used within the healthcare system. Higher utilization reflects improved access to care, service efficiency, and continuity of care, particularly for remote and underserved populations. Supports WHO Digital Health Strategy and SDG 3.8.		
Methodology	Calculate as Numerator: Number of teleconsultations Denominator: Total number of consultations (in-person + teleconsultations) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark ranges vary depending on healthcare system maturity, regulatory environment, and digital readiness. In literature, teleconsultations typically represent a smaller share of total consultations in normal conditions, increasing significantly during public health emergencies or in highly digitized health systems.		
Source (s) / References	Health service records, telehealth usage data		
Data Sources / Relevant Databases	Health facility teleconsultation logs National Health Information Systems (HIS) Tele-health platform usage analytics Hospital consultation databases The World Bank's Living Standards Measurement Study (LSMS) conducted High-Frequency Phone Surveys (HFPS) across muliple low- and middle-income countries to track the socio-economic impacts of COVID-19. COVID-19 Telemedicine experiences from HFPS Data.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	27		
KPI Name	**Telemedicine Usage by Patients**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of patients who have used telemedicine services (video, audio, or text-based consultations) at least once within a defined period, relative to the total patient population served.		
Rationale / Interpretation	Indicates patient adoption and acceptance of telemedicine services. Higher usage reflects improved accessibility, convenience, and inclusiveness of healthcare delivery, particularly for remote and underserved populations. Supports WHO Digital Health Strategy and SDG 3.8.		
Methodology	Calculate as Numerator: Number of unique patients who used telemedicine services at least once during the reporting period. Denominator: Total number of patients served in the same period (or registered patients, if defined nationally. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary depending on digital health maturity, infrastructure, and regulatory environment. In more digitally advanced systems, patient telemedicine usage is expected to grow steadily, particularly for follow-up consultations and non-emergency care. No fixed global threshold is defined.		
Source (s) / References	Patient surveys, health provider records.		
Data Sources / Relevant Databases	Telemedicine platform usage logs National Health Information Systems (HIS) Patient surveys on telemedicine access and usage Facility reporting systems		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	28		
KPI Name	**Technological Coverage of Vulnerable Households**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the penetration rate of networked home environment sensors in households with vulnerable persons. A vulnerable household is officially registered with municipal social services as having at least one resident who is aged 75 years or older, or receives a disability benefit. A household is considered equipped if it contains at least two of the following sensors: Smoke detector/CO detector/Flood detector/Temperature/humidity meter/ Presence detector/CO_2 detector/Air Quality Index meter/VOC meter/PMx meter.		
Rationale / Interpretation	This indicator reflects the reach and effectiveness of policies and programmes deploying assistive technologies to enhance home safety and support independent living. Low coverage indicates gaps in technology deployment, leaving households reliant on informal monitoring by caregivers. An increasing penetration rate signals progress toward safer and more digitally enabled living environments for vulnerable populations.		
Methodology	Calculate as Numerator: Number of registered vulnerable households equipped with ≥2 sensors Denominator: Total number of registered vulnerable households Multiply by 100		
Unit	Percentage (%) of households		
Benchmarking	Currently, the trend of increasing sensor-equipped households is seen as a positive indicator. Specific targets vary by policy and locality specific targets should be set according to policy objectives (e.g., "Achieve 20% penetration by 2028"). Data should be stratified by city district, housing type (public vs. private), and vulnerability type (aged ≥75 vs. disability benefit).		
Source (s) / References	U4SSC Smart Sustainable City KPIs		
Data Sources / Relevant Databases	Municipal social and health service registries. Data from technology providers. Periodic sample surveys of populations receiving home care assistance. Data are subject to GDPR-compliant agreements. Information on vulnerable populations, Chapter 2.5: Idenifying and engaging high risk groups in disaster research in the WHO Guidance on Research Methods for Health Emergency and Disaster Risk Management, revised in 2022.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	29		
KPI Name	**Satisfaction with Digital Health Services**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of users who report satisfaction with digital health services based on their experience of usability, accessibility, responsiveness, and perceived effectiveness of care.		
Rationale / Interpretation	Reflects user experience, trust, and acceptance of digital health services. Higher satisfaction indicates that digital health systems are meeting patient needs and expectations, supporting improved uptake, inclusiveness, and equity in healthcare delivery.		
Methodology	Calculate as Numerator: Number of users reporting satisfaction with digital health services (e.g., satisfied or very satisfied in survey responses). Denominator: Total number of surveyed users of digital health services Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark levels vary depending on national healthcare quality, digital maturity, and user demographics. Many systems aim for high satisfaction levels. Results should be tracked over time and compared across population groups to assess equity and inclusiveness. Results should be disaggregated by age, gender, disability status, and socio-economic group to identify gaps in accessibility and service experience.		
Source (s) / References	U4SSC Smart Sustainable City KPIs WHO Digital Health Strategy Patient satisfaction surveys		
Data Sources / Relevant Databases	Patient satisfaction surveys National and local health service feedback systems Survey platforms and digital feedback tools		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	30		
KPI Name	**Telemedicine Experience and Satisfaction**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of users who report satisfaction with telemedicine services based on their experience of accessibility, technical performance, communication quality, and perceived effectiveness of care.		
Rationale / Interpretation	Indicates user experience, acceptance, and trust in telemedicine services. Higher satisfaction reflects effective, accessible, and patient-centered virtual care. Lower satisfaction highlights gaps in technology quality, connectivity, provider interaction, or service design. Supports WHO Digital Health Strategy and U4SSC principles of inclusive and high-quality digital services.		
Methodology	Calculate as Numerator: Number of users reporting satisfaction with telemedicine services (e.g., satisfied or very satisfied in surveys). Denominator: Total number of surveyed telemedicine users Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark levels vary depending on digital maturity, infrastructure quality, and user demographics. Performance should be monitored over time, with continuous improvement expected in mature digital health systems. No universal global threshold is defined. Results should be disaggregated by age, gender, digital literacy, socio-economic status, and type of telemedicine service to ensure inclusiveness and identify disparities.		
Source (s) / References	U4SSC Smart Sustainable City KPIs WHO Digital Health Strategy Telemedicine service quality guidelines		
Data Sources / Relevant Databases	Telemedicine service surveys User feedback platforms and reports National and local health service monitoring systems		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	31		
KPI Name	**Caregiver Well-being and Burden Reduction**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the average score reduction on the Zarit Burden Interview (ZBI) among caregivers in households where assistive sensors have been deployed. Assessed over a defined period (e.g., 12 months), this indicator reflects the extent to which smart technologies reduce caregiver stress and improve quality of life.		
Rationale / Interpretation	This indicator validates the effectiveness of sensor deployment programmes and other assistive technologies in supporting informal caregivers. A lower ZBI score indicates reduced caregiver burden and enhanced well-being. Tracking this KPI enables municipalities and health institutions to assess whether technology-driven interventions translate into tangible improvements in caregiver quality of life.		
Methodology	1. Define Cohort: Identify caregivers supporting vulnerable persons in households equipped with assistive sensors. 2. Baseline Measurement (T0): Administer ZBI at programme start to determine the initial average burden score. 3. Follow-up Measurement (T1): Re-administer ZBI after a defined interval (e.g., 12 months). 4. Calculate the average change in burden score across all participating caregivers. KPI Value = Average ZBI score at T0−Average ZBI score at T1		
Unit	Average change in Zarit Burden Interview (ZBI) score (numeric scale 0–88).		
Benchmarking	Higher positive values indicate greater reductions in caregiver burden and therefore better outcomes. A positive value (score reduction) represents a beneficial outcome. A ≥5 point average decrease over 12 months is considered a meaningful improvement, though targets may vary based on cohort and intervention scale. Statistical significance testing should be applied to confirm programme impact		
Source (s) / References	Comune di Castenaso: *Agenda Digitale Locale* (Digital Innovation Plan) Zarit SH, Zarit JM. *The Memory and Behavior Problems Checklist and the Burden Interview*. Gerontology Center, Penn State University, 1990. WHO guidelines on caregiver well-being and digital health interventions		
Data Sources / Relevant Databases	Longitudinal caregiver surveys (baseline and follow-up) administered by municipal health and social services. Clinical records and digital health platform usage data linked to sensor-enabled households.		

Dimension	Society and Culture		
Subdimension	**Health**		
KPI No	32		
KPI Name	**Autonomy and Independence in Assisted Living**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of vulnerable individuals (e.g., elderly, persons with disabilities, or those requiring assisted living) who maintain or improve functional independence over time. Independence is assessed through standardized tools (e.g., Activities of Daily Living [ADL], Instrumental Activities of Daily Living [IADL]) or through validated technology-supported monitoring systems.		
Rationale / Interpretation	Evaluates the effectiveness of assisted living services and digital supports in promoting self-sufficiency and reducing reliance on external care. Higher values indicate that vulnerable populations can sustain autonomy, thereby improving quality of life and reducing caregiver and institutional care burdens.		
Methodology	Calculate as Numerator: Number maintaining or improving functional status Denominator: Total vulnerable individuals assessed in a period of time Multiply by 100 1- Identify the target population. Define target group. Identify the cohort of vulnerable individuals living in assisted environments or monitored by digital health systems. 2- Baseline Measurement (T0): Assess functional independence using standardized ADL/IADL tools or technology-supported metrics. 3- Follow-up Measurement (T1): Calculate the percentage of individuals maintaining or improving functional independence after a predefined interval (e.g., 12 months).		
Unit	Percentage (%)		
Benchmarking	Higher percentages reflect more effective interventions. Benchmarks should be adjusted according to age profile, disability severity, care setting, and intervention type. The benchmarking of assisted living and long-term care models, particularly in relation to autonomy and independence, draws from several sources, with a focus on European and OECD reports.		
Source (s) / References	WHO: *World Report on Ageing and Health.* OECD: *Measuring Quality of Life in Long-Term Care* National health and social care assessment guidelines (ADL/IADL frameworks)		

Dimension	Society and Culture
Subdimension	**Health**
Data Sources / Relevant Databases	Health and social care functional assessment records (ADL/IADL) Digital monitoring platforms in assisted living facilities. Municipal or national health statistics databases. Informaton on vulnerable populatons, Chapter 2.5: Idenifying and engaging high risk groups in disaster research in the WHO Guidance on Research Methods for Health Emergency and Disaster Risk Management, revised in 2022.

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	33		
KPI Name	**Student Access to ICT Infrastructure**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of students with access to essential ICT infrastructure, including internet connectivity, digital learning platforms, and digital devices (e.g., computers, tablets, or equivalent). This KPI captures the baseline level of digital access necessary for participation in modern education.		
Rationale / Interpretation	Access to ICT infrastructure is a prerequisite for digital equity in education. A higher percentage reflects better preparedness of educational systems to deliver inclusive, technology-enabled learning. It also highlights gaps in access that may contribute to the digital divide among students.		
Methodology	Calculate as Numerator: Number of students with ICT access Denominator: Total number of students Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Targets should be adapted to the local context and level of digital development: Higher digital readiness: Very high levels of student access to ICT may be targeted Emerging digital readiness: Progressive targets may be established during the early phases of digital adoption. Targets may be aligned with UNESCO Education 2030 and SDG 4 (Quality Education) objectives on equitable access to technology and digital learning.		
Source (s) / References	UNESCO: ICT in Education Monitoring Framework OECD: Education at a Glance National Ministries of Education		
Data Sources / Relevant Databases	School ICT infrastructure surveys National education ministry databases Student household ICT access records Digital platform usage statistics		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	34		
KPI Name	**Digital Pedagogy and Educator Readiness**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of teachers who have completed training in ICT-integrated pedagogy and digital teaching methods, including the use of digital tools, online platforms, and technology-enabled instructional practices.		
Rationale / Interpretation	Indicates the readiness of educators to deliver technology-enabled learning. Higher values reflect stronger capacity to integrate digital tools into teaching, improving student engagement, learning outcomes, and reducing the digital divide. Supports UNESCO ICT Competency Framework for Teachers (ICT-CFT).		
Methodology	Calculate as Numerator: Number of teachers trained in ICT and digital pedagogy Denominator: Total number of teachers Multiply by 100		
Unit	Percentage (%)		
Benchmarking	High-performing education systems target very high levels of teacher training coverage Regional or local targets can be set progressively, particularly in developing contexts Alignment with UNESCO ICT Competency Framework for Teachers (ICT-CFT) is recommended		
Source (s) / References	UNESCO: ICT Competency Framework for Teachers National teacher training programme records OECD: Education at a Glance		
Data Sources / Relevant Databases	Education department teacher databases Training programme completion records Professional development monitoring systems		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	35		
KPI Name	**Adoption of Emerging Technologies in Education**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of educational institutions (schools, colleges, and universities) that have adopted at least one emerging technology to support teaching and learning processes. Emerging technologies may include artificial intelligence (AI), augmented/ virtual reality (AR/VR), digital twins, immersive learning environments, and other advanced education technologies as defined by national or institutional policy.		
Rationale / Interpretation	Indicates the innovation capacity and future-readiness of education systems. Higher adoption reflects stronger integration of next-generation learning tools, enhancing student engagement, experiential learning, and digital skills development. Low adoption may indicate gaps in infrastructure, funding, or educator readiness.		
Methodology	Calculate as Numerator: Number of educational institutions using at least one emerging technology in teaching or learning Denominator: Total number of educational institutions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary depending on national digital education strategies, infrastructure readiness, and institutional capacity. Countries are expected to show progressive increases in adoption over time, with higher penetration in higher education and urban institutions typically preceding wider school-level adoption.		
Source (s) / References	UNESCO: Trends in Digital Learning and Innovation OECD: Education Innovation Reports National education technology strategies		
Data Sources / Relevant Databases	Institutional surveys Technology adoption and innovation reports Ministry of Education digital learning records		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	36		
KPI Name	**Equitable Digital Access for Marginalized Learners**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of rural, disadvantaged, or marginalized students who have been provided with internet-enabled devices (e.g., laptops, tablets) to support access to digital learning platforms and resources.		
Rationale / Interpretation	This KPI reflects the effectiveness of equity-focused digital education initiatives. Higher percentages indicate that education systems are successfully bridging the digital divide and promoting inclusive learning opportunities for marginalized populations. Low percentages highlight gaps in policy implementation or resource allocation.		
Methodology	Calculate as Numerator: Number of marginalized students with devices Denominator: Total marginalized students Multiply by 100 Define Target Group: Identify students classified as rural, disadvantaged, or marginalized according to national or local criteria. Device Distribution Assessment: Determine the number of students who have received internet-enabled learning devices.		
Unit	Percentage (%)		
Benchmarking	High-priority indicator for equity-focused education programmes. Targets vary by region and institutional capacity. Benchmarks should be aligned with SDG 4 (Quality Education) and relevant national digital education and digital inclusion strategies, with emphasis on reducing disparities in access and adoption across regions and population groups.		
Source (s) / References	UNESCO: Digital Learning Equity Reports National Education Ministry Equity Programmes OECD: Education Equity and Inclusion Studies		
Data Sources / Relevant Databases	Device distribution programme records Student household surveys Education ministry enrollment and ICT access databases		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	37		
KPI Name	**Connectivity Infrastructure in Underserved Educational Settings**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of educational institutions (schools, colleges, and learning centers) that have access to reliable internet connectivity sufficient to support digital teaching and learning activities. Reliable connectivity refers to stable internet access that enables the use of online learning platforms, digital content, and communication tools for education delivery.		
Rationale / Interpretation	Reliable internet connectivity is a critical enabler for digital education. High connectivity percentages indicate that institutions can effectively deliver technology-enabled instruction and access online learning resources. Low connectivity signals infrastructure gaps that hinder digital learning, particularly in underserved or rural areas.		
Methodology	Calculate as Numerator: Number of educational institutions with reliable internet connectivity Denominator: Total number of educational institutions in the defined area Multiply by 100 Connectivity should be assessed based on nationally defined standards for "reliable internet," including minimum speed, stability, and availability thresholds suitable for digital learning.		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary by national infrastructure capacity and urban-rural distribution. Advanced systems aim for near-universal connectivity across educational institutions, while developing contexts adopt progressive improvement targets, prioritizing underserved and rural areas.		
Source (s) / References	National education infrastructure surveys OECD: Education at a Glance UNESCO: ICT in Education Monitoring Framework		
Data Sources / Relevant Databases	School infrastructure and ICT connectivity records. Ministry of Education infrastructure databases. National education infrastructure and ICT connectivity databases with disaggregated data on school connectivity. Reports from internet service providers detailing coverage and quality of connectivity. UN Habitat's Urban Indicators Database which includes urban digital infrastructure data Monitoring data supporting SDG localization efforts by UN Habitat and associated urban frameworks.		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	38		
KPI Name	**Digital Access and Learning Engagement**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of students who regularly use digital devices (such as laptops, tablets, or e-learning platforms) including adoption of AI learning agents for educational activities within a defined period. Regular engagement refers to consistent use (e.g., daily or weekly) of digital tools to support learning, assignments, or classroom activities.		
Rationale / Interpretation	Indicates the extent to which digital learning tools are actively integrated into student learning processes. Higher engagement reflects a strong digital learning culture and effective adoption of educational technology. Lower engagement may indicate gaps in digital literacy, access, or availability of appropriate learning content.		
Methodology	Calculate as Numerator: Number of students who regularly use digital devices for learning activities within the defined period. Denominator: Total number of students in the defined population Multiply by 100 Results should be disaggregated by grade level, region, gender, and socio-economic background to identify digital access and participation gaps.		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary depending on digital infrastructure, institutional capacity, and socio-economic context. Higher engagement levels are typically observed in digitally advanced education systems, with progressive targets applied in developing contexts. Continuous improvement is expected over time rather than reliance on fixed global thresholds. The UN Habitat UMF recommends a set of indicators aligned with SDG 11 (Sustainable Cities) and SDG 4 (Quality Education), focusing on urban infrastructure, inclusion, safety, resilience, and sustainability.		
Source (s) / References	UNESCO: Digital Learning Engagement Reports National education surveys OECD: Education at a Glance		
Data Sources / Relevant Databases	Learning management system usage data Student engagement surveys School ICT usage logs		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	39		
KPI Name	**Digital Content Consumption**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the average number of hours students spend accessing digital educational content through online learning platforms, e-learning tools, digital libraries, and other digital learning resources during a defined reporting period.		
Rationale / Interpretation	This KPI reflects student engagement and utilization of digital learning materials. Higher average hours indicate deeper engagement with digital content and potentially more effective integration of digital resources into learning. Low average hours may signal limited access, low motivation, or insufficient digital learning resources.		
Methodology	Calculate as Numerator: Total number of hours spent accessing digital educational content by students during the reporting period. Denominator: Total number of students during the same reporting period		
Unit	Average hours per student per reporting period		
Benchmarking	Benchmarks vary depending on curriculum design, digital learning policies, and the level of integration of digital education. Higher average usage generally indicates stronger engagement with digital learning resources, provided that usage contributes to educational outcomes. Results should be analyzed by grade level, subject area, gender, and socio-economic group to identify disparities in digital learning engagement and access. The benchmarking sources and references for connectivity infrastructure in underserved educational settings align with the UN Habitat Global Urban Monitoring Framework (UMF) and the Global Digital Compact perspectives.		
Source (s) / References	Learning platform analytics National or institutional digital education reports UNESCO: Digital Learning Engagement Studies		
Data Sources / Relevant Databases	Digital learning platforms and LMS analytics Student digital engagement surveys Education ministry digital learning records		

