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ISO/CD 37122
Sustainable development in communities - Indicators for Smart Cities

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Sustainable Development in Communities - Indicators for Smart Cities

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 268, *Sustainable development in communities*.

Introduction

ISO 37120: *Sustainable Development of Communities – Indicators for City Services and Quality of Life* indicators have quickly become the international reference point for sustainable cities, ISO/TC268/WG2 experts have identified the need for additional indicators for smart cities.

ISO 37122: *Sustainable Development of Communities – Indicators for Smart Cities* will complement ISO 37120 and establish indicators and indicator definitions and methodologies to measure and consider aspects and practices that dramatically increase the pace at which cities improve their social, economic and environmental sustainability outcomes, responding to challenges such as climate change, rapid population growth, and political and economic instability by fundamentally improving how cities engage society, apply collaborative leadership methods, work across disciplines and city systems, and use data information and modern technologies.

This International Standard will help cities to implement Smart City policies to:

- Provide better services for citizens;
- Provide a better life environment where smart policies, practices and technology are put to the service of citizens;
- Achieve their sustainability and environmental goals in a more innovative way;
- Identify the need for smart infrastructure;
- Facilitate innovation and growth; and
- Build a dynamic and innovative economy ready for the challenges of tomorrow.

Indicators in this International Standard will also complement the metrics for smart infrastructure identified in ISO/TR 37151 and will build upon the concepts from this Technical Report but from a city services and quality of life perspective.

1 Scope

This International Standard defines and establishes definitions and methodologies for a set of indicators for Smart Cities.

As accelerating improvements in city services and quality of life is fundamental to the definition of a Smart City, this standard shall be implemented in conjunction with ISO 37120 Sustainable Development of Communities: City Services and Quality of Life to provide a complete set of indicators to measure progress towards a Smart City. This is represented in Figure 1.

Figure 1 – Complete Set of Indicators for Smart Cities

2 Normative references

ISO 37120: *Sustainable development of communities – Indicators for city services and quality of life* shall be used in conjunction with this document.

ISO 37101: *Sustainable develop and resilience of communities – Management systems – General principles and requirements* can be used in conjunction with this document.

3 Terms and definitions for cities

For the purposes of this document, the terms and definitions given in ISO 37101, ISO 37120 and the following apply.

3.1 Smart city

A smart city is one that increases the pace at which it provides social, economic, and environmental sustainability outcomes. Smart cities respond to challenges such as climate change, rapid population growth, and political and economic instability by fundamentally improving how they engage society, apply collaborative leadership methods, work across disciplines and city systems, and use data

information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors), now and for the foreseeable future, without unfair disadvantage of others or degradation of the natural environment.

4 City Indicators

This International Standard is designed to assist cities in steering and assessing the performance management of city services and all service provisions as well as quality of life. It considers sustainability as its general principle and "smart city" as a guiding concept in the development of cities. All indicators shall be reported on an annual basis.

For data interpretation purposes cities shall take into consideration contextual analysis when interpreting results. The local institutional environment may affect the capacity to apply indicators. In some cases, services may be delivered by the private sector or the community itself.

The list of indicators is based on the following criteria:

- Completeness: indicators have to measure all relevant aspects for evaluation of the smart city.
- Technology neutral: not favouring one technology over another, existing or future.
- Simplicity: indicators can be expressed and presented in an understandable and clear way.
- Validity: indicators are an accurate reflection of the facts and data can be collected using scientific techniques.
- Verifiable: indicators are verifiable and reproducible. Methodologies are rigorous enough to give certainty to the level of implementation of the criteria.
- Availability: quality data is available or it is feasible to initiate a monitoring process that will make it available in the future.

When interpreting the results of a particular service area, it is important to review the results of multiple types of indicators across themes; focussing on a single indicator can lead to a distorted or incomplete conclusion. Elements of aspiration must also be taken into consideration in the analysis.

Users may also consider the following aspects which shall be clearly stated in the report and justified: indicators can be aggregated to larger administrative areas (ex. region, metropolitan areas etc.); since some indicators are indirectly linked to sustainability, there is a need to consider the resource efficiency of a city; indicators can be grouped together for analysis when taking into consideration holistic characteristics of a city; and, this set of indicators may be complemented by other indicator sets in order to have a more comprehensive holistic approach to analysis on smart and sustainable cities.

Furthermore, it is also important to acknowledge potential antagonistic effects of the outcome of particular indicators, either positive or negative, when analysing results.

Cities using this International Standard shall report at least 50% of the indicators in this standard. "Smart Cities" is a relatively new concept that cities worldwide are beginning to address and it is important that cities report progressively more indicators in this standard over time.

5 Culture

5.1 Number of library book titles per 100 000 population

5.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Libraries help to educate the general population, in addition to providing civic spaces for interaction. Libraries can be considered a local gateway to knowledge, and provide "a basic condition for lifelong learning, independent decision-making and cultural development of the individual and social groups" (UNESCO Public Library Manifesto). Ultimately, as stated in UNESCO's Public Library Manifesto, "the public library [can be thought of as] a living force for education, culture and information, and as an essential agent for the fostering of peace and spiritual welfare through the minds of men and women."

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion" and "well-being" purpose of the city as defined in ISO 37101.

5.1.2 Indicator requirements

The number of library book titles per 100 000 population shall be calculated as the total number of library book titles (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of library book titles per 100 000 population.

The city shall include in this indicator the number of library book titles available to its citizens from public libraries. The city shall count any book titles available and accessible at a public library within city limits, and include both physical books/monographs and e-books, which include those books/monographs that have been digitized and are available for reading on a computer or other electronic devices. A public library is any library that has an organized collection of printed or other library materials, or a combination thereof, is supported in whole or in part with public funds and has an established schedule in which services of the staff are available to the public.

5.1.3 Data sources

Data on the number of library book titles should be sourced through local libraries, library boards or relevant city departments, or through ministries.

5.2 Number of library e-book titles per 100 000 population

5.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Libraries help to educate the general population, in addition to providing civic spaces for interaction. E-books have become popular amongst the public due to their ease of accessibility, allowing citizens to more conveniently continue lifelong learning, cultural development, and be exposed to a plethora of information. Furthermore, the availability of e-books indicates the level of digitization of a community's libraries, and also the ease of access to books via a library's website Moreover, e-books are comparatively more eco-friendly and promote sustainability, since e-books require less paper and labour to manufacture, and do not require shelf space. Also, e-books have grown significantly in popularity and prevalence within the publishing industry.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion" and "well-being" purpose of the city as defined in ISO 37101.

5.2.2 Indicator requirements

The number of library e-book titles per 100 000 population shall be calculated as the total number of library e-book titles (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of library e-book titles per 100 000 population.

The city shall include in this indicator the number of library e-book titles available to its citizens from public libraries. The city shall count any e-book titles available at a public library within city limits. An e-book shall refer to a book/monograph made available to read and access in digital form via computers or other electronic devices. A public library is any library that has an organized collection of printed or other library materials, or a combination thereof, is supported in whole or in part with public funds and has an established schedule in which services of the staff are available to the public.

5.2.3 Data sources

Data on the number of library e-book titles should be sourced through local libraries, library boards or city relevant departments, or through ministries.

5.3 Active library users as a percentage of total population

5.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Libraries help to educate the general population, in addition to providing civic spaces for interaction. The number of active library users is a measure of the reach and effectiveness of local libraries providing "a basic condition for lifelong learning, independent decision-making and cultural development of the individual and social groups" (UNESCO Public Library Manifesto).

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion" and "well-being" purpose of the city as defined in ISO 37101.

5.3.2 Indicator requirements

The number of active library users as a percentage of total population shall be calculated as the total number of active library users measured as citizens who are registered library members or measurably use library services (numerator) divided by the city's total population (denominator). The result shall then be multiplied by 100 and expressed as active library users as a percentage of total population.

An active library user shall refer to a registered public library member, or an individual with a user account at a public library that frequently utilizes library services with at least one transaction per month, such as accessing library/online databases to download articles or e-books that require library user privilege, or signing out library books.

The city shall include in this indicator the number of active library users who are library members at public libraries, or are measurably known to access the foregoing library services. The city shall count any active library users with a public library within city limits. A public library is any library that has an organized collection of printed or other library materials, or a combination thereof, is supported in whole or in part with public funds and has an established schedule in which services of the staff are available to the public.

5.3.3 Data sources

Data on the number of active library users should be sourced through local libraries, library boards or city relevant departments, or through ministries.

5.3.4 Data interpretation

A high number of active library users indicates that the city's libraries meet the needs of the population and that libraries help to educate the population.

6 Economy

6.1 Percentage of local businesses contracted to provide city services which have data communication openly available

6.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Data communication is the process of using computing and communication technologies to transfer data from one place to another, and vice versa. The ability to search and find business data available online beyond word-of-mouth or contacting a business is a component of a technologically forward and transparent business community.

NOTE 2 This indicator reflects the economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "attractiveness" purpose of the city as defined in ISO 37101.

6.1.2 Indicator requirements

The percentage of local businesses contracted to provide city services which have data communication openly available, such as an internet webpage that allows people to download company data, shall be calculated as the total number of local businesses contracted to provide city services with data communication openly available (numerator) divided by the total number of businesses in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of local businesses contracted to provide city services which have data communication openly available.

Local businesses contracted to provide city services shall refer to businesses that operate in the city and assist the city with providing city services and are contracted by the city to provide these city services, such as garbage collection, recycling, water/wastewater treatment, engineering and construction services, recreation services, etc.

City services shall refer to services provided by the city and typically cover the following areas: Garbage and Recycling; Public Safety; Fire Department; Roads and Traffic; Bylaws, Violations and Enforcement; Permits and Licences; Planning; Building; Policies, Projects and Initiatives; Rentals and Catering of City Buildings; Water and Sewers; and Property Taxes and Utilities.

6.1.3 Data sources

Data on local businesses contracted to provide city services with data communication openly available should be sourced from relevant city departments, or market research companies and survey companies.

6.1.4 Data interpretation

The higher the number of local businesses relevant to city services which have data communication openly available leads to more transparency of city service performance and a technologically forward community allowing people to review the data and performance of businesses contracted by the city to complete city services that may not be normally covered by performance measurements published by the city.

6.2 Annual number of new start-ups per 100 000 population

6.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Start-up companies make a positive contribution to local economies and start-up activity can signal a city's economic potential. Start-ups can potentially contribute a substantial number of new jobs to the economy, and tend to have faster employment growth rates, especially those in innovation-driven/technologically-focused enterprises, such as start-ups in computer or software development.

NOTE 2 This indicator reflects the economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "attractiveness" purpose of the city as defined in ISO 37101.

6.2.2 Indicator requirements

The annual number of new start-ups per 100 000 population shall be calculated as the annual total number of new start-ups in a city (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the annual number of new start-ups per 100 000 population.

Start-ups shall refer to those businesses which have been founded and registered within in the city in the last year. Businesses shall refer to companies or enterprises. The enterprise is the smallest combination of legal unit, which is an organizational unit producing goods or services. Business can either be categorized as simple (one operating entity) or complex (multiple operating entities) as stated in ISO 37120: 2018 indicator, Number of businesses per 100 000 population.

6.2.3 Data sources

Data on new start-ups should be obtained through relevant city departments or ministries that oversee the approval of new business licenses or new registrations of businesses.

6.3 Percentage of labour force employed in the Information and Communications Technology (ICT) sector

6.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The information and communication technologies (ICT) sector is a combination of manufacturing and services industries that capture, transmit and display data and information electronically (OECD). With the rapid development of ICT and the mainstreaming of ICT into everyday life, the link between ICT technologies and human development has never been more evident (ITU). ICT has long been recognized as key enablers for bridging the digital divide and achieving the three dimensions of sustainable development — economic growth, environmental balance and social inclusion; as well as promoting innovation in society (ITU). Thus, having a labour force to develop the ICT sector will be one of the main drivers for economic growth, augmenting labour productivity and enhancing international competitiveness via innovative ICT development, including by the wider use of ICT products and services across the economy and society.

NOTE 2 This indicator reflects "Living together, interdependence and mutuality" and "Economy and sustainable production and consumption" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "Social cohesion", "Well-being", "Attractiveness" and "Resilience" purposes of the city as defined in ISO 37101.

6.3.2 Indicator requirements

The percentage of labour force employed in the Information and Communications Technology (ICT) sector shall be calculated as the number of city residents in the labour force employed in the ICT sector (numerator) divided by the city's total labour force (denominator). The result shall then be multiplied by 100 and expressed as the percentage of labour force employed in the ICT sector.

The ICT sector shall refer to a combination of manufacturing and services industries that capture, transmit and display data and information electronically. For manufacturing industries, the products of a candidate industry must be intended to fulfil the function of information processing and communication including transmission and display; and must use electronic processing to detect, measure and/or record physical phenomena or control a physical process (OECD). For services industries, the products of a candidate industry must be intended to enable the function of information processing and communication by electronic means (OECD).

More specifically, the ICT sector shall refer to the United Nations Statistics Division's International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4 (Link: https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27) section J (Information and communication) in its entirety; and those subsections of section C of ISIC Rev. 4 (Manufacturing) that align with ICT manufacturing industries stated above, such as sections 26 - Manufacture of computer, electronic and optical products and 27 - Manufacture of electrical equipment.

The labour force shall refer to, as defined by the International Labour Organization (ILO), the sum of persons in employment plus persons in unemployment who are legally eligible to work. Thus, working-age shall refer to all persons that are the same age or older than the legal working age in the jurisdiction of reference. This indicator shall exclude child labour, which is labour completed by persons 14 years of age or younger.

6.3.3 Data sources

Data on employment by industry should be obtained through labour force surveys or city employment assessments administered by local, regional or national authorities/statistical bodies, or Ministry or Department of Labour Employment.

6.4 Percentage of the labour force employed in the Education and Research & Development sectors

6.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 As cities and communities strengthen their focus on the development of their knowledge economy the role of the education and research and development (R & D) industries are all the more important in the development of human capital. Both of these industries play a critical role in economic development, promoting innovative thought processes to enhance existing products or services or to develop new products and services. In addition, the education sector also includes those employed in all levels of the educational system, ensuring that citizens have access to education and receive effective educational services. Thus, the labour force employed in these two industries aid in the development or enhancement of products and services, as well as ensure that citizens receive quality education to become actively involved in the knowledge economy.

NOTE 2 This indicator reflects "Living together, interdependence and mutuality" and "Economy and sustainable production and consumption" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "Social cohesion", "Well-being", "Attractiveness" and "Resilience" purposes of the city as defined in ISO 37101.

6.4.2 Indicator requirements

The percentage of labour force employed in the Education and Research & Development sectors shall be calculated as the number of city residents in the labour force employed in the Education and Research & Development sectors (numerator) divided by the total labour force (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the labour force employed in the Education and Research & Development sectors.

Cities shall refer to the United Nations Statistics Division's International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4 (Link: https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=27) when defining the Education and Research & Development sectors.