Dimension	Society and Culture		
Subdimension	**Education**		
KPI No	40		
KPI Name	**Digital Equity Index**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of students from underserved or vulnerable groups (e.g., rural learners, low-income students, refugees, and students with disabilities) who actively use digital educational content during a defined reporting period.		
Rationale / Interpretation	This KPI evaluates the extent of digital inclusion and equity in education. High values demonstrate that vulnerable groups are effectively integrated into digital learning ecosystems, while lower values may indicate barriers such as affordability, accessibility, or lack of inclusive design.		
Methodology	Calculate as Numerator: Number of underserved or vulnerable students actively using digital educational content during the reporting period. Denominator: Total number of underserved or vulnerable students Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarks vary depending on national digital inclusion policies, infrastructure availability, and baseline levels of digital access. Higher percentages indicate stronger digital inclusion and equitable access to digital learning opportunities. Results should be disaggregated by gender, disability status, geographic location, and socio-economic background to monitor disparities and support targeted interventions.		
Source (s) / References	Education equity and inclusion studies UNESCO and UNICEF reports on digital access OECD education equity frameworks		
Data Sources / Relevant Databases	Learning Management System (LMS) usage logs Student demographic databases National education statistics Student surveys on digital learning and inclusion UNESCO, UNICEF, and OECD reports on digital education and equity		

2 Environment Dimension

Dimension	Environment		
Subdimension	**City Resilience**		
KPI No	41		
KPI Name	**Environmental Sustainability and Urban Resilience**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city's geographic area covered by IoT-enabled monitoring and early warning systems capable of detecting and communicating natural or human-induced hazards, including floods, earthquakes, storms, heatwaves, and air pollution events. Percentage of city area covered by IoT based alert systems for early warning of disasters.		
Rationale / Interpretation	IoT-enabled early warning systems strengthen environmental sustainability and urban resilience by improving disaster preparedness, reducing vulnerability, and supporting timely emergency response. Higher coverage indicates greater adaptive capacity and protection of people, infrastructure, and the environment.		
Methodology	Calculate as Numerator: City area covered by IoT-based early warning systems (km^2) Denominator: Total city area (km^2) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark targets vary according to a city's disaster risk profile, geography, and infrastructure. Higher-risk cities should aim for extensive coverage of IoT-enabled early warning systems, particularly in vulnerable areas. International frameworks such as the UNDRR Sendai Framework, U4SSC, and ITU encourage progressive expansion of early warning coverage to strengthen disaster preparedness and urban resilience.		
Source (s) / References	United Nations Office for Disaster Risk Reduction (UNDRR) ITU-T Focus Group on Smart Sustainable Cities U4SSC KPIs for Smart Sustainable Cities Sendai Framework for Disaster Risk Reduction 2015–2030		
Data Sources / Relevant Databases	City disaster management agency records Municipal GIS databases IoT monitoring system operators National meteorological and seismological agencies Environmental monitoring agencies Public safety authorities UN-Habitat urban monitoring databases		

Dimension	Environment		
Subdimension	**City Resilience**		
KPI No	42		
KPI Name	**AI and Big Data for Disaster Prediction**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of natural disasters and climate-related events within the city that are predicted in advance using AI-based models, big data analytics, and integrated alert platforms. Prediction is defined as the successful detection, recognition, or anticipation of such events with sufficient lead time for authorities to respond. Events may include, but are not limited to, floods, earthquakes, tsunamis, hurricanes, and wildfires.		
Rationale / Interpretation	AI and big data analytics enhance urban resilience by improving the accuracy and timeliness of disaster prediction. By integrating meteorological, geological, hydrological, environmental, satellite, and sensor data, these technologies enable proactive risk management and more effective emergency response. Higher values indicate stronger predictive capability and greater disaster preparedness, consistent with the Sendai Framework for Disaster Risk Reduction.		
Methodology	Calculate as Numerator: Number of natural disasters and climate-related events during the reporting period successfully predicted in advance by an AI-based prediction system, with sufficient lead time to enable an appropriate response. Denominator: Total number of natural disasters and climate-related events that occurred within the city during the reporting period and considered potentially predictable using available monitoring, modelling, or early-warning systems. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values depend on the city's hazard profile, availability of environmental data, and analytical capabilities. Higher prediction rates indicate more mature AI-enabled disaster risk management systems. Cities should aim for continuous improvement in prediction accuracy and lead time in line with national disaster risk reduction strategies and international frameworks such as the Sendai Framework, WMO Multi-Hazard Early Warning Systems, and U4SSC guidance.		
Source (s) / References	United Nations Office for Disaster Risk Reduction (UNDRR) World Meteorological Organization (WMO). ITU-T Focus Group on Smart Sustainable Cities U4SSC KPIs for Smart Sustainable Cities. Sendai Framework for Disaster Risk Reduction (2015–2030)		

Dimension	Environment
Subdimension	**City Resilience**
Data Sources / Relevant Databases	National meteorological, geological, and hydrological agencies. Municipal emergency management agencies. AI-enabled disaster prediction platforms. Remote sensing and satellite monitoring systems. Environmental sensor networks. WMO Global Multi-Hazard Alert System (GMAS) Best practices for National and Private early warning systems such as Wind Energy Management Tool and Wind Turbine Noise Metering.

Dimension	Environment		
Subdimension	**City Resilience**		
KPI No	43		
KPI Name	**IoT-Based Disaster Alert Systems**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of identified disaster risks for which IoT-based early warning systems successfully detect, process, and issue timely alerts to relevant authorities and/or the public. Disaster risks may include floods, earthquakes, storms, heatwaves, wildfires, landslides, and other natural or human-induced hazards.		
Rationale / Interpretation	IoT-based early warning systems improve disaster preparedness and urban resilience by enabling timely detection and communication of hazards. Higher values indicate more effective operational use of IoT technologies for disaster risk management and stronger capacity to protect people, infrastructure, and the environment. This KPI aligns with the Sendai Framework for Disaster Risk Reduction and U4SSC smart city principles.		
Methodology	Calculate as Numerator: Number of identified disaster risks for which IoT-based early warning systems successfully issued alerts during the reporting period. Denominator: Total number of identified disaster risks requiring early warning during the reporting period. Multiply by 100		
Unit	Percentage reduction (%) and/or average response time (minutes/hours)		
Benchmarking	Benchmark values depend on the city's disaster risk profile, IoT infrastructure, and monitoring capabilities. Higher percentages indicate more comprehensive operational coverage of IoT-based early warning systems. Cities should aim for continuous improvement in alert coverage and reliability in line with national disaster management strategies and international frameworks such as the Sendai Framework, U4SSC, ITU, and WMO.		
Source (s) / References	UNDRR World Bank – Disaster Risk Management reports ITU / U4SSC best practices Sendai Framework 2015–2030		
Data Sources / Relevant Databases	Municipal emergency management agency records National disaster management authorities IoT-based early warning system logs Public safety agencies (fire, police, civil defense, emergency medical services) Meteorological, geological, and environmental monitoring agencies Emergency operations and command centre records		

Dimension	Environment		
Subdimension	**City Resilience**		
KPI No	44		
KPI Name	**Disaster Response and Impact Reduction**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage reduction in the average disaster response time achieved associated with the use of digital technologies, resilient infrastructure, and coordinated emergency management systems. Disaster response time refers to the elapsed time between the occurrence or detection of a disaster and the initiation of effective emergency response actions by the relevant authorities.		
Rationale / Interpretation	Timely disaster response is essential for reducing casualties, minimizing economic losses, and protecting critical infrastructure. Digital technologies such as IoT-enabled early warning systems, AI-based prediction models, integrated communication platforms, and resilient urban infrastructure enable faster and more coordinated emergency response. Higher reductions in response time indicate stronger disaster preparedness and urban resilience.		
Methodology	Calculate as Numerator: Baseline average disaster response time – Current average disaster response time (after implementation of digital technologies) Denominator: Baseline average disaster response time Multiply by 100 Supplementary Indicator: Average disaster response time (minutes or hours)		
Unit	Percentage reduction (%), and/or Average response time (minutes/hours)		
Benchmarking	Benchmark values depend on the city's disaster risk profile, emergency management capacity, and level of digital maturity. Cities should demonstrate continuous reductions in disaster response time through investments in digital technologies and resilient infrastructure. International best practices emphasize timely emergency response rather than prescribing universal percentage targets.		
Source (s) / References	United Nations Office for Disaster Risk Reduction (UNDRR) ITU-T Focus Group on Smart Sustainable Cities. U4SSC KPIs for Smart Sustainable Cities Sendai Framework 2015–2030 World Bank Disaster Risk Management publications		
Data Sources / Relevant Databases	Municipal emergency management and disaster response records National disaster management and civil defense agencies Fire, police, and emergency medical service records IoT-based early warning systems and command-and-control platforms Emergency operations centre reports		

Dimension	Environment		
Subdimension	**Urban Planning**		
KPI No	45		
KPI Name	**Data-Driven Urban Governance**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of urban plans, strategies, and policies developed using quantitative and qualitative data analytics, evidence-based research, and digital insights derived from sources such as GIS, IoT sensors, big data analytics, citizen feedback platforms, and integrated urban dashboards.		
Rationale / Interpretation	Data-driven governance improves the quality, transparency, efficiency, and accountability of urban decision-making. Higher values indicate greater use of evidence and digital intelligence in planning and policymaking, supporting sustainable urban development and adaptive governance. This KPI aligns with SDG 11 (Sustainable Cities and Communities), SDG 16 (Peace, Justice and Strong Institutions), and international smart city governance frameworks.		
Methodology	Calculate as Numerator: Number of urban plans, strategies, or policies developed using documented data-driven insights. Denominator: Total number of urban plans, strategies, or policies developed during the reporting period. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to institutional digital maturity, data governance capacity, and planning practices. Higher percentages indicate greater integration of data and analytics into urban governance. Cities should demonstrate continuous improvement in the use of evidence-based planning, consistent with international guidance from U4SSC, UN-Habitat, OECD, and the Global Digital Compact.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities UN-Habitat – Data-Driven Urban Governance Guidelines ITU-T Focus Group on Smart Sustainable Cities OECD Smart Cities Governance Publications. SDG 11 and SDG 16 targets		
Data Sources / Relevant Databases	Municipal urban planning and policy repositories GIS and spatial planning databases IoT platforms and integrated urban dashboards Citizen engagement and e-governance platforms National statistical offices Urban development authorities		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	46		
KPI Name	**Environmental Monitoring and Public Health**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city's geographic area covered by operational IoT-enabled air quality monitoring and alert systems capable of detecting and reporting real-time pollutant levels, including PM2.5, PM10, NO_2, CO, O_3, and other harmful gases. Coverage refers to areas where sensors reliably generate and transmit air quality data for public health monitoring and early warning.		
Rationale / Interpretation	IoT-based environmental monitoring supports evidence-based urban management, public health protection, and early warning of hazardous air conditions. Higher coverage indicates stronger capacity for real-time environmental surveillance, regulatory compliance, and climate-resilient urban governance.and respond to pollution events, aligning with SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action). This KPI also supports urban resilience, smart city initiatives, and regulatory compliance for environmental standards.		
Methodology	Calculate as Numerator: Geographic area (km^2) covered by operational IoT air quality monitoring sensors capable of real-time data reporting. Denominator: Total city geographic area (km^2) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary based on urban density, pollution risk levels, and national environmental monitoring capacity. Higher coverage reflects stronger environmental surveillance systems. Cities are encouraged to progressively expand monitoring coverage, particularly in high-risk and densely populated areas, in line with U4SSC, WHO Air Quality Guidelines, and national environmental standards.		
Source (s) / References	World Health Organization (WHO) – Air Quality Guidelines. U4SSC KPIs for Smart Sustainable Cities. ITU-T Focus Group on Smart Sustainable Cities. UN-Habitat – Urban Environment Monitoring Guidelines. SDG 3, SDG 11, SDG 13 targets		
Data Sources / Relevant Databases	Municipal environmental monitoring and public health agencies. IoT sensor networks and smart city dashboards. Satellite and remote sensing air quality data (where applicable) National environmental protection and meteorological agencies. Citizen-generated environmental monitoring platforms (e.g., low-cost sensors, mobile apps). World Health Organization (WHO) – Air Quality Guidelines.		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	47		
KPI Name	**Smart Energy and Grid Management**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of renewable energy generation infrastructure (solar, wind, biomass, etc.) within the city that is monitored using smart meters and IoT sensors integrated with AI-based forecasting systems for real-time monitoring of energy production, consumption, and grid performance.		
Rationale / Interpretation	Smart energy systems improve sustainability, resilience, and efficiency by integrating IoT-enabled monitoring with AI-based forecasting. This enables optimized renewable energy integration, reduced emissions, and improved grid stability. Higher coverage indicates stronger capability for intelligent energy management and supports climate and energy transition goals under SDG 7, SDG 11, and SDG 13.		
Methodology	Calculate as Numerator: Installed renewable energy capacity (or production units) monitored by smart meters and IoT systems integrated with AI forecasting. Denominator: Total renewable energy capacity (or production) within city boundaries Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary depending on renewable energy penetration, grid maturity, and national energy transition strategies. Higher coverage reflects stronger smart grid capability and renewable integration. Cities should progressively expand monitoring coverage in line with international guidance from the IEA, U4SSC, ITU, and national energy transition frameworks. Benchmarks, sources, and data recommendations supported across the U4SSC framework, ITU reports, IEA guidelines, UN-Habitat's Global Urban Monitoring Framework, and global digital standards efforts such as the UN Global Digital Compact.		
Source (s) / References	International Energy Agency (IEA): Smart Energy Systems Reports. U4SSC KPIs for Smart Sustainable Cities. ITU-T Focus Group on Smart Sustainable Cities. UN-Habitat: Sustainable Energy in Cities Guidelines. SDG 7, SDG 11, SDG 13 targets		
Data Sources / Relevant Databases	Smart meters and IoT sensor networks in renewable energy infrastructure Municipal energy management and utility companies. AI forecasting platforms and energy dashboards. National energy agencies and grid operators. GIS data on renewable energy facilities and urban grid maps		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	48		
KPI Name	**Urban Noise Management**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city's geographic area covered by operational digital systems for urban noise monitoring, including smart sensors, mobile reporting applications, alert systems, and GIS-based mapping tools that record and visualize noise pollution levels.		
Rationale / Interpretation	Urban noise monitoring supports public health, environmental quality, and urban livability. Higher coverage indicates stronger capacity to detect, map, and manage noise pollution using digital technologies, enabling evidence-based urban planning and enforcement of environmental regulations. This KPI aligns with SDG 3 (Good Health and Well-Being), SDG 11 (Sustainable Cities and Communities), and international smart city environmental monitoring frameworks.		
Methodology	Calculate as Numerator: Geographic area (km^2) where noise levels are actively monitored through fixed IoT sensors and GIS-integrated noise mapping systems capable of continuous or frequent data collection. Denominator: Total city geographic area (km^2) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values depend on urban density, land use patterns, and environmental monitoring maturity. Higher coverage reflects stronger urban environmental sensing capacity. Cities should progressively expand monitoring networks, particularly in high-density and high-risk noise zones, in line with WHO Environmental Noise Guidelines, U4SSC smart city frameworks, and national environmental standards.		
Source (s) / References	World Health Organization (WHO) – Environmental Noise Guidelines U4SSC KPIs for Smart Sustainable Cities. ITU-T Focus Group on Smart Sustainable Cities SDG 3 and SDG 11 indicators. National environmental protection and urban planning authorities.		
Data Sources / Relevant Databases	Municipal environmental monitoring agencies and noise sensor networks Mobile app analytics and user data from noise reporting platforms. GIS and smart city dashboards with noise mapping. National and local environmental monitoring databases.		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	49		
KPI Name	**Water Quality**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city's water bodies, distribution networks, and critical water infrastructure that is monitored using IoT-enabled sensors and alert systems providing real-time data on water quality parameters such as pH, turbidity, dissolved oxygen, heavy metals, and microbial contamination for early warning and intervention.		
Rationale / Interpretation	IoT-based water quality monitoring enhances public health protection, environmental sustainability, and safe water management. Higher coverage enables early detection of contamination, real-time response, and improved water resource governance. This supports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), aligned with smart city environmental monitoring frameworks.		
Methodology	Calculate as Numerator: Number of designated water quality monitoring locations equipped with operational IoT-enabled sensors providing real-time or near-real-time data. Denominator: Total number of designated water quality monitoring locations within the city. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary depending on water system complexity, urban density, and national water governance capacity. Higher coverage indicates stronger real-time water quality monitoring capability. Cities should progressively expand monitoring coverage, particularly in drinking water supply networks and high-risk environmental zones, in line with WHO Water Quality Guidelines, U4SSC frameworks, and national water safety standards.		
Source (s) / References	World Health Organization (WHO) – Water Quality Guidelines U4SSC KPIs for Smart Sustainable Cities ITU-T Focus Group on Smart Sustainable Cities SDG 6, SDG 11 SDG 13 indicators National water and environmental protection authorities		
Data Sources / Relevant Databases	Municipal water utilities and water quality monitoring networks IoT sensor platforms integrated with smart city dashboards Environmental agencies and water resource authorities Remote sensing and real-time water quality monitoring systems		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	50		
KPI Name	**Circular Economy and Waste Reduction**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the total amount of electronic waste (e-waste) collected and properly processed per capita within the city, including materials recycled, recovered, or safely disposed of through certified facilities in accordance with national and international environmental standards.		
Rationale / Interpretation	Effective e-waste collection and processing reduce environmental pollution, prevents exposure to hazardous materials, and supports circular economy principles. Higher per capita values indicate stronger waste management systems, recycling capacity, and citizen participation. This KPI aligns with SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action).		
Methodology	Calculate as Numerator: Total mass (kg) of e-waste collected and processed through certified recycling, recovery, or environmentally sound disposal systems during the reporting period. Denominator: Total city population during the reporting period Total e-waste collected and properly processed (kg) ÷ Total city population		
Unit	kg per capita per year (kg/person/year)		
Benchmarking	Benchmark values vary depending on economic development level, consumer electronics usage, and regulatory enforcement. Higher values indicate more effective collection and recycling systems. Cities should aim for continuous improvement in e-waste recovery rates in line with national circular economy strategies, U4SSC guidance, and global e-waste monitoring reports.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities UN E-Waste Reports (including the 2024 edition) ITU-T Focus Group on Smart Sustainable Cities SDG 11, SDG 12, SDG 13 indicators. National waste management authorities and environmental agencies contribute to standards and data on e-waste management.		
Data Sources / Relevant Databases	Municipal waste management authorities Certified e-waste recycling facilities National environmental protection agencies Smart waste tracking systems (IoT-enabled logistics platforms) United Nations Environment Programme Global E-Waste Reports International Telecommunication Union U4SSC Smart City Framework		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	51		
KPI Name	**Real-Time Renewable Energy Monitoring**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of city-wide energy data systems that enable real-time monitoring of renewable energy generation and total energy consumption, including identification of peak and off-peak demand periods through smart grids, IoT sensors, and AI-based analytics platforms.		
Rationale / Interpretation	Real-time energy monitoring improves grid stability, enables demand-response management, and optimizes the integration of renewable energy sources. Higher adoption indicates stronger capacity for intelligent energy management, reduced energy losses, and improved sustainability performance. This KPI aligns with SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).		
Methodology	Calculate as Numerator: Number of city energy data systems or defined grid segments with operational real-time monitoring capabilities for both renewable energy generation and energy consumption, including identification of peak and off-peak demand periods. Denominator: Total number of city energy data systems or defined grid segments identified as relevant for real-time monitoring. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary depending on grid maturity, renewable penetration, and digital infrastructure readiness. Higher values indicate stronger real-time energy monitoring capability. Cities should progressively expand monitoring coverage to support smart grid optimization and renewable integration in line with IEA, U4SSC, and national energy transition strategies.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ITU Smart Sustainable Energy Framework IEA (International Energy Agency) Smart Grid Metrics. UN DESA Energy Data. National energy and sustainability reports. Clean Energy Transition Methodology.		
Data Sources / Relevant Databases	Municipal energy monitoring agencies National smart grid operators and utilities IoT-enabled energy monitoring platforms City energy dashboards and open data portals Private renewable energy providers		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	52		
KPI Name	**Change in Air Pollution**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the change in urban air quality levels over time based on internationally recognized pollutants, including PM2.5, PM10, NO_2, SO_2, and O_3, reflecting the effectiveness of city policies, technologies, and environmental interventions in improving air quality and public health.		
Rationale / Interpretation	Air pollution has significant impacts on human health, ecosystems, and climate change. Monitoring changes in air quality provides insight into the effectiveness of urban policies such as sustainable mobility, renewable energy adoption, green infrastructure, and emission control regulations. This KPI supports SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).		
Methodology	Calculate as Numerator: Baseline-year pollutant concentration – Current-year pollutant concentration Denominator: Baseline-year pollutant concentration Multiply by 100 The calculation should be performed separately for each pollutant (PM2.5, PM10, NO_2, SO_2 and O_3).		
Unit	Percentage reduction (%)		
Benchmarking	Benchmark values depend on baseline air quality conditions, urban density, and emission sources. Cities with severe pollution may experience higher initial reduction rates, while cleaner cities may show slower but steady improvements. Continuous reduction in pollutant concentrations in line with WHO Air Quality Guidelines indicates effective environmental management.		
Source (s) / References	World Health Organization (WHO) Global Air Quality Database and 2021 Air Quality Guidelines UNEP Air Quality and Health Reports U4SSC KPI Framework European Environment Agency (EEA) Air Quality Index National and municipal environmental agencies		
Data Sources / Relevant Databases	IoT-based urban air quality monitoring systems. Municipal environmental monitoring centers. Satellite-based air quality data (e.g., NASA, ESA). Public health and hospital records (for health impacts correlation). National meteorological and environmental databases. World Health Organization (WHO) Air Quality Guidelines.		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	53		
KPI Name	**Clean Energy Production**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the share of renewable energy production (solar, wind, hydro, geothermal, biomass) relative to total final energy consumption within the city, reflecting progress toward a sustainable energy transition and alignment with ISO 37120 and global climate goals.		
Rationale / Interpretation	The shift towards renewable energy is essential for climate change mitigation, air quality improvement, and long-term energy security. Monitoring the renewable share enables policymakers to evaluate the effectiveness of clean energy policies, investments, and urban planning measures. This KPI directly supports SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).		
Methodology	Calculate as Numerator: Total renewable energy generated within the city boundary during the reporting period (MWh). Denominator: Total final energy consumption within the city boundary during the reporting period (MWh). Multiply by 100		
Unit	Percentage (%)		
Benchmarking	ISO 37120: Renewable energy indicators provide a basis for assessing and comparing aspects of city-level energy performance. The EU has set a 2030 target of at least 42.5% renewable energy in gross final energy consumption, with an aspiration to reach 45%. Some cities may achieve renewable energy shares above 50%, depending on local resource availability, energy systems and policy frameworks. Continuous increases in renewable energy share are considered a key indicator of progress toward climate neutrality under SDG 7, SDG 11, and SDG 13.		
Source (s) / References	ISO 37120 Sustainable Cities Indicators UNSD SDG Indicators Database. International Renewable Energy Agency (IRENA) International Energy Agency (IEA) Statistics. U4SSC KPI Collection Methodology		
Data Sources / Relevant Databases	Municipal and national energy agencies. Utility companies and smart grid data. Renewable energy production monitoring platforms (IoT, AI forecasting tools). City energy balance reports. International datasets (IEA, IRENA, World Bank Energy Data). Clean Energy Transition Methodology		