The Education sector shall refer to organizations primarily engaged in providing instruction and training in a wide variety of subjects. This instruction and training is provided by specialized establishments, such as schools, colleges, universities and training centres. Cities shall refer to any organizations that fall within section P of the ISIC, Rev.4, which is divided into the following subsections: 851 - Pre-primary and primary education, 852 - Secondary education, 853 - Higher education, 854 - Other education, and 855 - Educational support activities.

The Research & Development section shall refer to organizations primarily engaged in conducting original investigation, undertaken on a systematic basis to gain new knowledge (research), and in the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development). Cities shall refer to organizations that fall within Division 72 - Scientific research and development of section M- Professional, scientific and technical activities of ISIC, Rev.4. Division 72 "includes the activities of three types of research and development: 1) basic research: experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without particular application or use in view, 2) applied research: original investigation undertaken in order to acquire new knowledge, directed primarily towards a specific practical aim or objective and 3) experimental development: systematic work, drawing on existing knowledge gained from research and/or practical experience, directed to producing new materials, products and devices, to installing new processes, systems and services, and to improving substantially those already produced or installed".

The numerator of this indicator shall be calculated as the sum of the total number of persons employed in these two sectors, Education and Research & Development.

The labour force shall refer to, as defined by the ILO, the sum of persons in employment plus persons in unemployment who are legally eligible to work. Thus, working-age shall refer to all persons that are the same age or older than the legal working age in the jurisdiction of reference. This indicator shall exclude child labour, which is labour completed by persons 14 years of age or younger.

6.4.3 Data sources

Data on employment by industry should be obtained through labour force surveys or city employment assessments administered by local, regional or national authorities/statistical bodies, or a Ministry or Department of Labour Employment.

7 Education

7.1 Number of online databases available through public libraries per 100 000 population

7.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Libraries help to educate the general population, in addition to providing civic spaces for interaction. Online databases are an important supplement to printed resources provided by libraries, such as books, since they are easily accessible and feature a variety of data via virtual means.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion"," well-being" and "attractiveness" purpose of the city as defined in ISO 37101.

7.1.2 Indicator requirements

The number of online databases available through public libraries per 100 000 population shall be calculated as the total number of online databases available through public libraries (numerator) divided by one 100,000th population (denominator). The result shall be expressed as the number of online databases available through public libraries per 100 000 population.

Online databases shall refer to databases of articles, encyclopaedias, consumer reviews and much more that you can find online. Online databases available through public libraries refer to online databases where access is provided by public libraries, and available for use at public libraries or remotely. Online databases available through public libraries allow access for public library users to informational materials that might otherwise be accessible only via academic collections. Examples of online databases available through public libraries may include databases of scientific, legal, and scholarly journals, newspaper archives, curricula to learn new skills, and other resources.

7.1.3 Data sources

Data on the number of online databases available through public libraries should be sourced through local libraries, library boards or city relevant departments, or through ministries.

7.2 Percentage of city population with professional proficiency in one or more foreign languages

7.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Foreign language skills are indicative of a diverse, employable workforce. They also suggest a high degree of immigration and/or highly successful educational programming.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion", " well-being" and "resilience" purpose of the city as defined in ISO 37101.

7.2.2 Indicator requirements

The percentage of city population with professional proficiency in one or more foreign languages shall be calculated as the total number of people who are able to communicate in one or more foreign languages with professional proficiency (numerator) divided by the city's total population (denominator). The result shall then be multiplied by 100 and expressed as the percentage of city population with professional proficiency in one or more foreign languages.

A foreign language shall refer to a language spoken with professional proficiency other than one of the country's official languages in which the city is located. For example, the official language in the United States of America (USA) is English, so a city resident speaking a language other than English at a professional proficiency is counted as a foreign language in the USA. In the case of a country with more than one official language, such as Canada with two official languages - English and French - designated as Canada's official languages, then a person that is knowledgeable of the two official languages at professional proficiency level, one official language shall be included in the count of foreign languages and the other language shall be excluded from the count of foreign languages. For example, if a person in

Canada speaks both English and French, they would have one foreign language and be counted in the numerator of this indicator. Similarly, if a Canadian speaks only English (only one of the official languages) but also has professional proficiency in Spanish for example, then that person would be counted as having professional proficiency in one or more foreign languages.

Professional proficiency shall refer to the following level of competence:

- able to speak the language with sufficient structural accuracy, vocabulary and cohesiveness in discourse to participate effectively in most formal and informal conversations on practical, social, and professional topics;
- understanding is essentially complete;
- can discuss with fluency and ease, abstract issues and special fields of competence and interest;
- can support opinion and hypothesize;
- can provide a structured argument that is clear and well organized; and,
- while the influence of the speaker's first language can be noticed (in pronunciation, grammar and vocabulary), there should not be any patterned errors and errors should never distract the listener or interfere with communication.

For reference, the above definition of professional proficiency corresponds to level C1 of the Common European Framework of Reference for Languages: Learning, Teaching, Assessment.

7.2.3 Data sources

Data on foreign languages spoken by the city population should be sourced using census data, or local, regional or national surveys pertaining to languages spoken.

7.2.4 Data interpretation

A high number of residents who are able to communicate in more than one foreign language indicates that the city has a well-educated and diverse population that can handle interactions that extend beyond national borders. Globalisation, economic growth in developing economies, and improved transport infrastructure have resulted in a considerable shift in world trading patterns and a higher proportion of the world's population being able to visit other countries, whether for business, pleasure or other reasons.

Foreign language skills have the potential to increase the mobility, employability and personal development of people.

7.3 Number of computers, laptops, tablets, or other digital learning devices available per 1 000 primary school students

7.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Computer literacy is becoming an essential aspect of professional employability and also allows an alternative form of civic engagement for citizens. The increase in accessibility of electronic devices for students, as well as the exposure to computers, laptops, tablets, or other digital learning devices, can enhance a student's computer literacy. In addition, computer literacy allows citizens to access a broader array of information, where such information literacy empowers people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion", " well-being" and "resilience" purpose of the city as defined in ISO 37101.

7.3.2 Indicator requirements

The number of computers, laptops, tablets, or other digital learning devices available per 1 000 primary school students shall be calculated as the total number of computers, laptops, tablets, or other digital learning devices with internet access available to primary school students attending primary school in the city (numerator) divided by one 1 000th of the city's total primary school population (denominator). The result shall be expressed as the number of computers, laptops, tablets, or other digital learning devices available per 1 000 primary students.

Primary school students shall refer to students enrolled in primary education as defined in the "Terms and definitions" section of ISO 37120: 2018.

7.3.3 Data sources

Data on the number of electronic devices with internet access should be sourced from local school boards, or a Ministry or Department of Education.

7.4 Number of computers, laptops, tablets, or other digital learning devices available per 1 000 secondary school students

7.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Computer literacy is becoming an essential aspect of professional employability and also allows an alternative form of civic engagement for citizens. The increase in accessibility of electronic devices for students, as well as the exposure to computers, laptops, tablets, or other digital learning devices, can enhance a student's computer literacy. In addition, computer literacy allows citizens to access a broader array of information, where such information literacy empowers people in all walks of life to seek, evaluate, use and create information effectively to achieve their personal, social, occupational and educational goals.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion", " well-being" and "resilience" purpose of the city as defined in ISO 37101.

7.4.2 Indicator requirements

The number of computers, laptops, tablets, or other digital learning devices available per 1 000 secondary school students shall be calculated as the total number of computers, laptops, tablets, or other digital learning devices with internet access available to secondary school students attending secondary school in the city (numerator) divided by one 1 000th of the city's total secondary school population (denominator). The result shall be expressed as the number of computers, laptops, tablets, or other digital learning devices available per 1 000 secondary students.

Secondary school students shall refer to students enrolled in secondary education as defined in the "Terms and definitions" section of ISO 37120: 2018.

7.4.3 Data sources

Data on the number of electronic devices with internet access should be sourced from local school boards, or a Ministry or Department of Education.

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7.5 Number of Science, Technology, Engineering, and Mathematics (STEM) higher education degrees per 100 000 population

7.5.1 General

NOTE 1 Receiving higher education provides individuals with a foundation for meaningful participation in the labour force and helps reduce poverty and inequality. This pillar of human development is widely recognized as the main avenue for social mobility. All disciplines taught by higher education institutions benefit society in some way, such as Science, Technology, Engineering, and Mathematics (STEM) disciplines, which are critical to the technological development and innovation of a city. STEM education helps to create critical thinkers, increase science literacy, and enable the next generation of innovators. Furthermore, STEM is important because science pervades every part of our lives, and the demand for STEM degree holders is increasing with the growing demand for innovators of products and processes that will help sustain, as well as promote, economic growth.

NOTE 2 This indicator reflects the "Education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to "Social Cohesion", "Resilience", "Attractiveness" and "Well-being" purposes of the city as defined in ISO 37101.

7.5.2 Indicator requirements

The number of Science, Technology, Engineering, and Mathematics (STEM) higher education degrees per 100 000 population shall be calculated as the number of people holding higher education degrees with a specialization or major in a discipline within a STEM subject (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of STEM higher education degrees per 100 000 population.

STEM higher education degrees shall refer to higher education degrees specializing in subjects within the fields of science, technology, engineering and mathematics, and is intended to capture a broad field of education and employment opportunities, beyond the more narrow fields of science and mathematics. STEM programs of study are typically classified based upon several occupational clusters: computer science and technology; mathematical sciences; engineering and surveying; and natural, physical and life sciences.

This indicator shall only include people that comprise the city's total population, and shall not include temporary residents or foreign students.

Higher education shall refer to the definition of tertiary education stated within the "Terms and definitions" section of ISO 37120: 2018.

7.5.3 Data sources

Data on higher education degrees by subject should be sourced from local tertiary/postsecondary degree, diploma or certificate granting institutions, or the relevant Ministry or Department of Education, if available. If higher education data from these sources is not available, data from surveys or censuses may be used.

8 Energy

8.1 Electrical and thermal energy (KWh) produced from wastewater treatment per capita per year

8.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Wastewater is a renewable resource that conveys thermal and chemical energy. In some instances, wastewater is found to contain nearly five times the amount of energy needed to process and treat the wastewater. It is important for cities to recognize the potential of wastewater as a sustainable energy source and utilize wastewater in their energy source mix.

Furthermore, wastewater treatment plants use a lot of energy and create greenhouse gas emissions, but they also have the potential to be sources of renewable energy for cities. Wastewater treatment plants can use sewage to generate energy on site, where this energy can then be used to help operate the wastewater treatment plants helping to reduce a wastewater treatment plant's operating costs, energy consumption and greenhouse gas emissions.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.1.2 Indicator requirements

The electrical and thermal energy (KWh) produced from wastewater treatment per capita per year shall be calculated as the total amount of electrical and thermal energy expressed in KWh produced from wastewater treatment in the city (numerator) divided by the city's total population (denominator). The result shall be expressed as the amount of electrical and thermal energy in KWh produced from wastewater treatment per capita for a given year.

Wastewater treatment shall refer to the physical, chemical, and biological processes used to remove, reduce, or neutralize contaminants from wastewater before discharging it into a water body. Wastewater treatment can include primary, secondary or tertiary wastewater treatment, or wastewater treatment of a higher standard.

8.1.3 Data sources

Data on the amount of electrical and thermal energy produced from wastewater treatment should be sourced from city departments or ministries that oversee such matters, as well as from regulators and local utility providers.

8.2 Electrical and thermal energy (KWh) produced from solid waste treatment per capita per year

8.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 While reduction, recycling and composting can do their part in mitigating the environmental impacts of municipal solid waste, not all types of materials can be practically and economically recycled in an environmentally beneficial manner. This leftover solid waste may therefore present an opportunity to recover energy, using new and possibly cleaner technologies.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.2.2 Indicator requirements

The electrical and thermal energy (KWh) produced from solid waste treatment per capita per year shall be calculated as the total amount of electrical and thermal energy expressed in KWh produced from solid waste treatment in the city (numerator) divided by the city's total population (denominator). The result shall be expressed as the amount of electrical and thermal energy in KWh per capita for a given year.

8.2.3 Data sources

Data on the amount of electrical and thermal energy produced from solid waste treatment should be sourced from city departments or ministries that oversee such matters, as well as from regulators and local utility providers.

8.3 Percentage of the city's energy that is produced using decentralized energy production systems

8.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A decentralized energy production system can be defined as locating energy production closer to the site of consumption, such as locating energy production facilities within a city rather than sourcing energy from a regional energy production facility that is most likely distant from a city. Although a relatively new approach for the power industry and utility providers, a decentralized system may potentially lead to more optimal use of renewable energy sources, which in turn can reduce fossil fuel use and increase energy efficiency and sustainability of a region. Therefore, tracking the amount of decentralized energy production can be used to assess a region's potential for utilizing renewable energy sources and expanding access to clean energy services that may not otherwise have been available due to distance from centralized energy production facilities.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.3.2 Indicator requirements

The percentage of the city's energy that is produced using decentralized energy production systems shall be calculated as the amount of energy produced by decentralized energy production systems/facilities in kilowatt-hours (KWh) (numerator) divided by the total amount of energy produced for the city in the same units as the numerator (KWh) - this includes energy produced by both centralized and decentralized energy production facilities (denominator). The result shall be multiplied by 100 and expressed as the percentage of the city's energy that is produced using decentralized energy production systems.

Decentralized energy, also referred to as distributed energy, production shall refer to energy production at or near the point of use, irrespective of size, technology, or fuel used - both off-grid and on-grid. In addition, decentralized energy production refers to the wide range of technologies that do not rely on the high-voltage electricity transmission network or the gas grid, such technologies include wind turbines or plants, photovoltaic (solar) panels, micro-turbines and modular internal combustion engines, etc.

8.3.3 Data sources

Data on the amount of energy produced by both centralized and decentralized energy production systems/facilities should be sourced from local utilities, and relevant city departments or ministries that oversee energy production.

8.4 Storage capacity of the city's energy grid per capita (KWh)

8.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Efficient storage capacity is essential to balance the supply and demand for energy in a region and to ensure that the frequency of energy shortages/interruptions is reduced. Without sufficient energy storage capacity to accommodate grid users during off-peak and peak times of energy use, regions can face difficulties providing consistent sources of energy to grid users.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.4.2 Indicator requirements

Storage capacity of the city's energy grid per capita shall be the total amount of energy that can be stored on the city's energy grid in kilowatt-hours (KWh) (numerator) divided by the city's total population. Storage capacity of the city's energy grid per capita shall be expressed the total amount of energy that city's energy grid is capable of storing in KWh per person.

Energy storage shall refer to the process of converting energy into a stored form that can later be converted back into energy when needed. Thus, storage capacity shall refer to the amount of energy capable of being stored.

8.4.3 Data sources

Data for storage capacity should be sourced from relevant city departments or ministries that oversee the energy grid of the city, or local utilities.