Dimension	Environment		
Subdimension	**Environment and Sustainability**		
KPI No	54		
KPI Name	**Sustainable Last-Mile Logistics**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of urban population living within 500 meters walking distance of sustainable last-mile logistics infrastructure, including smart parcel lockers (including solar-powered units), pick-up/drop-off (PUDO) points, and automated parcel delivery facilities.		
Rationale / Interpretation	The growth of e-commerce increases the need for efficient and sustainable last-mile delivery systems. Access to shared parcel collection infrastructure reduces failed delivery attempts, traffic congestion, and carbon emissions, while improving logistics efficiency and urban livability. Higher values indicate better integration of sustainable logistics infrastructure into the urban environment and stronger support for sustainable urban development.		
Methodology	Calculate as Numerator: Population living within 500m walking distance of at least one sustainable last-mile logistics facility. Denominator: Total urban population. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarking can be conducted using international smart city, postal logistics, and urban accessibility frameworks. Cities with advanced e-commerce logistics systems typically aim to maximize population access to parcel collection infrastructure, especially in dense urban areas. Comparisons may be made across: • smart logistics and urban mobility programmes • postal infrastructure accessibility indices • sustainable urban freight distribution strategies Continuous improvement in spatial coverage is considered a best practice under SDG 9, SDG 11, SDG 12, and SDG 13.		
Source (s) / References	Universal Postal Union (UPU) – Integrated Index for Postal Development (2IPD) UPU Postal Solutions (OSCAR platform). UN-Habitat – Global Urban Monitoring Framework. OECD – Smart Cities and Urban Logistics Publications. Sustainable Development Goals (SDGs 7, 9, 11, 12, 13). International Post Corporation (IPC) – Sustainability Measurement and Management System (SMMS).		
Data Sources / Relevant Databases	Universal Postal Union. Integrated Index for Postal Development (2IPD). Measures the country's postal development level (PDL) based on the 2IPD score and International Post Corporation (IPC Sustainability Measurement and Management System Reports (SMMS). Municipal GIS databases		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	55		
KPI Name	**Smart Grid Infrastructure and Control**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of critical electrical grid infrastructure, including transformers, substations, distribution lines, and smart meters, that can be remotely monitored, automated, or controlled using smart grid technologies. Effective control includes real-time monitoring, fault detection, demand-response management, load optimization, and the integration of renewable energy sources.		
Rationale / Interpretation	Smart grid technologies improve the reliability, efficiency, resilience, and sustainability of electricity networks. Higher values indicate greater digitalization and operational control of the electrical grid, enabling real-time monitoring, faster fault detection, demand-response management, and improved integration of renewable energy sources. This KPI supports SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), and aligns with the U4SSC Smart Sustainable Cities framework.		
Methodology	Calculate as Numerator: Number of critical electrical grid assets that can be remotely monitored or controlled through smart grid technologies. Denominator: Total number of critical electrical grid assets Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to the maturity of electricity infrastructure, investment in smart grid technologies, and national energy transition strategies. Higher percentages indicate greater digitalization and operational capability of the electrical grid.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ITU-T Focus Group on Smart Sustainable Cities. IEEE Smart Grid Standards. ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life. SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action)		
Data Sources / Relevant Databases	Smart grid operators and electricity utility companies City energy management and SCADA systems IoT sensor and smart meter deployment databases. National electrical grid asset registries. Real-time energy management dashboards and monitoring platforms.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	56		
KPI Name	**Smart Buildings**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of commercial and public buildings within the city equipped with IoT-enabled technologies for monitoring and managing energy consumption, heating, ventilation and air conditioning (HVAC), lighting, indoor climate, and water usage. These technologies are typically integrated through Building Automation Systems (BAS), including smart thermostats, automated lighting, energy meters, HVAC controllers, and water management systems.		
Rationale / Interpretation	IoT-enabled smart buildings improve energy efficiency, water conservation, operational performance, and environmental sustainability. Higher values indicate greater adoption of digital building technologies that optimize resource use, reduce greenhouse gas emissions, and enhance occupant comfort and building performance. This KPI supports SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), and aligns with international smart city frameworks.		
Methodology	Calculate as Numerator: Number of commercial and public buildings equipped with Building Automation Systems (BAS) for monitoring or controlling HVAC, lighting, energy, and water systems. Denominator: Total number of commercial and public buildings Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to building stock, digital infrastructure, and national energy efficiency policies. Higher percentages indicate greater adoption of smart building technologies and stronger digital enablement of the built environment.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities, developed collaboratively by UN agencies and international experts, provide a standardized framework for measuring smart building adoption as part of the smart city environment dimension. ITU-T Focus Group on Smart Sustainable Cities guidelines and Recommendation ITU-T Y.4903 define KPIs aligned with SDGs. ISO 37120 Sustainable Cities Indicators include energy and building measures. National energy efficiency and smart building certification programmes provide policy frameworks for measurement. SDG 7, SDG 11, SDG 13 targets.		
Data Sources / Relevant Databases	Municipal building registries. Building Automation System (BAS) deployment records Smart building management platforms. Utility company energy management databases National energy efficiency and smart building certification authorities		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	57		
KPI Name	**Smart Meters**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of electricity customers within the city who have operational smart meters installed, enabling real-time monitoring of electricity consumption, demand-response management, remote meter reading, and automated billing. Smart meters support efficient energy use, integration with smart grids, and improved customer awareness of energy consumption patterns.		
Rationale / Interpretation	Smart meter deployment enhances the digitalization of urban energy infrastructure by improving energy efficiency, customer engagement, grid reliability, and operational performance. Higher percentages indicate greater adoption of smart energy technologies that enable real-time monitoring, demand-response programmes, and renewable energy integration. This KPI supports SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action), and aligns with international smart city frameworks.		
Methodology	Calculate as Numerator: Number of electricity customers with operational smart meters Denominator: Total number of electricity customers Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to the maturity of the electricity network, national smart grid policies, and investment in digital energy infrastructure. Higher percentages indicate greater digitalization of electricity distribution systems and improved energy management capabilities.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ITU-T Focus Group on Smart Sustainable Cities ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life National electricity regulatory authorities and utility standards. SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action)		
Data Sources / Relevant Databases	Utility customer databases linked to smart meter deployment. City energy management systems and real-time dashboards. Data from national energy regulatory agencies. Smart grid monitoring platforms incorporating IoT-enabled energy systems.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	58		
KPI Name	**Drinking Water Infrastructure**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of critical drinking water infrastructure, including pipelines, pumps, storage tanks, valves, and treatment plants, that is equipped with IoT-enabled sensors for real-time monitoring. These systems monitor water flow, pressure, leakage, water quality, and operational performance to support efficient, reliable, and sustainable water management.		
Rationale / Interpretation	IoT-enabled monitoring improves the efficiency, reliability, and resilience of drinking water infrastructure by enabling real-time detection of leaks, pressure fluctuations, water quality issues, and operational faults. Higher values indicate greater digitalization of water infrastructure, supporting proactive maintenance, reduced water losses, improved service delivery, and sustainable resource management. This KPI supports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production), and aligns with international smart city and water management frameworks.		
Methodology	Calculate as Numerator: Number of critical drinking water infrastructure assets equipped with operational IoT-enabled sensors for real-time monitoring. Denominator: Total number of critical drinking water infrastructure assets within the city Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to the maturity of water infrastructure, investment in digital technologies, and national smart water management strategies. Higher percentages indicate greater digitalization of drinking water infrastructure and improved capacity for real-time monitoring and asset management.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ITU-T FG-SSC Technical Reports. ISO 37120: Sustainable Cities. Water Indicators. International Water Association (IWA) Smart Water Guidelines SDG 6, SDG 11, SDG 12 targets		
Data Sources / Relevant Databases	Utility and municipal water authority databases. SCADA and IoT-enabled smart water monitoring platforms. National infrastructure and water regulatory agencies. Real-time GIS-based water distribution mapping systems.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	59		
KPI Name	**Smart Water Meter Penetration Rate**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of water utility customers whose water consumption is monitored through IoT-enabled smart water meters, enabling real-time usage tracking, leak detection, demand management, and automated billing.		
Rationale / Interpretation	High smart water meter penetration reflects the digital enablement of urban water infrastructure, supporting efficient water use, early leak detection, demand management, and data-driven decision-making. Greater adoption enhances operational efficiency, improves water conservation, and supports sustainable resource management. This KPI aligns with SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Methodology	Calculate as Numerator: Number of water customers with operational smart meters Denominator: Total number of water customers Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to the maturity of water infrastructure, investment in digital technologies, and national smart water strategies. Higher percentages indicate greater digitalization of water utilities and improved capacity for real-time monitoring and efficient water management.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities. ITU-T Focus Group on Smart Sustainable Cities ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life (Water and Utilities). International Water Association (IWA) Smart Water Guidelines. SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Data Sources / Relevant Databases	Water utility customer databases SCADA systems and IoT-enabled smart water meter platforms Municipal water management information systems. National water regulatory authorities. Smart city dashboards and real-time water monitoring platforms.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	60		
KPI Name	**Reduction in Electricity Consumption**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the observed percentage change in average electricity consumption per resident over a defined period. The indicator may reflect the combined effects of digital energy management systems, energy-efficiency measures, demand-response programmes, behavioural changes, and other factors affecting electricity consumption and may include residential, commercial, and public sectors, depending on the defined scope.		
Rationale / Interpretation	Assesses changes in electricity consumption associated with efforts to improve energy efficiency and sustainable energy management. The indicator provides a correlational measure and should not be interpreted as demonstrating that digitalization alone caused the observed reduction. Electricity consumption can also be influenced by factors such as weather and climate conditions, economic activity, population changes, energy prices, energy mix, changes in occupancy or service demand, and non-digital energy-efficiency policies. An observed reduction in electricity consumption should not be attributed solely to digitalization or digital energy-management systems. Weather conditions, economic activity, population changes, energy prices, energy mix, occupancy, changes in demand, and other energy-efficiency measures may contribute to the observed change.		
Methodology	Calculate as Numerator: Per-capita electricity consumption in the baseline period – per-capita electricity consumption in the current period (kWh per inhabitant). Denominator: Per-capita electricity consumption in the baseline period (kWh per inhabitant) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to urban development, climate, economic activity, population characteristics, energy prices, energy mix, and energy-efficiency policies. Higher percentage reductions indicate lower electricity consumption but should not, on their own, be interpreted as evidence of improved energy efficiency or the effectiveness of digitalization. Comparisons should preferably use comparable periods and account for material external influences.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities; ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life; International Energy Agency (IEA) energy-efficiency reports; SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).		
Data Sources / Relevant Databases	Municipal and national electricity consumption statistics; utility billing and smart-meter data; city energy-management dashboards; IoT and smart-building monitoring systems; national energy-efficiency programme reports.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	61		
KPI Name	**Electricity Reliability Measures (SAIDI, SAIFI, CAIDI)**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures electricity supply reliability using three internationally recognized indices: • SAIDI: Average total outage duration per customer (hours/customer/year) • SAIFI: Average number of interruptions per customer (interruptions/customer/year) • CAIDI: Average duration of each interruption experienced by affected customers (hours/interruption).		
Rationale / Interpretation	Measures electricity service reliability and helps utilities identify reliability issues, improve maintenance and operations, and assess smart-grid investments. Lower values indicate higher reliability. This KPI supports SDG 7, SDG 9 and SDG 11.		
Methodology	Calculate as SAIDI: Numerator: Sum of all customer outage durations Denominator: Total number of customers served SAIFI: Numerator: Total number of customer interruptions Denominator: Total number of customers served CAIDI: Numerator: Sum of all customer interruption durations Denominator: Total number of customer interruptions		
Unit	SAIDI: Hours/customer/year SAIFI: Interruptions/customer/year CAIDI: Hours/interruption		
Benchmarking	Benchmark values vary according to grid maturity, network design, climatic conditions, and regulatory requirements. Lower SAIDI, SAIFI, and CAIDI values indicate higher electricity reliability and service quality. Benchmark references include IEEE Standard 1366, U4SSC KPIs, ITU-T smart city guidelines, and national electricity regulatory authorities.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities. IEEE Standard 1366 – Electric Power Distribution Reliability Indices. ITU-T Focus Group on Smart Sustainable Cities. ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life (Energy and Utilities). SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), and SDG 11 (Sustainable Cities and Communities).		
Data Sources / Relevant Databases	Utility outage management systems (OMS), SCADA and smart-grid records, customer outage systems, regulatory authorities, and utility performance reports.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	62		
KPI Name	**Water Consumption**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the average annual or daily water consumption per resident within the city, including residential, commercial, and public water use. This KPI reflects overall water demand, resource efficiency, and consumption patterns.		
Rationale / Interpretation	Monitoring per capita water consumption enables cities to assess water use efficiency, identify excessive consumption, support infrastructure planning, and implement conservation measures. Lower per capita consumption, while maintaining adequate service levels, indicates more sustainable use of water resources. This KPI supports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Methodology	Calculate as Numerator: Total water consumption within the city during the reporting period (m^3) Denominator: Total city population during the reporting period		
Unit	m^3 per capita per year (m^3/person/year)		
Benchmarking	Benchmark values vary according to climate, water availability, urban development, and local consumption patterns. Lower per capita water consumption indicates more efficient water use, provided adequate service levels are maintained. Benchmark references include U4SSC KPIs, ISO 37120, International Water Association (IWA) guidance, and national water efficiency strategies.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ISO 37120 – Sustainable Cities and Communities: Indicators for City Services and Quality of Life (Water and Utilities). World Health Organization (WHO) guidance on water management International Water Association (IWA) Water Efficiency Reports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Data Sources / Relevant Databases	Municipal water utility supply records. Smart water meter databases. City water distribution and management dashboards. National water regulatory authorities and census data. IoT-enabled water monitoring platforms.		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	63		
KPI Name	**Electricity Transmission and Distribution Losses**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage reduction in electricity transmission and distribution (T&D) losses relative to a baseline year. Losses include both technical losses (e.g., resistance in transmission lines and equipment inefficiencies) and non-technical losses (e.g., electricity theft, metering inaccuracies, and billing errors).		
Rationale / Interpretation	Reducing electricity transmission and distribution losses improves energy efficiency, grid reliability, and the sustainability of electricity systems while lowering operational costs and greenhouse gas emissions. Greater reductions indicate more effective grid management, infrastructure modernization, and integration of smart grid technologies. This KPI supports SDG 7 (Affordable and Clean Energy), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).		
Methodology	Calculate as Numerator: Transmission and distribution losses in the baseline year (%) – Transmission and distribution losses in the current year (%). Denominator: Transmission and distribution losses in the baseline year (%) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmark values vary according to grid infrastructure, network age, system configuration, and national regulatory requirements. Lower transmission and distribution losses indicate more efficient and reliable electricity networks. Continuous reductions in losses are encouraged through smart grid technologies, advanced metering infrastructure, and network modernization programmes. Benchmark references include U4SSC KPIs, IEEE standards, ISO 37120, and national electricity regulatory authorities.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities IEEE Power & Energy Society Standards ISO 37120 Energy Indicators ITU-T FG-SSC Smart Energy Guidelines. SDG 7, SDG 11, SDG 13 targets		
Data Sources / Relevant Databases	Utility transmission and distribution records. Smart grid monitoring systems SCADA and IoT-enabled grid dashboards. National energy regulatory agencies		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	64		
KPI Name	**Change in Water Consumption**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage change in per capita water consumption compared with a baseline year. It reflects trends in water use, conservation efforts, and the effectiveness of water demand management policies.		
Rationale / Interpretation	Monitoring changes in per capita water consumption enables cities to assess the effectiveness of water conservation programmes, efficiency initiatives, and infrastructure improvements. A reduction or stabilization in per capita water use indicates more sustainable urban water management. This KPI supports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Methodology	Calculate as Numerator: Per capita water consumption in the baseline year – per capita water consumption in the current year (m^3 per inhabitant). Denominator: Per capita water consumption in the baseline year (m^3 per inhabitant) Multiply by 100 Interpretation: Positive values indicate a reduction in per capita water consumption, while negative values indicate an increase.		
Unit	Percentage (%)		
Benchmarking	There are no universally accepted benchmarks for this indicator because trends depend on local climate, water availability, and consumption patterns. Good performance is demonstrated by a reduction or stabilization in per capita water consumption over time. Cities should establish baseline values and set progressive reduction targets consistent with local water conservation strategies. Benchmarking should align with ISO 37120, U4SSC KPIs, SDG 6, and national water efficiency policies.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities ISO 37120: Sustainable Cities and Communities – Indicators for City Services and Quality of Life World Health Organization (WHO) water use guidance. International Water Association (IWA) water efficiency reports and benchmarking studies. National water conservation strategies and utility performance reports.		
Data Sources / Relevant Databases	Municipal and regional water utility consumption records. Smart water meter and IoT-enabled monitoring platforms. Water utility performance dashboards. National water regulatory authority databases. Urban water management and infrastructure databases		

Dimension	Environment		
Subdimension	**Energy and Utilities**		
KPI No	65		
KPI Name	**Reduction in Water Transmission and Distribution Losses**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage reduction in water transmission and distribution losses compared with a baseline year. Losses include both physical losses (e.g., leaks, pipe bursts, and overflows) and apparent losses (e.g., metering inaccuracies, unauthorized consumption, and theft). Indicator: Percentage reduction in water transmission and distribution losses.		
Rationale / Interpretation	Reducing water transmission and distribution losses improves water use efficiency, system reliability, operational performance, and environmental sustainability. Higher reductions indicate effective infrastructure maintenance, leak detection and repair programmes, and the adoption of digital water management technologies. This KPI supports SDG 6 (Clean Water and Sanitation), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production).		
Methodology	Calculate as Numerator: Water transmission and distribution loss (%) in the baseline year – Water transmission and distribution loss (%) in the current year. Denominator: Water transmission and distribution loss (%) in the baseline year Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Performance should be assessed against internationally recognized benchmarks for non-revenue water (NRW) and transmission and distribution losses. Benchmarking should align with ISO 37120, U4SSC KPIs, International Water Association (IWA) guidance, and national water efficiency strategies.		
Source (s) / References	U4SSC KPIs for Smart Sustainable Cities. ISO 37120 Sustainable Cities Indicators (Water & Utilities) International Water Association (IWA) Water Loss Reports. SDG 6, SDG 11, SDG 12 targets		
Data Sources / Relevant Databases	Water utility operational records Smart water meters and IoT sensor data GIS-based water distribution mapping systems Municipal dashboards and national water authority reports		

3 Economy Dimension

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	66		
KPI Name	**Online Presence**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of businesses within the city that maintain an active online presence through an official website and/or mobile application. This indicator reflects the adoption of digital technologies by Equity and Inclusivity in Digital Engagement businesses and their readiness to participate in the digital economy.		
Rationale / Interpretation	A strong online presence is a key indicator of business digitalization and competitiveness. Businesses with websites or mobile applications are better positioned to reach broader markets, engage customers digitally, adopt e-commerce, and participate in digital value chains. Higher adoption reflects greater digital readiness, particularly among SMEs, and supports economic resilience and digital transformation.		
Methodology	Calculate as Numerator: Number of businesses with a website or mobile app Denominator: Total number of businesses Multiply by 100		
Unit	Percentage (%)		
Benchmarking	National averages for business digital adoption OECD or EU digital economy indicators (e.g., DESI – Digital Economy and Society Index) Peer cities of similar size, economic structure, or digital-transformation stage Sector-specific benchmarks, since online presence varies widely across industries (e.g., retail vs. manufacturing).		
Source (s) / References	ITU – United for Smart Sustainable Cities (U4SSC) KPIs. OECD Digital Economy Outlook World Bank – Digital Adoption Index (DAI). ISO 37122:2019 – Indicators for Smart Cities European Commission – Digital Economy and Society Index (DESI)		

Dimension	Economy
Subdimension	**Digital Economy**
Data Sources / Relevant Databases	Local business registries or licensing databases National statistics offices. Chambers of commerce and industry associations Business survey datasets. Web-analytics tools or domain-registration databases (e.g., WHOIS) App store listings (Google Play, Apple App Store). Municipal digital-economy observatories or open-data portals.