8.5 Energy consumption of public street lighting as a percentage of total annual municipal energy consumption

8.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Street lighting can account for up to 15-50% of the total electricity consumption of municipalities. Accounting for the energy use of public street lighting and effectively managing public street lighting energy use can help cities realise energy savings, maintenance costs reductions and CO2 emissions reductions.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.5.2 Indicator requirements

Energy consumption of public street lighting as a percentage of total annual municipal energy consumption shall be calculated as the energy consumption of public street lighting in the city in KWh (numerator) divided by the overall municipal energy consumption in KWh (denominator). The result shall then be multiplied by 100 and expressed as energy consumption of public street lighting as a percentage of total annual municipal energy consumption.

Energy consumption of public street lighting shall include the energy consumed by all light points of a city's public street lighting network. A light point shall refer to any single source of public street lighting, such as a street light, light pole, lamppost, street lamp, light standard, or lamp standard.

For the purposes of the standard, the street lighting should meet locally or nationally defined standards for illumination and/or the requirements set by the International Commission on Illumination, Technical Report CIE 115:2010, "Lighting of Roads for Motor and Pedestrian Traffic."

8.5.3 Data sources

Energy consumption energy of street lighting should be sourced from relevant city ministries or department responsible for street lighting, or local energy utilities.

8.6 Percentage of street lighting that has been refurbished

8.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Street lighting can account for up to 15-50 % of the total electricity consumption of municipalities. Refurbishing city street lights can help improve energy efficiency, thus reducing street lighting energy consumption. In addition, the recent market introduction of LED and other energy efficient technologies for street lighting offers high cost savings with comparatively short pay-back times. The annual energy and maintenance cost savings may then possibly cover the investment and capital costs.

NOTE 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.6.2 Indicator requirements

The percentage of street lighting that has been refurbished shall be expressed as the number of refurbished light points (numerator) divided by the total number of light points (denominator). The result shall then be multiplied by 100 and expressed as the percentage of street lighting that has been refurbished.

Refurbishment of existing street light systems, for example upgrading ballasts, shall refer to activities that have an aim to not only help to decrease energy consumption but also improve energy efficiency of the street lighting system. This may include upgrading to an LED or other high efficiency lighting technologies. Refurbishment shall not include the removal and/or replacement of street lights.

A light point shall refer to any single source of public street lighting, such as a street light, light pole, lamppost, street lamp, light standard, or lamp standard.

8.6.3 Data sources

Data on street lighting refurbishment and street lighting systems should be sourced from city departments or ministries responsible for street lighting inventory, and tracking the number of new light points and the number of existing light points.

8.7 Percentage of public buildings requiring renovation/refurbishment (by floor area)

8.7.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Buildings are the largest energy consumers in most cities. Reduced and efficient energy use can create substantial savings and can enhance stability of the energy supply. As such, buildings requiring renovation/refurbishment can hinder progress to reduce energy consumption thus contributing more to climate change and other negative externalities.

Note 2 This indicator reflects the "economy and sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "responsible resource use" purpose of the city as defined in ISO 37101.

8.7.2 Indicator requirements

The percentage of public buildings requiring renovation/refurbishment shall be calculated as the square footage of public buildings requiring renovation/refurbishment (numerator), divided by the total square footage of public buildings (denominator). The result shall then be multiplied by 100 and expressed as the percentage of public buildings requiring renovation/refurbishment (by floor area).

Public buildings shall be defined as buildings owned and operated by the city such as government offices and schools.

Buildings requiring renovation/refurbishment shall be assessed on the basis of a city's own audit and registration of building in need of renovation/refurbishment. Renovation and refurbishment of a building

shall not include the demolition/removal and replacement of building, but does include buildings requiring renewal.

8.7.3 Data sources

Data on public buildings requiring renovation/refurbishment should be sourced from city ministries, departments or agencies that oversee the building and maintenance of buildings in the city.

9 Environment and Climate Change

9.1 Percentage of ecosystems that are mapped by remote sensing monitoring

9.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Mapping and monitoring changes in biodiversity and natural ecosystems is a crucial component in protecting and promoting healthy urban environments. The percentage of ecosystems that are mapped by remote sensing is an indication of a city's capacity to understand the evolution of the natural environment and to prevent undesirable outcomes.

NOTE 2 This indicator reflects the "biodiversity and ecosystem services" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of environment" purpose of the city as defined in ISO 37101.

9.1.2 Indicator requirements

The percentage of ecosystems that are mapped by remote sensing monitoring shall be calculated as the area of ecosystems within the city's administrative boundary that are mapped by remote sensing (numerator) divided by the total area of the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of ecosystems that are mapped by remote sensing monitoring.

Remote sensing shall refer to the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance from the targeted area using remote sensors. Remote sensors shall refer to sensors that collect data by detecting the energy that is reflected from Earth. Remote sensors can be on satellites or mounted on aircraft. Remote sensors can be either passive or active. Passive sensors respond to external stimuli. They record natural energy that is reflected or emitted from the Earth's surface. The most common source of radiation detected by passive sensors is reflected sunlight.

9.1.3 Data sources

Data on ecosystems that are mapped by remote sensing monitoring should be sourced from relevant city departments that are responsible for the environment or remote sensing monitoring and mapping.

9.2 Annual frequency of ecosystem remote sensing monitoring

9.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Mapping and monitoring changes in biodiversity and natural ecosystems is a crucial component in protecting and promoting healthy urban environments. The frequency of monitoring of ecosystems is an indication of a city's capacity to understand the evolution of the natural environment and to prevent undesirable outcomes.

NOTE 2 This indicator reflects the "biodiversity and ecosystem services" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "preservation and improvement of environment" purpose of the city as defined in ISO 37101.

9.2.2 Indicator requirements

The annual frequency of ecosystem remote sensing monitoring shall be calculated as the number of days for which data is collected from ecosystem remote sensing monitoring in the city (denominator) divided by the total number of days in the year (numerator). The result shall be expressed as the annual frequency of ecosystem remote sensing monitoring.

9.2.3 Data sources

Data on ecosystem remote sensing monitoring should be sourced from relevant city departments that are responsible for the environment or remote sensing monitoring and mapping.

9.3 Percentage of buildings built or refurbished within the last 5 years in conformity with green building principles

9.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Buildings that are constructed in conformity with green building principles are substantially more sustainable. 'Green' buildings are built with higher design standards which dramatically reduce energy consumption. Green buildings can also be built or refurbished according to Green building standards, which offer continual building benchmarking to track environmental performance.

NOTE 2 This indicator reflects the "city and community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "responsible resource use" "attractiveness, and "well-being" purpose of the city as defined in ISO 37101.

9.3.2 Indicator requirements

The percentage of buildings built or refurbished within the last 5 years in conformity with green building principles shall be calculated as the total number buildings built or refurbished within the last 5 years in conformity with green building principles (numerator) divided by the city's total number of buildings built or refurbished in the last 5 years (denominator). The result shall then be multiplied by 100 and expressed as the percentage of buildings built or refurbished within the last 5 years in conformity with green building principles.

Refurbishment of buildings shall refer to activities that have an aim to not only help to decrease energy consumption but also improve energy efficiency and lessen the environmental impacts of a building. Refurbishment shall not include the removal and/or replacement of buildings.

A green building principles shall refer to a set of guidelines and criteria against which a building can be judged to have been built in conformity to "green building". Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building may also be known as a sustainable or high performance building.

NOTE: Green buildings may be buildings that are built or refurbished in accordance with a green building standard and may be classified as a green building under standards such as: BREEAM, LEED, CASBEE, BOMA BEST, BCA Green Mark, etc. But, the building need not be certified as a green building rather simply follow a green building standard throughout the construction process.

9.3.3 Data sources

Data on the number of buildings built or refurbished within the last 5 years in conformity with a green building principles should be sourced from city departments and ministries that oversee the construction and maintenance of buildings in the city, or oversee building permits and standards.

9.4 Number of real-time ICT-based air quality monitoring stations per 100 000 population

9.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE A remotely operated, real-time ICT-based system can help to monitor climate change impacts on environment (e.g., air quality). Such systems can also provide real-time observations, data processing, and analysis, giving people timely information on the safety of a city's air quality.

Indicator requirements

The number of real-time ICT-based air quality monitoring stations per 100 000 population shall be calculated as the total number of real-time ICT-based air quality monitoring stations in the city (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of real-time ICT-based air quality monitoring stations per 100 000 population.

A monitoring station shall refer to a physical structure or device that uses specialized equipment and analytical methods to track pollutant levels, such as fine particles (PM2.5), carbon dioxide (CO_2) and sulphur dioxide (SO_2).

A real-time ICT-based system shall refer to any form of technology that provides instantaneous information such as mobile applications. More specifically, an ICT system is a set-up consisting of hardware, software, data and the people who use them. An ICT system commonly includes communications technology, such as the internet. It should be noted that ICT and computers are not the same thing - computers are the hardware that is often part of an ICT system.

9.4.2 Data sources

The number of real-time ICT-based air quality monitoring stations should be sourced from city departments or ministries that oversee the air quality of the city.

10 Finance

10.1 Percentage of municipal budget spent on smart city innovations and initiatives per year

10.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Smart city innovations and initiatives are helping pave the way toward more liveable and sustainable cities. The extent to which municipalities are spending on smart city innovations and initiatives provides insight into the commitment cities have towards smart city models.

NOTE 2 This indicator reflects the "governance, empowerment and engagement" and "economy and sustainable production and consumption" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "resilience" and "responsible resource use" and "attractiveness" purpose of the city as defined in ISO 37101.

10.1.2 Indicator requirements

The percentage of municipal budget spent on smart city innovations and initiatives per year shall be calculated as the total municipal budget spent on smart city innovations and initiatives per year (numerator) divided by the total annual municipal budget (denominator). The result shall then be multiplied by 100 and expressed as the percentage of municipal budget spent on smart city innovations and initiatives per year.

Smart city innovations and initiatives shall refer to the uses information and communication technologies to increase operational efficiency and to apply to various stages of planning, designing, building and operating a city's infrastructure, as well, to share information with the public and improve both the quality of city services and citizen welfare. Smart city innovations and initiatives should be based on categories including people, economy, environment, government, living, and mobility. In general, smart city innovations and initiatives apply collaborative leadership methods, work across disciplines and city systems, and use data information and modern technologies to deliver better services and quality of life to those in the city (residents, businesses, visitors). For instance, these can include the integration of technology such as open data portals, digitalized city services, smart traffic lights, sensors for automated accesses and entrances; and the internetworking of physical objects and devices networked and used to collect and exchange data (i.e., Internet of Things), but these examples are not exhaustive.

10.1.3 Data sources

Data on municipal budgets should be sourced through city budget documents which are approved, audited and posted annually.

10.2 Annual amount of tax collected from the sharing economy as a percentage of total tax collected

10.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE The sharing economy or peer-to-peer based sharing of access to goods and services is a growing component of the municipal economy. The inclusion of these economies into existing policy allows for taxation which supplements municipal capital budgets.

10.2.2 Indicator requirements

The annual amount of taxes collected from the sharing economy as a percentage of total tax collected shall be represented as the total amount of money collected per year from sales or other use taxes levied on sharing economy transactions (numerator) divided by the city's total tax collected (denominator). The result shall then be multiplied by 100 and expressed as the annual amount of tax collected from the sharing economy as a percentage of total tax collected.

The sharing economy shall refer to businesses that connect individuals seeking particular services (particularly transportation, short-term property rentals, informal short-term contract labour) with individuals willing to provide that service using their own assets (i.e., vehicle, property, skills). The sharing economy consists of marketplaces and platforms that allow individuals and organizations to buy and sell goods and services directly from one another, and rent, share or lend goods or assets on a short-term or time-share basis.

The sharing economy is also known as the on-demand economy, collaborative consumption, or peer-to-peer economy.

10.2.3 Data sources

Data on taxes collected from the sharing economy should be sourced from relevant city departments or ministries that oversee municipal finance.

10.3 Percentage of payments to the city that are paid electronically based on electronic invoices

10.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE The use of electronic invoices (e-invoices) and transfer of payments to the city increases security and quality and reduce costs for the city, businesses and citizens. Cities that combine e-invoice and e-transfers with automatic accounting and control systems can experience a noticeable increase in productivity.

10.3.2 Indicator requirements

The percentage of payments to the city that are paid electronically based on electronic invoices (e-invoices) shall be calculated as the number of payments to the city that are made electronically based on an e-invoice (numerator) divided by the total number of payments made to the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of payments to the city that are paid electronically based on e-invoices.

Electronic invoicing (e-invoicing) shall refer to the exchange of an invoice document between the city and a business or a citizen in an electronic format. The invoice is generated directly from the relevant systems and is not just a scanned paper invoice or a Word/PDF document or a paper invoice mailed to a business or citizen. Generating of the e-invoice is thereby a natural part of the administrative working process.

Electronic payment is a payment via an electronic medium without the use of cash or checks.

10.3.3 Data sources

Data on payments to the city that are paid electronically should be sourced from the economic department in the city or from other city departments responsible for payments.

10.3.4 Data interpretation

A high percentage of e-payments is a sign of a city with a high level of digitalization.

11 Governance

11.1 Annual number of online visits to the municipal open data portal per 100 000 population

11.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Open data portals provide a means of increasing public access to data managed by municipalities. It creates greater transparency and allows for innovation by community organizations and citizens. Although many municipalities offer online portals, not all are equally visited.

NOTE 2 this indicator reflects the “governance, empowerment and engagement” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the” social cohesion” and “attractiveness” purpose of the city as defined in ISO 37101.

11.1.2 Indicator requirements

The annual number of online visits to the municipal open data portal per 100 000 population shall be calculated as the total number of municipal open data portal visits (numerator) divided by one 100 000th

of the city's total population (denominator). The result shall be expressed as the annual number of online visits to the municipal open data portal per 100 000 population.

An open data portal shall refer to a data portal operated by the city providing access to open data, which shall be defined as structured data that is machine-readable, freely shared, used and built on without restrictions.

An online visit shall refer to an individual visitor who arrives at the city's open data portal online and proceeds to browse and peruse the open data portal. A visit counts all visitors, no matter how many times the same visitor may have been to the open data portal.

11.1.3 Data sources

Data on the number of visits to the open data portal should be obtained from websites hosting statistics obtained from the municipality's website administration or provided by the domain host(s).

11.2 Number of datasets offered on the municipal open data portal per 100 000 population

11.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Open data portals provide a means of increasing public access to data managed by municipalities. It creates greater transparency and allows for innovation by community organizations and citizens. The number of datasets provides insight into the range of data being made available on a municipality's open data portal.

NOTE 2 This indicator reflects the "governance, empowerment and engagement" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the" social cohesion" and "attractiveness" purpose of the city as defined in ISO 37101.

11.2.2 Indicator requirements

The number of datasets offered on the municipal open data portal per 100 000 population shall be calculated as the total number of datasets offered on the municipal open data portal (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of datasets offered on the municipal open data portal per 100 000 population.