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	67		
KPI Name	**Digital Payments**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of businesses within the city that accept digital payment methods (e.g., debit cards, credit cards, mobile wallets, QR code payments, or other electronic payment systems). The indicator reflects the adoption of digital financial technologies and the readiness of businesses to participate in a cashless digital economy.		
Rationale / Interpretation	Digital payment acceptance reflects the adoption of digital financial technologies by businesses and supports a more efficient, secure, and inclusive economy. Higher adoption improves customer convenience, facilitates electronic commerce, enhances financial transparency, reduces reliance on cash, and strengthens economic resilience. This indicator also reflects the maturity of the city's digital business ecosystem.		
Methodology	Calculate as Numerator: Business accepting digital payment Denominator: Total number of businesses Multiply by 100		
Unit	Percentage (%)		
Benchmarking	National digital-payment adoption rates. OECD Digital Economy indicators. Peer cities with similar economic profiles. Indicative levels: Low adoption – Digital payments remain at an early stage of adoption Moderate adoption – Digital payments are widely adopted across the population High adoption – Digital payments represent the predominant mode of payment		
Source (s) / References	ITU – United for Smart Sustainable Cities (U4SSC) KPIs OECD Digital Economy Outlook World Bank – Digital Adoption Index (DAI) European Commission – Digital Economy and Society Index (DESI) World Bank – Global Findex Database (digital payments and financial inclusion)		
Data Sources / Relevant Databases	Local business registries. National statistics offices Payment service providers (PSPs). Central bank digital-payment statistics Chambers of commerce and industry associations Business survey datasets. Municipal open-data portals		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	68		
KPI Name	**Workforce Digital Skills**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city's workforce that possesses foundational digital competencies, based on recognized frameworks such as the European Digital Competence Framework (DigComp). The indicator reflects the workforce's readiness to participate effectively in an increasingly digital economy.		
Rationale / Interpretation	Foundational digital skills are essential for employment, productivity, innovation, and participation in the digital economy. Monitoring workforce digital skills enables cities to identify skills gaps, evaluate digital inclusion efforts, and inform education and workforce development policies. Higher levels of digital competency indicate a workforce better equipped to adopt new technologies, support business digitalization, and enhance economic resilience and competitiveness.		
Methodology	Calculate as Numerator: Population of the city workforce with basic digital skills Denominator: Total population of the city labour force Multiply by 100 Basic Digital Skills Definition: An individual is considered to have basic digital skills if they have performed activities in at least one area of the DigComp framework. These activities may include: Using email or messaging apps, searching for information online, using word processing or spreadsheet software, installing software or apps, and managing privacy settings or security software.		
Unit	Percentage (%)		
Benchmarking	The EU aims for at least 80% of the population to have basic digital skills by 2030, as part of the Digital Decade Policy Programme.		
Source (s) / References	Digital Competence Framework (DigComp) https://joint-research-centre.ec.europa.eu/projects-and-activities/education-and-training/digital-transformation-education/digital-competence-framework-digcomp_en -		
Data Sources / Relevant Databases	National Labor Force Surveys and Household ICT Usage Surveys. Ministry of Labour, Ministry of Education, and Skills Development Authorities. City-level Digital Inclusion or Smart City Surveys. International Telecommunication Union, Organisation for Economic Co-operation and Development, and European Commission.		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	69		
KPI Name	**Online Businesses (adoption-based)**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of businesses within the city that sell products or services through digital platforms, websites, mobile applications, online marketplaces, or other e-commerce channels. The indicator reflects the adoption of digital commerce and businesses' participation in the digital economy.		
Rationale / Interpretation	Selling products and services online demonstrates the adoption of digital commerce by businesses and expands access to local, national, and international markets. Higher adoption indicates greater digital maturity, stronger competitiveness, increased business resilience, and improved opportunities for SMEs to participate in the digital economy. Monitoring this KPI helps cities identify barriers to e-commerce adoption and design policies that support business digital transformation.		
Methodology	Calculate as Numerator: Number of businesses selling online Denominator: Total Number of businesses Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Global Average: According to OECD data, approximately 26% of small businesses (10–49 employees) across 30 OECD countries engaged in e-commerce sales in 2023. European Union (EU): In 2023, 21.88% of small enterprises and 30.51% of medium-sized enterprises in the EU made e-sales, with large enterprises reaching 46.45%. These benchmarks provide reference points for assessing digital commerce adoption and setting targets appropriate to the city's economic structure and business profile. Cities seeking to strengthen digital maturity may aim to achieve adoption levels above relevant regional or peer-city benchmarks.		
Source (s) / References	OECD Going Digital Toolkit OECD Indicator: Share of small businesses making e-commerce sales Eurostat Eurostat: E-commerce statistics Cross-Border E-commerce Magazine & Statista Cross-Border Magazine: E-Commerce Adoption in EU SMEs		

Dimension	Economy
Subdimension	**Digital Economy**
Data Sources / Relevant Databases	National and Municipal Business Registries Data from e-commerce platforms (e.g., Amazon, Shopify), social media commerce tools, and company websites to assess online sales activity. Surveys and Questionnaires: Targeted surveys conducted by city governments, chambers of commerce, or research institutions to gather self-reported data on online sales practices.

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	70		
KPI Name	**Online Procurement (adoption-based)**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of businesses that procure goods and services through digital procurement channels, including e-procurement platforms, electronic marketplaces, websites, or other digital purchasing systems. The indicator measures the adoption of digital procurement practices among businesses within the defined geographic or sectoral scope.		
Rationale / Interpretation	Online procurement provides an indication of the extent to which businesses have adopted digital technologies in their purchasing processes. Higher adoption indicates wider use of digital procurement channels and may support improved purchasing efficiency, supplier access, and integration with digital supply chains. Monitoring this KPI helps cities assess business digitalization and identify opportunities to support SMEs in adopting digital procurement technologies.		
Methodology	Calculate as Numerator: Number of eligible businesses reporting that they procure goods or services through digital procurement channels during the reference period. Denominator: Total number of eligible businesses covered by the survey or statistical population during the same reference period. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Adoption levels may be compared across cities, regions, countries, business sectors, and business-size groups, as well as over time. Interpretation should take into account differences in business structure, sector composition, digital infrastructure, survey methodology, and the availability of digital procurement services.		
Source (s) / References	Eurostat – Digitalization and ICT usage statistics for enterprises, including relevant indicators on business use of digital technologies and electronic commerce. OECD – Digital economy and digital transformation indicators and publications, including relevant work on digital procurement. National Statistical Offices – Business ICT, digitalization, and electronic procurement surveys, where available.		

Dimension	Economy
Subdimension	**Digital Economy**
Data Sources / Relevant Databases	National Statistical Offices and nationally representative business ICT/ digitalization surveys Eurostat enterprise ICT and digitalization datasets, where relevant data are available OECD digital economy and business digitalization datasets. Surveys where appropriate Chambers of Commerce and business organizations. Government, academic, or sectoral surveys where nationally representative data are unavailable.

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	71		
KPI Name	**Patents**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the number of Information and Communication Technology (ICT)-related patents registered by inventors, organizations, or institutions located within the city per 100 000 inhabitants. The indicator reflects the city's innovation capacity, research performance, and ability to generate and protect new digital technologies and intellectual property.		
Rationale / Interpretation	ICT-related patents are a direct output of research, innovation, and technological development. A higher number of patents indicates stronger innovation capacity, greater investment in research and development, and an increased ability to generate commercially valuable digital technologies. Monitoring ICT patents enables cities to assess technological maturity, benchmark innovation performance, and evaluate the effectiveness of investments in digital skills, research, and entrepreneurship.		
Methodology	Calculate as Numerator: Number of patents classified under International Patent Classification (IPC) codes related to Information and Communication Technologies (ICT), such as H04 (Electric Communication Technique), G06 (Computing; Calculating; Counting), and others. Denominator = 1/100 000 of the city population Include patents filed by entities located within the city or region under assessment.		
Unit	ICT patents per 100 000 inhabitants		
Benchmarking	Compare with historical data and peer cities to identify trends and performance gaps Tracking ICT patents over time can reveal trends in technological maturity, sectoral focus, and international competitiveness. Benchmarking ICT-related patent activity enables cities to evaluate their innovation performance relative to peers and global standards.		
Source (s) / References	National Patent Registration Offices		
Data Sources / Relevant Databases	Retrieve patent data from recognized patent databases such as: WIPO PATENTSCOPE. European Patent Office (EPO) Espacenet United States Patent and Trademark Office (USPTO). National patent offices		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	72		
KPI Name	**Digital Payments Usage**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of business and consumer payment transactions conducted through digital payment methods, including bank cards, mobile wallets, QR-code payments, online banking, instant payment systems and other electronic payment channels. The indicator reflects the extent to which digital payment methods are used within the city's economy.		
Rationale / Interpretation	Digital payment usage indicates the adoption of digital financial services by businesses and consumers. Higher usage can improve transaction efficiency, convenience, transparency and traceability while reducing reliance on cash. Monitoring this KPI helps cities assess progress in financial digitalization, identify barriers to digital payment adoption, support financial inclusion and strengthen the resilience and competitiveness of the local economy.		
Methodology	Calculate as Numerator: Total number of business and consumer payment transactions conducted through digital payment methods during the reporting period. Denominator: Total number of business and consumer payment transactions, including both digital and cash transactions, during the same reporting period. Multiply by 100. Where transaction data are not available, cities may use a clearly defined alternative measure, such as the percentage of businesses or adults using digital payments. The alternative measure should be reported separately and should not be presented as the transaction-based KPI.		
Unit	Percentage (%)		
Benchmarking	Compare results with relevant international indicators from the World Bank Global Findex, OECD digital economy statistics and other recognized payment datasets. Use national and regional payment-system targets, central-bank statistics and digitalization programmes as additional reference points.		
Source (s) / References	World Bank – Global Findex Database. OECD – Digital Economy Outlook. Bank for International Settlements (BIS) – Payment Statistics. ITU – U4SSC KPIs. ISO 37122:2019 – Smart City Indicators. Central bank payment statistics. National statistical offices. Commercial banks and payment service providers. Business and household ICT surveys. Municipal digital economy observatories.		
Data Sources / Relevant Databases	World Bank Global Findex Database; OECD *Digital Economy Outlook*; BIS Payment Statistics; ITU U4SSC KPIs; ISO 37122:2019; central-bank and national statistical-office data; commercial banks and payment service providers; business and household ICT surveys; municipal digital economy observatories; government digitalization programmes; industry reports from GSMA, World Bank and OECD; and business surveys covering payment practices.		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	73		
KPI Name	**Business Electronic Invoices**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of invoices processed through structured electronic invoicing systems (e.g., ERP integrations, Peppol, EDI, or XML-based platforms), excluding paper-based and email-only invoices.		
Rationale / Interpretation	Electronic invoicing is a key indicator of business digitalization and process automation. Higher adoption improves operational efficiency, reduces manual processing errors and administrative costs, accelerates payment cycles, enhances financial transparency, and reduces paper consumption. Monitoring e-invoicing adoption enables cities to assess business digital maturity and support digital transformation initiatives.		
Methodology	Calculate as Numerator: Number of Electronic Invoices Processed Denominator: Total Number of Invoices Issued Multiply by 100.		
Unit	Percentage (%)		
Benchmarking	Excellent: Indicates strong automation and efficiency Good: Moderate adoption; room for improvement Poor: Requires immediate focus on digital transformation		
Source (s) / References	APQC Open Standards Benchmarking, KPI Depot Whitevision EY and KPMG reports on global e-invoicing mandates, OpenText Guide to Global e-Invoicing Mandates		
Data Sources / Relevant Databases	APQC Benchmarking Database: Market research reports (Data Bridge, IMARC); Government compliance portals for e-invoicing mandates Industry studies (Avalara, Gartner)		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	74		
KPI Name	**Digital Tax Fillings**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Percentage of tax filings submitted electronically through official digital tax platforms or systems, by individuals and businesses within the city.		
Rationale / Interpretation	This KPI reflects the extent to which digital platforms are being adopted for tax-related transactions, indicating both the accessibility and usability of digital public services. A higher percentage of digital tax filings suggests improved efficiency, reduced administrative burden, and enhanced transparency in government operations. It also demonstrates the population's digital literacy and trust in digital systems. Tracking this KPI helps identify gaps in digital infrastructure or user engagement, guiding policy and investment decisions to foster inclusive digital transformation.		
Methodology	Calculate as Numerator: Number of tax filings submitted via digital channels (e-filing systems, online portals, authorized digital tax platforms). Denominator: Total number of tax filings by city inhabitants Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarking can be conducted by comparing: Average across different years to assess progress. Peer cities or countries with similar digital infrastructure or population size. Global best practices, such as OECD or UN digital government indices. Targets set by national digital transformation strategies or e-government initiatives.		
Source (s) / References	OECD – Tax Administration 2024; OECD – Digital Government Index; United Nations – E-Government Survey; World Bank – GovTech Maturity Index; relevant national tax authority and e-government regulations and reporting frameworks.		
Data Sources / Relevant Databases	National tax authority databases (e.g., Canada Revenue Agency, US IRS) Government digital service portals Ministries of Finance or equivalent agencies Open government data platforms Surveys on digital service usage International databases (e.g., OECD Digital Government Indicators, UN E-Government Survey)		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	75		
KPI Name	**Online Retail Sales**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of total retail sales in the city that are conducted through online channels, including e-commerce websites, mobile applications and digital marketplaces. The indicator reflects the adoption and use of online sales channels by businesses and consumers.		
Rationale / Interpretation	This KPI provides insight into the adoption of digital commerce within the city's retail sector. A higher share of online retail sales indicates greater use of digital sales channels by businesses and consumers and may reflect the availability of e-commerce platforms, digital payment systems, logistics, consumer readiness and trust in online transactions. Monitoring this KPI can help cities assess the digitalization of retail activity, identify gaps in digital adoption and support policies aimed at strengthening the local digital economy.		
Methodology	Calculate as Numerator: Total value of online retail sales in the city during the reference period. Denominator: Total value of retail sales in the city during the same reference period. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Cities can compare their online retail penetration with peer cities and relevant national or regional trends to assess the adoption of digital retail channels. Benchmarking should consider differences in retail structures, consumer behaviour, digital infrastructure, business adoption and data availability. Cities can use the results to identify gaps, monitor changes over time and establish context-specific targets aligned with local economic and digital transformation priorities.		
Source (s) / References	UN Trade and Development (UNCTAD). Business E-commerce Sales and the Role of Online Platforms. OECD. The OECD Definition of E-commerce and Guidelines for Interpretation. OECD. Unpacking E-commerce: Business Models, Trends and Policies.		
Data Sources / Relevant Databases	Government Sources: U.S. Census Bureau – Quarterly Retail E-Commerce Sales Report: Statistics Canada – Retail Trade Reports Eurostat – Retail Trade Statistics. Industry and Commercial Databases: Statista: https://www.statista.com/topics/871/online-shopping/ Digital Commerce 360: https://www.digitalcommerce360.com/about-our-databases/ AfterShip Ecommerce Statistics: https://www.aftership.com/ecommerce/statistics/regions Data.gov: https://data.gov/		

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	76		
KPI Name	**Online Procurement (value-based)**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of total procurement expenditure conducted through digital procurement systems, including e-procurement platforms, digital marketplaces, and system-to-system purchasing integrations. The indicator measures the proportion of procurement value processed through digital channels and complements the adoption-based measure of business participation in digital procurement.		
Rationale / Interpretation	This KPI measures the share of procurement expenditure conducted through digital channels and indicates the extent to which digital procurement is embedded in business purchasing processes. A higher share indicates greater use of digital procurement and may support more efficient, transparent, and data-driven purchasing processes, depending on the level of system integration and automation. Note: Public-sector organizations are recommended to achieve traceability in procurement through end-to-end tracking of public spending across linked records covering budget allocation, procurement procedures, contracts, suppliers, payments, and the delivery or completion of procured goods and services. The value of public procurement used in this KPI is recommended to include the traceable public procurement value.		
Methodology	Calculate as Numerator: Total value of eligible procurement transactions conducted through digital procurement systems during the reference period. Denominator: Total value of eligible procurement transactions during the same reference period, regardless of procurement channel. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Cities can compare the share of procurement value conducted through digital procurement systems with relevant national or regional practices, peer cities where comparable data are available, and trends over time. Where comparable international benchmarks are unavailable, cities should prioritize comparison over time and against relevant national or sectoral benchmarks rather than applying fixed global thresholds.		

Dimension	Economy
Subdimension	**Digital Economy**
Source (s) / References	OECD – Digital Transformation of Public Procurement, as a methodological reference for digital procurement processes, digital systems, integration, and data use. APQC – Procurement Key Benchmarks, for procurement process and electronic procurement benchmarking. National Statistical Offices, procurement authorities, and business-sector data sources, where procurement expenditure and digital transaction data are available.
Data Sources / Relevant Databases	National Statistical Offices and business surveys that collect data on procurement expenditure and digital procurement. Government procurement and business databases, where they cover the relevant business population. Enterprise resource planning (ERP), procurement, or e-procurement system data, subject to appropriate aggregation and data protection arrangements. Sectoral procurement databases and business associations, where representative coverage is available. APQC procurement benchmarking data, where relevant and comparable Custom surveys conducted by governments, research institutions, or other appropriate organizations.

Dimension	Economy		
Subdimension	**Digital Economy**		
KPI No	77		
KPI Name	**Digital Economy GDP Contribution**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the share of total city GDP attributable to economic activities that form part of the digital economy, including the production of ICT goods and digital services and economic activities significantly reliant on or enhanced by digital technologies, digital infrastructure, digital services and data.		
Rationale / Interpretation	This KPI provides insight into the economic contribution and structural importance of digital activities within the city economy. It helps policymakers assess the extent to which digitalization contributes to economic output, innovation and competitiveness, and can inform policies and investments supporting digital economic development. A higher share indicates a greater economic contribution from digital activities and may be associated with stronger integration of digital technologies into production and services, innovation and competitiveness.		
Methodology	Calculate as Numerator: Gross value added attributable to the digital economy in the city. Denominator: Total GDP of the city. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Cities can compare the contribution of the digital economy to GDP with peer cities, relevant national or regional benchmarks, and trends over time. Comparisons should take into account differences in the definition and measurement of the digital economy, economic structure, statistical systems, and availability of city-level data. Cities can use the results to assess the structural role of digital activities in the local economy and establish context-specific targets.		
Source (s) / References	International Monetary Fund. (2018). Measuring the Digital Economy. https://www.imf.org [imf.org]. OECD. (2024). Digital Economy Outlook. https://www.oecd.org [oecd.org] UNCTAD. (2024). Digital Economy Report 2024. https://unctad.org [unctad.org] IDCA. (2025). Global Digital Economy Report 2025. https://www.idc-a.org		
Data Sources / Relevant Databases	BEA Digital Economy Satellite Account – U.S. Bureau of Economic Analysis. https://www.bea.gov/data/special-topics/digital-economy [bea.gov] ADB Key Indicators Database – Asian Development Bank. https://kidb.adb.org/globalization/digital_economies [kidb.adb.org] KAPSARC Digital Economy Data Portal – Regional GDP contribution and adoption metrics. https://datasource.kapsarc.org [datasource...apsarc.org] World Bank Digital Progress and Trends Report – ICT sector and digital economy indicators.		

Dimension	Economy		
Subdimension	**Digital Skills**		
KPI No	78		
KPI Name	**Advanced Digital Skills**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of the city's workforce possessing advanced digital skills, enabling the use, creation, and management of complex digital systems such as data analytics, programming, AI tools, cloud computing, cybersecurity, and advanced digital problem-solving.		
Rationale / Interpretation	Advanced digital skills are a key driver of innovation, productivity, and economic competitiveness in digitally transformed economies. Cities with a higher share of advanced digitally skilled workers are better positioned to attract high-value industries, support entrepreneurship, and adapt to emerging technologies such as artificial intelligence, automation, and advanced data systems.		
Methodology	Calculate as Numerator: Number of the city workforce with advanced digital skills Denominator: Employed population/workforce within the city Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Global Frameworks: SFIA levels for professional digital competencies and IEEE standards for digital intelligence. City Comparisons: Use indicators from the Digital Economy and Society Index (DESI) and World Benchmarking Alliance Digital Inclusion Benchmark for cross-city and international comparisons. Websites and services should be accessible following WCAG 2.0 and EN301549.		
Source (s) / References	European Commission. (2024, July 27). Digital Skills Indicator 2.0: Measuring digital skills across the EU. Digital Skills & Jobs Platform. https://digital-skills-jobs.europa.eu/en/inspiration/resources/digital-skills-indicator-20-measuring-digital-skills-across-eu. International Telecommunication Union. (2025). Manual for measuring ICT access and use by households and individuals. OECD. (2025). Digital skills. https://www.oecd.org/en/topics/digital-skills.html		
Data Sources / Relevant Databases	O*NET Database (U.S. Department of Labor) – Occupational digital skill requirements OECD Skills Outlook & PIAAC – Adult digital competency data Eurostat DESI Indicators – EU-level digital skills statistics National Skills Coalition Reports – U.S. workforce digital skill gap analysis Brookings Digitalization Index – Digital intensity of occupations. [bls.gov], [datasmart....arvard.edu]		

Dimension	Economy		
Subdimension	**Digital Skills**		
KPI No	79		
KPI Name	**Digital Literacy Training in Disadvantaged Areas**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Density of structured digital literacy training programmes available in disadvantaged or underserved areas of the city, measured relative to population size in those areas. The KPI assesses geographic equity in access to foundational digital skills development opportunities.		
Rationale / Interpretation	Digital literacy training in disadvantaged areas addresses structural digital inequality that limits access to education, employment, health care, and civic participation. Marginalized communities often face barriers such as limited infrastructure, low affordability, and lack of training opportunities, which can deepen socio-economic inequality. Providing structured training programmes fosters social inclusion, enhances employability, and supports sustainable development goals (SDG 4.4: "increase the number of youth and adults with relevant skills for employment").		
Methodology	Calculate as Numerator: Number of programmes in disadvantaged areas Denominator: 1/ 100 000 inhabitants of disadvantaged areas		
Unit	Programmes per 100 000 inhabitants		
Benchmarking	Cities can assess the extent to which digital skills training programmes reach disadvantaged areas and support participation through to completion. Leading approaches demonstrate broad geographic coverage and strong participant completion, with targets adapted to local needs, capacity and population characteristics.		
Source (s) / References	IEEE 3527.1™ Digital Intelligence Framework (DQ): Defines competencies for digital literacy and readiness. UNESCO SDG Indicator 4.4.2: Percentage of youth/adults achieving minimum digital proficiency. UNHCR Innovation Service. (2025). Digital literacy interventions – a guide for organizations working in forced displacement contexts. Retrieved from https://www.unhcr.org/innovation/wp-content/uploads/2025/03/Digital-Literacy-Guidance-1.pdf		
Data Sources / Relevant Databases	Surveys of local governments and NGOs GIS mapping for spatial coverage Qualitative interviews for programme quality assessment UN-Habitat Urban Indicators Database: https://data.unhabitat.org UNDP Digital Development Compass: https://digitaldevelopmentcompass.undp.org ITU & UNESCO SDG Indicator 4.4.2 datasets. Local government open data portals for programme locations and socio-economic indicators. NGO programme registries (e.g., fundsforNGOs, Byte Back, Tech Goes Home).		

Dimension	Economy		
Subdimension	**Digital Skills**		
KPI No	80		
KPI Name	**Disadvantaged Areas with Broadband Access**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of households in disadvantaged areas of the city with access to reliable broadband internet services.		
Rationale / Interpretation	Broadband access is a foundational enabler of economic and social inclusion. Disadvantaged communities may experience a persistent digital divide that limits access to education, employment opportunities, healthcare services, including telemedicine, and civic participation. Measuring broadband access in these areas provides insight into progress toward digital equity and supports the design of targeted interventions to reduce digital inequalities. Limited access to reliable internet can constrain education, workforce participation and access to essential services, making this KPI relevant to inclusive urban development and resilience.		
Methodology	Calculate as Numerator: Number of households in disadvantaged areas with access to reliable broadband internet services. Denominator: Total number of households in disadvantaged areas Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Cities can compare broadband access in disadvantaged areas with national and international benchmarks, peer cities, and trends over time. Benchmarking should consider differences in geographic characteristics, infrastructure availability, affordability, population characteristics and definitions of disadvantaged areas. Cities can use the results to identify connectivity gaps and establish context-specific targets for achieving more equitable broadband access.		
Source (s) / References	Federal Communications Commission. (2025). *Internet Access Services Reports*. Retrieved from https://www.fcc.gov/internet-access-services-reports [fcc.gov] OECD. (2024). *Broadband statistics*. Retrieved from https://www.oecd.org/en/topics/broadband-statistics.html [oecd.org]. U.S. Census Bureau & NTIA. (2024). *ACCESS BROADBAND Dashboard Quick Guide*. Retrieved from https://www2.census.gov/programs-surveys/demo/technical-documentation/access-broadband/quick_guide_ACCESS_BROADBAND_Dashboard.pd		

Dimension	Economy
Subdimension	**Digital Skills**
Data Sources / Relevant Databases	US FCC National Broadband Map – Detailed availability by location. [fcc.gov] American Community Survey (ACS) – Household broadband subscription data. [countyheal...nkings.org].ACCESS BROADBAND Dashboard (NTIA & Census) – Socio-economic and broadband adoption indicators. [www2.census.gov]. OECD ICT Access and Usage Database – International benchmarking. [goingdigit...l.oecd.org]. Ookla Speedtest Data – Quality and performance metrics for disadvantaged urban areas. [ookla.com]

Dimension	Economy		
Subdimension	**Digital Skills**		
KPI No	81		
KPI Name	**Digital Device Ownership**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of households that own and have regular access to at least one functional digital device, including smartphones, tablets, laptops, or desktop computers, used for communication, education, work, access to services, or participation in the digital economy.		
Rationale / Interpretation	Digital device ownership is a foundational enabler of digital inclusion, economic participation, and lifelong learning in people-centred cities. Access to devices allows residents to connect to digital public services, employment opportunities, financial services, education platforms, and social networks. Higher levels of household device ownership generally indicate stronger readiness to participate in the digital economy and benefit from smart city services. Equitable device ownership helps reduce barriers faced by low-income households, women, older persons, youth, migrants, and persons with disabilities. Low ownership levels may signal affordability challenges, unequal access, or broader digital divides that limit inclusion and opportunity.		
Methodology	Calculate as Numerator: Number of households in disadvantaged areas with at least one digital device Denominator: Total number of households in disadvantaged areas Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Emerging Level: Limited household ownership of digital devices, with significant gaps among disadvantaged households and population groups. Progressing Level: Increasing household ownership, with remaining gaps in access among disadvantaged households and population groups. Advanced Level: High household ownership of digital devices, with relatively limited access gaps across disadvantaged households and population groups. Leading Level: Very high and broadly equitable household ownership of digital devices, with inclusive distribution across disadvantaged households and population groups.		
Source (s) / References	ITU – Measuring Digital Development: ICT Household Indicators. United Nations E-Government and Digital Inclusion frameworks. UN-Habitat – People-Centred Smart Cities approaches. U4SSC Key Performance Indicators for Smart Sustainable Cities		

Dimension	Economy
Subdimension	**Digital Skills**
Data Sources / Relevant Databases	National household ICT access surveys. Population census data Municipal digital inclusion assessments. Telecommunications regulatory authorities National statistics offices. Household expenditure and living conditions surveys