An open data portal shall refer to a data portal operated by the city providing access to open data, which shall be defined as structured data that is machine-readable, freely shared, used and built on without restrictions.

Repeating datasets under different geographies shall be counted as one.

11.2.3 Data sources

Data on the number of datasets offered on municipal open data portal should be sourced through the city's data portal or the managing department of the city's open data platform.

11.3 Percentage of municipal datasets available to the public

11.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Open data portals provide a means of increasing public access to data managed by municipalities. It creates greater transparency and allows for innovation by community organizations and citizens. The number of datasets provides insight into how intensive a municipality's open data portal may be.

NOTE 2 This indicator reflects the "governance, empowerment and engagement" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the" social cohesion" and "attractiveness" purpose of the city as defined in ISO 37101.

11.3.2 Indicator requirements

The percentage of municipal datasets available to the public shall be calculated as the total number of datasets available to the public in downloadable, machine-readable format (numerator) divided by the total number of datasets compiled and held by all city departments (denominator). The result shall then be multiplied by 100 and expressed as the percentage of municipal datasets available to the public.

Datasets shall refer to data collected by city departments related to any aspect of the city. These include geospatial datasets showing locations of schools, police activity, traffic congestion, or any other matter of interest; as well, datasets on records of temperature and rainfall, budget-related data; energy usage, or any other compilation of data related to the city collected by a city department or agency.

This indicator shall include both historical and current datasets.

11.3.3 Data sources

Data on the number of datasets available to the public should be sourced through the city's data portal or the managing department of the city's datasets.

11.4 Percentage of city services accessible online

11.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Delivering city services through digital portals provides exponential benefits to citizens and local governments. Municipalities are able to provide services without fixed hours and are able to provide these services with reduce resources. Moreover, the use of mobile technology, such as geotagging and photos, is aiding the efficiency and effectiveness of city services.

NOTE 2 This indicator reflects the "governance, empowerment and engagement" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the" social cohesion" and "attractiveness" purpose of the city as defined in ISO 37101.

11.4.2 Indicator requirements

The percentage of city services accessible online (i.e. via the Internet) shall be calculated as the total number of city services offered to people and businesses through a centralized Internet interface (numerator) divided by the total number of city services offered by the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of city services accessible online.

City services shall refer to services provided by the city and typically cover the following areas: Garbage and Recycling; Public Safety; Fire Department; Roads and Traffic; Bylaws, Violations and Enforcement; Permits and Licences; Planning; Building; Policies, Projects and Initiatives; Rentals and Catering of City Buildings; Water and Sewers; and Property Taxes and Utilities. City services is a broad term encompassing the many "touch-points" cities have with citizens and businesses. Particularly for city services accessible online this term can include, for example, requesting and receiving permits; assessing and collecting taxes; lodging and addressing complaints; and requesting information on services within the city's jurisdiction or authority.

11.4.3 Data sources

An inventory of all city services offered must be taken to provide an accurate percentage output. Information on city services should be sourced from city departments, or institutions that provide services. Figures on services available through web or mobile should also be obtained from city

departments, or institutions providing the service, or from the municipal government website administrators.

11.5 Average response time to relevant inquiries made through the city's non-emergency inquiry system (days)

11.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A non-emergency line is as a single-window access point to municipal services. It refers to the response rate of single-window access points through various mediums including telephone, apps, twitter, email, in person contacts etc. The access point can be used by citizens as well as business.

NOTE 2 This indicator reflects the "governance, empowerment and engagement" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "attractiveness" and "well-being" purpose of the city as defined in ISO 37101.

11.5.2 Indicator requirements

The average response time to relevant inquiries made through the city's non-emergency inquiry system shall be expressed as the total number of hours taken to respond to all relevant inquiries made through the city's non-emergency system (numerator) divided by the total number of relevant inquiries received by the city's non-emergency system (denominator). The result shall be divided by 24 and expressed as average response time to relevant inquiries made through the city's non-emergency inquiry system in days.

Relevant inquiries shall refer to inquiries from citizens and business that actually refer to an existing problem that is economically and practically realistic to address on a shorter term basis. It is, for example, not a relevant inquiry to ask for a new bike lane or a new park, but an inquiry addressing a matter that is urgent and timely, such as reporting a dead animal or request planning, pruning or removal of a tree or making an accessibility complaint about a city program or service.

A non-emergency inquiry system shall refer to a system citizens contact when their health, safety or property is not in immediate jeopardy, or there is not a crime currently in progress. Non-emergency inquiry systems may include hotlines, internet-based applications (webpage, social media, mobile applications, etcetera) that allow residents to submit an inquiry, such as a complaint about unfavourable city conditions or nuisances (i.e. report a pothole, request a street clean-up or graffiti removal, report a broken traffic signal etc.), to a centralized location. The system dispatcher then relays the inquiry to the appropriate city authority to address, rather than requiring the resident to know which city department should properly address their inquiry.

11.5.3 Data sources

Data on the response time to relevant inquiries made through the city's non-emergency inquiry system should be sourced from records retained by the non-emergency inquiry system and the relevant city department dispatched to address the inquiry.

12 Health

12.1 Percentage of the city population with online unified health file accessible to health care providers

12.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The digitization and centralization of health histories enables health care providers to care for patients from a holistic approach. Health care providers, regardless of their speciality or location, can access the health history of these individuals and provide better care accordingly.

NOTE 2 Although health care is often beyond the jurisdiction of city-level governments, the availability of, and access to, primary health care is one characteristic of cities that has the potential to impact health, therefore, representing an important area of focus for cities. Furthermore, city health care providers face some of the greatest cost pressures and difficulties in adapting health care delivery to reduce the cost of providing health care while improving the quality of that care, and thus, allowing health care providers to access a patient's unified health file online may help conquer some these problems by allowing health providers to more efficiently and easily access a unified health file online rather than awaiting for a paper copy.

NOTE 3 This indicator reflects the "health and care in the community" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "resilience, and "well-being" purpose of the city as defined in ISO 37101.

12.1.2 Indicator requirements

The percentage of the city's population with online unified health file accessible to health care providers shall be calculated as the total number of persons with an online unified health file that can be accessed by any type of health care provider (numerator) divided by the total population in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city's population with online unified health file accessible to health care providers.

A unified health file shall refer to a health file containing all of a patient's health records, which would usually otherwise be spread among multiple health care providers, resulting in fragmented care. The unified health file should show all medication and medical records made by public and private medical doctors. It brings together relevant information from different parts of the health service system, e.g. hospitals and family doctors, clinics, test centres, etc.

12.1.3 Data sources

Data on the number of persons with unified health histories that are accessible to health care providers should be sourced from local, regional, or provincial health care providers or insurers; or relevant departments and ministries.

12.2 Annual number of medical appointments conducted through telecommunication or online video services per 100 000 population

12.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Telecommunication and online medical appointments provide a vital alternative to traditional walk-in appointments. Consideration could include aging populations, decreased mobility, or limited access to transportation.

NOTE 2 This indicator reflects the "health and care in the community" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "resilience, and "well-being" purpose of the city as defined in ISO 37101.

12.2.2 Indicator requirements

The annual number of medical appointments conducted through telecommunication or online video services per 100 000 population shall be calculated as the total number of medical appointments conducted through telecommunication, such as through mobile phone, or online video services (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the annual number of medical appointments conducted through telecommunication or online video services per 100 000 population.