Dimension	Economy		
Subdimension	**Digital Skills**		
KPI No	82		
KPI Name	**Digital Inclusion and Equity**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage change in access to digital infrastructure and e-services among previously underserved populations over time, reflecting progress in reducing the digital divide.		
Rationale / Interpretation	This KPI assesses the effectiveness of initiatives to bridge the digital divide by measuring improvements in access to digital infrastructure and services among underserved populations. It reflects the city's commitment to equitable and inclusive digital transformation, ensuring that all residents regardless of socio-economic status, age, ability, or geographic location, can benefit from digital development.		
Methodology	Calculate as Numerator: (Current access rate − Baseline access rate) Denominator: Baseline access rate Multiply by 100 Disaggregate results by population segment to identify disparities and ensure targeted interventions are effective. Accessibility compliance. Number or percentage of digital platforms, public services, facilities, or organizations that meet recognized accessibility standards, ensuring inclusive access for all users.		
Unit	Percentage (%)		
Benchmarking	Key benchmarking approaches include: ITU's U4SSC Indicators: Use benchmarks from the *United for Smart Sustainable Cities* initiative, which includes metrics on digital infrastructure, accessibility, and inclusion. OECD Smart City Measurement Framework: Reference indicators that assess whether smart city initiatives benefit all residents, focusing on inclusion, sustainability, and resilience. Websites and services should be accessible following WCAG 2.0 and EN301549. Progress over time, reduction of identified gaps, comparison with peer cities, and nationally established digital inclusion targets.		
Source (s) / References	United for Smart Sustainable Cities (U4SSC). United Nations Department of Economic and Social Affairs (UN DESA). UNICEF / UNESCO digital learning and connectivity frameworks.		
Data Sources / Relevant Databases	National census and household ICT surveys World Bank Digital Progress and Trends Report: https://www.worldbank.org/en/publication/digital-progress-and-trends-report ITU ICT access and usage datasets. UN-Habitat urban inclusion data. Local government administrative records. NGO and academic survey studies. Qualitative interviews for barrier analysis.		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	83		
KPI Name	**Household Fixed Broadband Availability**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of households with access to a fixed broadband connection at their place of residence through technologies such as fibre, cable, DSL, or other wired networks. By speed: 256 – 2 Mbit/s 2 – 10 Mbit/s >10 Mbit/s		
Rationale / Interpretation	This indicator demonstrates the access to information and technology connectivity and its correlation to economic prosperity, development, and growth. A higher penetration rate means that more of the population has access to knowledge and communications, as well as technologies to receive and send information and communications (i.e. mobile phones, computers, television, etc.). Fixed (wired) broadband subscriptions refer to subscriptions for high-speed access to the public Internet (a TCP/IP connection). 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). Mobile cellular network subscriptions are not included.		
Methodology	Calculate as Numerator: Total number of city households with fixed broadband access (Disaggregated by speed: 256 – 2 Mbit/s : 2 – 10 Mbit/s : >10 Mbit/s Denominator: Total number of city households Multiply by 100		
Unit	Percentage (%)		
Benchmarking	The highest percentage at >10 Mbit/s should be pursued. A higher percentage at higher speeds indicates means more households have access to high-speed internet access.		
Source (s) / References	Data can be collected from internet service providers. OECD Statistics: https://www.oecd.org/en/topics/sub-issues/broadband-statistics.html ITU Broadband Commission: https://www.broadbandcommission.org/publication/state-of-broadband-2023/		
Data Sources/ Relevant Databases	National telecom regulators. National statistics offices ITU ICT Household Indicators Database Internet service providers (aggregated data) Household ICT surveys. Municipal connectivity databases		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	84		
KPI Name	**Broadband Service Affordability**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the cost of fixed and mobile broadband services relative to the income of city inhabitants, providing an indication of the affordability of broadband access.		
Rationale / Interpretation	Broadband affordability is a critical determinant of digital inclusion. High costs relative to income can create barriers to adoption and continued use, particularly for low- and moderate-income households, potentially perpetuating the digital divide. Affordable broadband supports equitable access to education, health care, employment, public services and civic participation.		
Methodology	Calculate as Numerator: Average monthly cost of a representative broadband subscription in the city, disaggregated by fixed and mobile broadband. Denominator: Median monthly per-capita income of city inhabitants Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Cities can compare broadband affordability with international and national affordability benchmarks, peer cities, and changes over time. Benchmarking should consider differences in income levels, broadband service characteristics, market conditions, household composition and the availability of subsidized or discounted services. Lower broadband costs relative to income indicate greater affordability and generally support more inclusive access to digital connectivity.		
Source (s) / References	Broadband Commission for Sustainable Development. (2023). *Advocacy target 2: Make broadband affordable*. https://www.broadbandcommission.org/advocacy-targets/2-affordability/ International Telecommunication Union. (2024). *Facts and figures 2024: Affordability of ICT services*. https://www.itu.int/itu-d/reports/statistics/2024/11/10/ff24-affordability-of-ict-services/		
Data Sources / Relevant Databases	ITU ICT Price Baskets: Global data on mobile and fixed broadband costs https://www.itu.int/en/ITU-D/Statistics/Pages/ICTprices/default.aspx FCC Urban Rate Survey: U.S. broadband pricing and benchmarking data. https://www.fcc.gov U.S. Census Bureau & Bureau of Labor Statistics: Median income and expenditure data. USTelecom Broadband Pricing Index: Trends in broadband pricing. https://www.ustelecom.org Local Government Statistical Offices: City-level income and broadband cost data for localized KPI calculation.		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	85		
KPI Name	**5G Network Coverage**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city served by wireless 5G broadband		
Rationale / Interpretation	This indicator demonstrates the access to information and technology connectivity and is correlated to economic prosperity, development and growth. 5G network coverage is a critical enabler of digital transformation in cities. High-speed connectivity supports smart city applications such as IoT, autonomous transport, telemedicine, and real-time data analytics. Enhanced connectivity fosters job creation, operational efficiency, and equitable access to digital services, aligning with Sustainable Development Goals (SDG 8) for decent work and economic growth. The coverage of 5G high speed mobile internet from providers is key to enable these capabilities.		
Methodology	Calculate as Numerator: Area of city covered by 5G mobile services (km^2) Denominator: Total area of the city (km^2) Multiply by 100		
Unit	Percentage (%)		
Benchmarking	The long-term objective is to achieve comprehensive coverage. An increasing trend and higher values indicate positive progress.		
Source (s) / References	International Telecommunication Union (ITU), United Nations Economic Commission for Europe (UNECE), & U4SSC. (2017). *Collection methodology for key performance indicators for smart sustainable cities*. United for Smart Sustainable Cities (U4SSC). https://u4ssc.itu.int/u4ssc-methodology/ Oxford Economics. (2023). *The global economic potential of 5G-enabled technology*. Retrieved from https://www.oxfordeconomics.com/resource/the-global-economic-potential-of-5g-enabled-technology/ [oxfordeconomics.com]. World Economic Forum. (2020). *The impact of 5G: Creating new value across industries and society*. Retrieved from https://www3.weforum.org/docs/WEF_The_Impact_of_5G_Report.pdf [www3.weforum.org].		
Data Sources / Relevant Databases	Local Mobile Service Providers: Coverage maps and GIS shapefiles from carriers (e.g., Verizon, AT&T, T-Mobile). Regulatory Databases: FCC Broadband Data Collection (U.S.), GSMA Intelligence global coverage datasets.		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	86		
KPI Name	**Public Wi-Fi Coverage**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of the city covered by public Wi-Fi provided by the city		
Rationale / Interpretation	Public Wi-Fi coverage is a critical enabler of digital inclusion and smart city functionality. It reduces the digital divide by providing equitable internet access to all citizens, including underserved communities. This KPI supports economic development by attracting businesses and tourists, improving citizen engagement, and enabling IoT-based smart city services such as transportation updates and emergency alerts. High coverage correlates with improved quality of life, enhanced public safety, and better access to e-government services.		
Methodology	Calculate as Numerator: Area of the city with Public Wi-Fi (km2) Denominator: Total area of the city Multiply by 100 Calculation should be for areas with reliable public Wi-Fi signal (e.g., minimum -65 dBm for connectivity).		
Unit	Percentage (%)		
Benchmarking	Urban Public Spaces: ~75% coverage (Pew Research) Smart City Leaders: Cities like New York (LinkNYC) aim for near 100% coverage in high-traffic zones Recommended target for smart cities: ≥85% coverage in key public areas		
Source (s) / References	International Telecommunication Union (ITU), United Nations Economic Commission for Europe (UNECE), & U4SSC. (2017). *Collection methodology for key performance indicators for smart sustainable cities*. United for Smart Sustainable Cities (U4SSC). https://u4ssc.itu.int/u4ssc-methodology/ National Institute of Standards and Technology. (2022). *Smart Cities and Communities: A Key Performance Indicators Framework* (NIST SP 1900-206). https://doi.org/10.6028/NIST.SP.1900-206-upd1 [nvlpubs.nist.gov]		
Data Sources / Relevant Databases	US FCC National Broadband Map: https://broadbandmap.fcc.gov/ [broadbandmap.fcc.gov] NTIA National Broadband Availability Map (NBAM): https://broadbandusa.ntia.gov/resources/data-and-mapping [broadbandu...a.ntia.gov] City Open Data Portals (e.g., Free Wi-Fi Locations datasets): https://catalog.data.gov/dataset/free-wi-fi-locations [catalog.data.gov] Ookla Open Data Initiative: https://www.ookla.com/ookla-for-good/open-data [ookla.com]		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	87		
KPI Name	**Fixed (wired) broadband subscriptions**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the number of fixed (wired) broadband subscriptions per household. Fixed (wired) broadband includes broadband delivered through cable modem, DSL, fibre and other fixed wired technologies.		
Rationale / Interpretation	Fixed broadband connectivity is a foundational component of digital inclusion and access to digital services. Higher levels of household fixed broadband adoption can support access to e-government, telemedicine, online education, digital commerce, remote work and other digitally enabled services. Monitoring fixed broadband subscriptions helps cities assess connectivity and identify gaps in digital access and infrastructure.		
Methodology	Calculate as Numerator: Number of fixed (wired) broadband subscriptions. Denominator: Total number of households. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	An increasing value indicates greater adoption of fixed broadband connectivity. Cities can compare their fixed broadband penetration with peer cities, national and regional benchmarks, and trends over time. Comparisons should consider differences in household characteristics, technology availability, market structure, affordability and the availability of alternative broadband technologies.		
Source (s) / References	*U4SSC Collection methodology for key performance indicators for smart sustainable cities*. United for Smart Sustainable Cities (U4SSC). https://u4ssc.itu.int/u4ssc-methodology/ Organisation for Economic Co-operation and Development (OECD). (2024). *ICT Access and Usage by Households and Individuals Database*. Retrieved from https://goingdigital.oecd.org/en/indicator/13 [goingdigit...l.oecd.org] ITU. (2025). *ICT Statistics Database*. Retrieved from https://www.itu.int/en/ITU-D/Statistics/pages/stat/default.aspx [itu.int]		
Data Sources / Relevant Databases	Household ICT surveys and census data ITU World Telecommunication/ICT Indicators Database OECD ICT Access and Usage Database ISP subscription records and market reports		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	88		
KPI Name	**Wireless Broadband Subscriptions**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/ Usage
Definition / Description	Measures the number of wireless broadband subscriptions per 100 000 inhabitants. Wireless broadband includes broadband access provided through mobile cellular networks and satellite networks, where applicable.		
Rationale / Interpretation	This indicator provides insight into the level of wireless digital connectivity and population access to broadband services. Higher penetration indicates greater adoption of wireless connectivity and can support access to digital services, information, education, employment and other digitally enabled activities. The KPI can also provide insight into the availability and adoption of wireless broadband technologies and contribute to the assessment of digital connectivity and inclusion.		
Methodology	Calculate as Numerator: Number of wireless broadband subscriptions Denominator: City population ÷ 100 000		
Unit	Number per 100 000 inhabitants		
Benchmarking	Increasing values indicate greater adoption of wireless broadband connectivity. Cities can compare wireless broadband penetration with national averages, regional peers, comparable cities and relevant international benchmarks, including ITU indicators. Comparisons should consider differences in population characteristics, mobile and broadband markets, technology availability, affordability and the use of multiple subscriptions by individuals.		
Source (s) / References	International Telecommunication Union. (2022). *U4SSC KPIs Verification Manual: A guide for verifiers*. ITU. Retrieved from https://www.itu.int [itu.int] U4SSC. (2017). *Collection methodology for key performance indicators for smart sustainable cities*. United for Smart Sustainable Cities (U4SSC). https://u4ssc.itu.int/u4ssc-methodology/ ITU-T. (2022). *Recommendation Y.4903: Key performance indicators for smart sustainable cities to assess the achievement of sustainable development goals*. ITU. Retrieved from https://handle.itu.int/11.1002/1000/14173-en [handle.itu.int]		
Data Sources / Relevant Databases	ITU World Telecommunication/ICT Indicators Database – Provides global and national broadband subscription data. World Bank Development Indicators – Broadband penetration statistics OECD Broadband Statistics – Comparative data for developed economies Local Sources: Municipal statistics offices, national telecom regulators, and mobile network operators. FCC Internet Access Services Reports (for U.S. context)		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	89		
KPI Name	**5G Usage**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the 5G Penetration Rate		
Rationale / Interpretation	This KPI helps assess the extent to which 5G technology is being adopted by users, which in turn reflects the readiness of the city to support advanced digital services, IoT applications, and smart infrastructure. High penetration rates indicate strong network deployment and user engagement.		
Methodology	Calculate as Numerator: Number of active 5G connections Denominator: Total mobile subscriptions Multiply by 100		
Unit	Percentage (%)		
Benchmarking	South Korea and Puerto Rico lead in 5G availability with users connected to 5G networks nearly 50% of the time. The United States ranks fourth with 31.1% availability. In Europe, Finland and Bulgaria have the highest scores around 24%. Source: https://www.opensignal.com/2023/06/30/benchmarking-the-global-5g-experience-june-2023		
Source (s) / References	RF Wireless World - 5G KPIs Explained: https://www.rfwireless-world.com/terminology/5g-kpis 5G PPP - KPI Measurement Tools: https://5g-ppp.eu/wp-content/uploads/2023/05/TMV-KPI-Measurement-Tools_1.0-published.pdf GSMA Intelligence - 5G Connectivity Index: https://www.gsmaintelligence.com/subscriptions-services/data/5g-connectivity-index Statista - 5G Statistics: https://www.statista.com/topics/3447/5g/ MDPI - Smart Cities Journal: https://www.mdpi.com/2624-6511/8/2/70		
Data Sources / Relevant Databases	Data is typically collected from mobile network operators and national telecom regulators.		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	90		
KPI Name	**Wi-Fi Usage**		
Category • **Core** • **Advanced**	Core	**Type:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Output/Usage
Definition / Description	Measures the percentage of city residents Using Public Wi-Fi		
Rationale / Interpretation	Measuring the percentage of residents using public Wi-Fi is critical for assessing digital inclusion, urban connectivity, and readiness. Public Wi-Fi access reduces the digital divide by providing free or low-cost internet to underserved populations, enabling participation in education, employment, and civic engagement. It also supports economic development by attracting businesses and tourists and facilitates city services such as IoT applications and e-government platforms. High adoption rates indicate strong infrastructure and public trust in connectivity services.		
Methodology	Calculate as Numerator: Number of city inhabitants using public Wi-Fi Denominator: Total number of city inhabitants Multiply by 100.		
Unit	Percentage (%)		
Benchmarking	Mature smart cities: Widespread and regular public Wi-Fi use. Developing cities: Emerging public Wi-Fi adoption with coverage and accessibility gaps. Comparative Tools: Global Smart Cities Policy Benchmarking Tool and WBBA Gigacity criteria.		
Source (s) / References	IEEE Standards Association. (n.d.). IEEE standards for smart cities. Retrieved from https://standards.ieee.org/initiatives/smart-cities-standards/ [standards.ieee.org] Singh, A. (2023). Benchmarking network performance in smart cities. *Journal of Artificial Intelligence & Cloud Computing, 2*(2), 1–6. Retrieved from https://www.onlinescientificsresearch.com/articles/benchmarking-network-performance-in-smart-cities.pdf		
Data Sources / Relevant Databases	Data can be collected from local surveys of inhabitants WiGLE Database: Global crowdsourced Wi-Fi network statistics (https://wigle.net/stats). [wigle.net] NTIA Internet Use Survey: U.S. data on connectivity and device usage (https://www.ntia.gov/data/explorer). [ntia.gov] ITU ICT Statistics: Global and regional internet usage trends (https://www.itu.int/en/ITU-D/Statistics/pages/stat/default.aspx).		

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	91		
KPI Name	**Broadband Internet Satisfaction**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of households/businesses satisfied with fixed broadband internet		
Rationale / Interpretation	Broadband internet access satisfaction is a critical indicator of digital inclusion and infrastructure quality. High satisfaction levels correlate with improved economic productivity, social connectivity, and quality of life. Dissatisfaction often signals issues such as inadequate speed, reliability, affordability, or customer service, which can lead to higher churn rates and reduced trust in digital services. Measuring satisfaction helps policymakers and service providers identify gaps and prioritize investments in network performance and customer experience.		
Methodology	Calculate as Numerator: Number of businesses / households satisfied with fixed broadband Denominator: Total number of businesses / households with fixed broadband Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Satisfaction depends on survey methodology, market structure, service expectations and the dimensions included in the score. Benchmarking use comparable survey methodologies, peer cities, national targets and year-on-year changes. Satisfaction may also be disaggregated by speed tier, affordability, geography and population group to identify digital-inclusion gaps. Implementation can subsequently be demonstrated through repeated city reporting, survey results, consumer-protection or regulatory reports, and documented changes in satisfaction over time.		
Source (s) / References	Alliance for Affordable Internet. (2021). *Quantitative measures of meaningful connectivity: Methodology guide (v1.0)*. Web Foundation. https://globaldigitalinclusion.org/wp-content/uploads/2022/12/Quantitative-Measures-of-Meaningful-Connectivity_-Methodology-Guide-v1.pdf MedUX. (2025). *Assessing user QoE with MedUX's fixed broadband benchmarking methodology*. https://medux.com/blog/assessing-broadband-benchmarking-methodology.		

Dimension	Economy
Subdimension	**Infrastructure and Connectivity**
Data Sources / Relevant Databases	Conduct household and business surveys using standardized questionnaires to capture perceived satisfaction with fixed broadband services. Include Likert-scale questions (e.g., 1–5 rating) on speed, reliability, affordability, and support Broadband Customer Satisfaction Reports – Industry trend analysis and consumer sentiment [rsinc.com] Microsoft Airband Initiative Dataset – Broadband usage estimates by region

Dimension	Economy		
Subdimension	**Infrastructure and Connectivity**		
KPI No	92		
KPI Name	**5G Services Satisfaction**		
Category • **Core** • **Advanced**	Advanced	**Type:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Measures the percentage of satisfaction with 5G Services or broadband mobile		
Rationale / Interpretation	This KPI evaluates the perceived quality and effectiveness of 5G services from the perspective of end users. Satisfaction levels reflect not only technical performance (e.g., speed, coverage, reliability) but also user experience, affordability, and accessibility. High satisfaction indicates successful deployment and integration of 5G infrastructure, contributing to digital inclusion, economic competitiveness, and innovation. Conversely, low satisfaction may signal gaps in service delivery, digital literacy, or infrastructure equity, guiding policymakers and service providers toward targeted improvements.		
Methodology	Calculate as Numerator: Number of city inhabitants satisfied with 5G services Denominator: Total Number of city inhabitants Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Benchmarking should rely on consistent survey methodology, peer-city comparison, national regulatory targets and changes over time.		
Source (s) / References	Umlaut Mobile Benchmarking Framework – Industry-standard methodology for assessing mobile network quality and performance across 120+ countries. Accenture: Mobile Benchmarking Framework Ericsson ConsumerLab Reports – Global studies on 5G user satisfaction and experience drivers Ericsson: 5G Network Performance Global Smart Cities Alliance Benchmarking Tool – Framework for comparing digital infrastructure maturity and citizen satisfaction 5G-PPP KPI Measurement Tools White Paper ITU and 3GPP guidelines for enhanced mobile broadband (eMBB), ultra-reliable low-latency communications (URLLC), and massive machine-type communications (mMTC). RF Wireless World: 5G KPIs Explained		
Data Sources / Relevant Databases	Cities can develop a standardized questionnaire targeting residents, businesses, and public service users in the city. The survey should assess satisfaction across key dimensions such as: 1. Network speed and reliability 2. Coverage and accessibility 3. Affordability 4. Customer support and 5. Perceived impact on daily life and productivity.		

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	93		
KPI Name	**Smart Mobility and Transport Monitoring**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of public transport vehicles enabled with GPS (or equivalent) tracking by type.		
Rationale / Interpretation	The integration of GPS (or equivalent tracking technologies) in public transport vehicles is a foundational element of smart mobility. It enables real-time monitoring, improves operational efficiency, enhances passenger safety, and supports data-driven decision-making for transport planning. This KPI reflects the city's commitment to digital transformation in mobility by measuring the extent to which public transport fleets are digitally enabled. A higher proportion indicates better infrastructure for route optimization, service reliability, and user experience. It also facilitates transparency and accountability in public transport services, contributing to broader goals such as sustainability, accessibility, and urban resilience.		
Methodology	Calculate as Numerator: Number of public transport vehicles enabled with GPS (or equivalent) tracking Denominator: Total number of public transport vehicles Multiply by 100. Present results by vehicle type to highlight differences in digital enablement across modes.		
Unit	Percentage (%)		
Benchmarking	Basic Enablement: Public transport vehicles are equipped with GPS or equivalent tracking technologies. Advanced Enablement: Tracking is integrated with transport management and passenger-facing platforms. Best Practice: Comprehensive tracking across vehicle types, with real-time data sharing and integration into transport planning and services.		
Source (s) / References	Ajuntament de Barcelona. (n.d.). *Open Data BCN*. https://opendata-ajuntament.barcelona.cat/en/ General Transit Feed Specification. (2025, October 28). *Reference – GTFS documentation*. GTFS.org. https://gtfs.org/documentation/schedule/reference/ European Transport Research Review. (n.d.). *Journal homepage*. Springer. https://link.springer.com/journal/12544		

Dimension	Economy
Subdimension	**Transport and Mobility**
Data Sources / Relevant Databases	Fleet inventory and GPS installation records from city or regional transit agencies (e.g., TMB in Barcelona, TfL in London). Real-time tracking platforms used by operators to monitor vehicle positions and performance. GTFS-RealTime and GTFS-Static datasets provide structured data on vehicle locations, schedules, and service alerts. City-level open data platforms (e.g., Barcelona Open Data) often publish transport-related datasets, including GPS coverage and fleet details.

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	94		
KPI Name	**Public Transport Stops**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the proportion of public transport stops with real time information		
Rationale / Interpretation	This KPI measures the percentage of public transport stops providing accessible, real-time service information, enabling people to plan journeys with confidence, reducing uncertainty, and improving the overall travel experience. It reflects the city's commitment to inclusive, user-centred, and digitally enabled public transport. Access to real-time information at public transport stops significantly enhances the user experience by improving journey planning, reducing uncertainty, and increasing confidence in public transit systems. This KPI reflects the extent to which a city leverages digital technologies to provide accessible, timely, and accurate transit updates, such as arrival times, delays, and service changes. A higher proportion of stops with accessible and real-time information indicates a more digitally enabled and responsive transport infrastructure, which can lead to increased public transport usage, reduced reliance on private vehicles, and improved urban mobility, while demonstrating the city's commitment to inclusive, user-centred service delivery.		
Methodology	Calculate as Numerator: Total number of accessible public transport stops in the city with real time information. Denominator: Total number of accessible public transport stops in the city. Multiply by 100		
Unit	Number of accessibility compliance services from tickets to services		
Benchmarking	Basic Enablement: Limited availability of real-time information at accessible stops Intermediate Enablement: Increasing deployment and integration of real-time information across accessible stops. Advanced Enablement: Widespread availability of real-time information, demonstrating mature digital infrastructure. Cities differ substantially in stop density, transport modes, network complexity and technology deployment. Peer-city comparison, national requirements, historical improvement and city-specific targets provide a more defensible benchmarking approach.		
Source (s) / References	U4SSC *Collection methodology for key performance indicators for smart sustainable cities*. United for Smart Sustainable Cities (U4SSC). https://u4ssc.itu.int/u4ssc-methodology/ General Transit Feed Specification https://gtfs.org/resources/sharing-data/ The National Transit Database (NTD) https://www.transit.dot.gov/ntd		

Dimension	Economy
Subdimension	**Transport and Mobility**
Data Sources / Relevant Databases	City or regional transit agencies often maintain databases of public transport accessible stops and real-time information systems. Examples are: National Transit Databases: The U.S. National Transit Database https://www.transit.dot.gov/ntd and France's transport.data.gouv.fr provide structured transit data. Barcelona, Spain: The transport system incorporates voice navigation, tactile mapping, and a real-time tracking app. Access routes and ticket purchasing can be managed via the TMB App. Mobility Database: A global catalog of over 4,000 GTFS and GTFS Realtime feeds from 75+ countries, ideal for benchmarking and comparative analysis. https://mobilitydatabase.org/ World Transit Stops (Esri): Offers geospatial data on transit stops worldwide, updated monthly, https://www.arcgis.com/home/item.html?id=bd16f5a9ce574a14b5a68b65397b466e

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	95		
KPI Name	**Digital Payment System for Public Transport**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the share of public transport vehicles and stations that support digital payment systems across relevant transport modes, such as buses, metro and trams.		
Rationale / Interpretation	Digital payment systems are an important enabler of smart mobility and digital transformation in public transport. This KPI reflects the extent to which public transport infrastructure supports convenient and cashless fare transactions. Digital payment can improve passenger convenience, reduce boarding and transaction times, simplify fare management, and reduce the operational costs associated with cash handling and paper-based ticketing. Digital payment systems can also generate transaction data that can support demand analysis, service planning and operational improvements.		
Methodology	Calculate as Numerator: Number of public transport vehicles and stations where digital payment is available Denominator: Total number of public transport vehicles and stations where fare payment is applicable. Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Basic Enablement: Limited digital payment availability across the public transport network Intermediate Enablement: Digital payment deployed across multiple transport modes, with some coverage gaps. Advanced Enablement: Widespread digital payment availability across major transport modes Leading Practice: Seamless, interoperable digital payment integrated across the public transport network.		
Source (s) / References	International Association of Public Transport. (n.d.). *UITP reports and publications*. https://www.uitp.org International Transport Forum. (n.d.). *ITF research and statistics*. https://www.itf-oecd.org World Bank. (n.d.). *Urban mobility reports*. https://www.worldbank.org/en/topic/transport		

Dimension	Economy
Subdimension	**Transport and Mobility**
Data Sources / Relevant Databases	Use data from transport authorities, service providers, and digital payment vendors UITP (International Association of Public Transport) ITF (International Transport Forum) World Bank Urban Mobility Reports. UN-Habitat Smart City Profiles

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	96		
KPI Name	**Urban Traffic Monitoring and Alert Systems**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the percentage of major roads in the city covered by an active real-time alert systems for traffic, safety or environmental hazards.		
Rationale / Interpretation	Urban traffic monitoring and alert systems are essential for enhancing road safety, reducing congestion, and improving emergency response times. By covering major roads with real-time alert systems, cities can proactively manage traffic flow, detect incidents, and respond to environmental hazards such as air pollution or extreme weather. This KPI reflects a city's commitment to leveraging digital infrastructure to support mobility, safety, and sustainability. A higher percentage indicates better preparedness and responsiveness, contributing to a more resilient and people-centred urban environment.		
Methodology	Calculate as Numerator: Length of major roads with active alert systems Denominator: Total length of major roads Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Basic: Limited deployment and integration of traffic monitoring and alert systems Intermediate: Moderate deployment across key roads, with partial integration Advanced: Widespread deployment across major roads and key corridors Leading: Comprehensive, real-time integration with centralized traffic management systems		
Source (s) / References	Ajuntament de Barcelona. (n.d.). *Open Data BCN*. https://opendata-ajuntament.barcelona.cat/en/ [apastyle.apa.org] European Commission. (2021). *Intelligent Transport Systems (ITS) KPI frameworks and data collection methodologies*. https://transport.ec.europa.eu/document/download/93ba8375-0ac0-477d-b6a9-9deca6b5b01d_en [style-guid....europa.eu]		
Data Sources / Relevant Databases	City Transport Authority Databases: Road classifications, infrastructure maps, and sensor deployment records. Open Data Portals: For example, Open Data BCN provides datasets on mobility, traffic sensors, and environmental monitoring in Barcelona. [opendata-a...celona.cat] Centralized Traffic Management Systems: Real-time data from integrated platforms managing traffic signals, CCTV, and digital signage.		

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	97		
KPI Name	**Advanced Transit Management System**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the deployment of an Advanced Transit Management System (ATMS) featuring a centralized traffic management platform and operations centre.		
Rationale / Interpretation	Deployment of an Advanced Transit Management System (ATMS) reflects a city's commitment to leveraging digital technologies to enhance urban mobility. A centralized traffic management platform and operations centre enables real-time monitoring, data-driven decision-making, and coordinated responses to traffic conditions, incidents, and public transit operations. This KPI assesses the extent to which cities are integrating intelligent systems to improve efficiency, reduce congestion, and enhance the commuter experience. It also serves as an indicator of digital maturity in urban transport infrastructure.		
Methodology	Confirm the existence of a centralized traffic management platform and operations centre through official city documentation, infrastructure reports, or third-party audits. Existence of centralized traffic management platform Operational control centre with real-time capabilities System Capabilities Assessment Evaluate the system's functionalities, including: • Real-time traffic monitoring and analytics • Incident detection and response coordination • Integration with public transit operations • Integration with emergency services • Integration with environmental monitoring systems • Use of AI or predictive analytics for traffic flow optimization Scoring and Reporting Each category above is scored on a scale from 0 to 5, where: • 0 = Not present / No evidence • 1 = Initial / Pilot stage • 2 = Basic functionality • 3 = Operational with moderate integration • 4 = Advanced functionality and integration • 5 = Fully optimized, benchmark-level system		
Unit	Numerical Score 0 – 30		

Dimension	Economy
Subdimension	**Transport and Mobility**
Benchmarking	0–10: Low maturity 11–20: Moderate maturity 21–25: High maturity 26–30: Benchmark / Leading practice
Source (s) / References	National Institute of Standards and Technology. (n.d.). *Smart cities and communities: A key performance indicators framework* (NIST Special Publication 1900-206). U.S. Department of Commerce. https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1900-206-upd1.pdf Federal Transit Administration. (n.d.). *Mobility performance metrics for integrated mobility and beyond* (FTA Report No. 0152). U.S. Department of Transportation. https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/research-innovation/147791/mobility-performance-metrics-integrated-mobility-and-beyond-fta-report-no-0152.pdf CONDUITS Project. (2019). *Key performance indicators for traffic management and intelligent transport systems* (EU 7th Framework Programme). Polis Network. https://www.polisnetwork.eu/wp-content/uploads/2019/06/d-3-5-key-performance-indicators-for-traffic-management-and-its-final.pdf Econolite. (n.d.). *Advanced traffic management system software: City of Charlottesville case study*. Econolite. https://www.econolite.com/in-action/case-study/advanced-traffic-management-system-software/ New Jersey Department of Transportation. (n.d.). *Enhancing traffic operations through real-time data-driven strategies: NJDOT's arterial management center case study*. Transportation Operations. https://www.transportationops.org/case-studies/enhancing-traffic-operations-through-real-time-data-driven-strategies-njdots-arterial International Organization for Standardization. (n.d.). *Smart city mobility standards*. ISO. https://www.iso.org/transport/smart-city-mobility

Dimension	Economy
Subdimension	**Transport and Mobility**
Data Sources / Relevant Databases	City Transportation Management Systems: Official municipal traffic and transit management platforms and dashboards. Public Transit Operations Data: GTFS (General Transit Feed Specification) datasets from local transit agencies. Traffic Sensor and IoT Data: Real-time feeds from traffic cameras, inductive loops, and smart sensors. Incident and Emergency Response Logs: City emergency services and traffic incident databases. Environmental Monitoring Systems: Air quality and emissions data linked to transportation networks. National Transportation Statistics: U.S. Department of Transportation databases and mobility performance metrics. Smart City Open Data Portals: City-level open data repositories for mobility and infrastructure. International Standards Repositories: ISO standards for smart city mobility and ITS (Intelligent Transport Systems). Benchmarking Frameworks: NIST Smart Cities KPI framework and EU CONDUITS project datasets. Third-Party Audits and Case Studies: Reports from technology vendors (e.g., Econolite) and transportation research organizations.

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	98		
KPI Name	**Smart Intersection Management**		
Category • **Core** • **Advanced**	Core	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Digital Enablement
Definition / Description	Measures the use of intelligent transport systems (ITS) at urban intersections to optimize traffic flow, reduce congestion, and improve road safety through real-time data, sensors, and adaptive signal control technologies. Measures the percentage of intersections controlled through ICT (e.g., sensors, cameras).		
Rationale / Interpretation	Smart intersection management enhances traffic flow, reduces congestion, and improves road safety by leveraging ICT tools such as sensors and cameras. This KPI reflects a city's ability to digitally monitor and control intersections, which is a key indicator of its digital infrastructure maturity. A higher percentage suggests better integration of technology in urban mobility systems, contributing to reduced travel times, lower emissions, and improved emergency.		
Methodology	Calculate as Numerator: Number of ICT-Controlled Intersections Denominator: Total Number of Intersections Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Basic Level: Early-stage deployment of ICT-enabled intersection management Intermediate Level: Moderate integration of ICT systems at urban intersections Advanced Level: Widespread or comprehensive deployment of ICT-enabled intersection management.		
Source (s) / References	United for Smart Sustainable Cities (U4SSC) International Telecommunication Union (ITU) National Institute of Standards and Technology (NIST) World Bank		
Data Sources / Relevant Databases	Use municipal traffic management databases, smart city infrastructure inventories, and field surveys to gather data.		

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	99		
KPI Name	**Public Transit Usage**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Public Transit Usage measures the proportion of the commuting population that primarily uses public transportation as their main mode of travel.		
Rationale / Interpretation	Public Transit Usage is a critical indicator of how effectively a city supports sustainable, inclusive, and digitally enabled mobility. Greater reliance on public transit reduces traffic congestion, lowers greenhouse gas emissions, and improves air quality, aligning with environmental goals of people-centred cities. Widespread public transit usage suggests that mobility services are accessible, affordable, and inclusive, enabling equitable access to jobs, education, and services. Increased usage often correlates with successful deployment of digital tools such as real-time tracking, mobile ticketing, and integrated multimodal platforms, which enhance user experience and operational efficiency. Efficient public transit systems contribute to economic productivity by reducing travel time and improving connectivity across urban areas. This KPI helps cities benchmark their progress toward becoming smart, sustainable, and people-centred by evaluating the effectiveness of their transit systems i in meeting commuter demands.		
Methodology	Calculate as Numerator: Total number of commuters who primarily use public transportation Denominator: Total number of commuters Multiply by 100		
Unit	Percentage (%)		
Benchmarking	Low: Limited public transit adoption among commuters Moderate: Moderate reliance on public transit, with opportunities to increase adoption High: Strong public transit adoption and significant reliance on public transportation		
Source (s) / References	United for Smart Sustainable Cities (U4SSC) International Association of Public Transport (UITP) World Bank. OECD. World Economic Forum		
Data Sources / Relevant Databases	Municipal public transport authorities Smart ticketing and fare card systems Automated Passenger Counter (APC) systems Household travel surveys		

Dimension	Economy		
Subdimension	**Transport and Mobility**		
KPI No	100		
KPI Name	**Traffic Time Index**		
Category • **Core** • **Advanced**	Advanced	**Stage:** • **Digital Enablement** • **Output/Usage** • **Outcome/Impact**	Outcome/Impact
Definition / Description	Ratio of actual average travel time to travel time under free-flow conditions, indicating the level of traffic congestion and mobility efficiency in a city.		
Rationale / Interpretation	The Traffic Time Index measures the extent to which congestion increases travel times compared with free-flow conditions. A higher index indicates greater congestion and travel delays, while a lower index indicates more efficient traffic flow. The KPI helps cities assess mobility performance, identify congestion hotspots, and evaluate the effectiveness of transport strategies and infrastructure investments.		
Methodology	TTI = Average actual travel time ÷ Average free-flow travel time Calculate the index for relevant routes or road segments and aggregate the results to obtain a city-wide measure.		
Unit	Ratio (unitless), representing the proportion of actual travel time to free-flow travel time		
Benchmarking	Benchmarking the Traffic Time Index (TTI) involves comparing a city's performance against established standards, historical data, and peer cities to assess mobility efficiency and identify areas for improvement. Low: Travel times remain close to free-flow conditions, indicating limited congestion Moderate: Travel times are noticeably higher than free-flow conditions, indicating moderate congestion. High: Travel times are substantially higher than free-flow conditions, indicating significant congestion and mobility delays.		
Source (s) / References	TomTom Traffic Index TomTom Traffic Index [tomtom.com] Numbeo Traffic Index Numbeo Traffic Index [numbeo.com] INRIX Speed and Travel Time Data INRIX Speed Data [inrix.com] OpenTraffic Initiative OpenTraffic [datacollab...atives.org]		
Data Sources / Relevant Databases	Municipal traffic management centres GPS and navigation platform data Mobile network and anonymized mobility data Road sensors and smart cameras. Public transport authority traffic datasets TomTom Traffic Index		


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