A medical appointment shall refer to a patient visit to a health care facility, in which a patient discusses their health needs and concerns with one or more health care providers. Medical appointments conducted through telecommunication or online video shall include medical conducted through video and teleconferencing technologies in accessible formats; mobile phones; remote data-collection equipment and tele-monitoring (i.e. cardiac monitors), or etc.

12.2.3 Data sources

The annual number of medical appointments conducted through telecommunication or online video services data should be sourced from departments or ministries that oversee the health care provided to people of the city and track modes of health care provided to its citizens.

12.3 Percentage of the city population registered with public alert systems for air and water quality advisories

12.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Poor air and water quality affect human health and contribute to human mortality and morbidity in cities. Air quality alert systems provide important information and advice to the public to minimise air pollutant exposure. Similarly, water quality alert systems inform people whether or not the quality of the city's water is suitable for drinking, or use for other activities. Air and water quality public alert systems can help to mitigate or lessen the impacts of pollutants to health and prevent mortality.

NOTE 2 This indicator reflects the "health and care in the community" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "resilience, and "well-being" purpose of the city as defined in ISO 37101.

12.3.2 Indicator requirements

Percentage of the city population registered with public alert systems for air and water quality advisories shall be calculated as the number of people registered with public alert systems for air and water quality advisories (numerator) divided by the city's total population. The result shall then be multiplied by 100 and expressed as the percentage of the city population registered with public alert systems for air and water quality advisories.

A public alert system for air and water quality shall refer to a system that reports and notifies the public on the levels pollutants, allergens and particulate matter, and releases to the public near real-time data or data based on forecasting methods, and facilitates early identification of local air and water pollution problems and issues timely warnings of air and water pollution episodes reflecting levels of particulate matter and pollutants to the public via text message, email or pre-recorded voice message. An alert system may be in the form mobile or online applications.

In some instances, air and water quality may be reported by two separate public alert systems, one responsible for air quality and another responsible for water quality. People registered with more than one public alert system shall be counted once towards the calculation of this indicator. In addition, the calculation shall only include those people that reside in the city and exclude those that would not be included in the city's total population count, such that they reside beyond the city's administrative boundaries.

12.3.3 Data sources

Data on the number of people registered with public alert systems should be sourced from relevant city departments that are responsible for the management of alert systems.

12.4 Percentage of city area covered by an Electromagnetic Fields radiation mapping system

12.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Radio frequency radiation emanating from wireless control and communication relays has become the subject of studies for possible links to health hazards, particularly cancer in children and adults. While no study has been accepted as conclusive evidence on the ill effects of Electromagnetic Fields (EMF) radiation, there have been a number of results that have urged caution in exposure to the electromagnetic waves. Thus, there is a great need for cities to develop and utilize technologies for an EMF radiation mapping system, which also has the additional benefit of data collection on EMF radiation– allowing researchers and the city to have access to reliable and easily accessible EMF mapping data.

12.4.2 Indicator requirements

Percentage of city area covered by an Electromagnetic Fields (EMF) radiation mapping system shall be calculated as the area of the city that is covered by an EMF(s) radiation mapping system (numerator) divided by the city's total land area. The result shall then be multiplied by 100 and expressed as the percentage of city area covered by an EMF(s) radiation mapping system.

The EMF(s) mapping system infrastructure should consist of static radio frequency (RF) sensors, mobile RF sensors and remote servers/central server, or similar technologies that could be used to collect spatial data on EMFs radiation. The static sensors monitor the RF power reading for a small coverage area periodically, store locally or forward the same to a central server. The static and mobile sensors report their RF power measurements to a central server using periodic wireless calls with the measurement values as content. The data reported to the central server should then be used with support of GIS-based application to estimate EMF(s) radiation pollution exposure, as well, the total city area that is accounted for by the EMF(s) radiation mapping system.

EM radiation spans an enormous range of wavelengths and frequencies. This range is known as the electromagnetic spectrum. The EM spectrum is generally divided into seven regions, in order of decreasing wavelength and increasing energy and frequency. The common designations are: radio waves, microwaves, infrared (IR), visible light, ultraviolet (UV), X-rays and gamma rays.

12.4.3 Data sources

Data on the percentage of city area covered by EMF(s) radiation mapping system should be sourced from relevant city departments that oversee public health, environment or EMF mapping.

13 Housing

13.1 Percentage of households with smart electricity meters

13.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Smart electricity meters record and display the consumption of electricity in real-time. Smart meter data can be sent to a central location wirelessly, thus providing electricity providers with the means to understand how and when power is being used to better plan and conserve electricity. Also, a smart electricity meter data helps consumers better understand and monitor energy usage.

NOTE 2 This indicator reflects the "city and community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "responsible resource use" "attractiveness, and "well-being" purpose of the city as defined in ISO 37101.

13.1.2 Indicator requirements

The percentage of households with smart electricity meters shall be calculated as the total number of households with smart electricity meters (numerator) divided by the total number of households in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of households with smart electricity meters.

A smart electricity meter shall refer to an electricity meter that includes in-home real-time digital displays or be available through a real-time online application, so a customer can better understand their energy usage. Also, a smart electricity meter can digitally send meter readings to an energy supplier for more accurate energy bills, and for better planning and conservation of electricity by providers.

13.1.3 Data sources

Data on smart electricity meter figures should be sourced from local or regional electrical providers, or relevant city departments or ministries that may have data on local smart electricity meters.

13.2 Percentage of total land area that is a mixed use zone

13.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Mixed use development can improve neighbourhood liveability and sustainability by providing a higher density of varying uses in an area. Also, communities or neighbourhoods with mixed use buildings and land that have a variety of uses, such as residential, retail and commercial, promote walking, cycling, and public transportation, making these areas more engaging environments for citizens.

NOTE 2 This indicator reflects the "living together" and "living environment and working" issues as defined in ISO 37101. It can allow an evaluation of the contribution "social cohesion "resilience and well-being" purpose of the city as defined in ISO 37101.

13.2.2 Indicator requirements

The percentage of land area that is a mixed use zone shall be calculated as the total amount land area that is a mixed use zone (numerator) divided by the city's total land area (denominator). The result shall be multiplied by 100 and expressed as the percentage of land area that is a mixed use zone.

A mixed-use zone shall refer to a development of city land area consisting of three or more significant uses (such as retail/entertainment, office, industry, residential, hotel, and/or civic/cultural/recreation) that in well planned projects are mutually supporting. Mixed use zones have a significant physical and functional integration of project components (and thus a relatively close-knit and intensive use of land), including uninterrupted pedestrian connections and are developed in conformity with a coherent plan (that frequently stipulates the type and scale of uses, permitted densities, and related items).

13.2.3 Data sources

Data on mixed use developments and land use should be sourced from city planning departments, land use planning documents, or spatial information related to zoning can also be aggregated through GIS software.

13.3 Percentage of households with smart water meters

13.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Smart water meters record and display the consumption of water in real-time. Smart meter data can be sent to a central location wirelessly, thus providing water providers with the means to understand how and when water is being used to better plan and conserve water. Also, a smart water meter data helps consumers better understand and monitor water usage.

NOTE 2 This indicator reflects the "city and community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "responsible resource use" "attractiveness, and "well-being" purpose of the city as defined in ISO 37101.

13.3.2 Indicator requirements

The percentage of households with smart water meters shall be calculated as the total number households with smart water meters (numerator) divided by the total number of households in the city (denominator). The result shall be multiplied by 100 and expressed as the percentage of households with smart water meters.

A smart water meter shall refer to a water meter that includes in-home real-time digital displays or be available through a real-time online application, so a customer can better understand their water usage. Also, a smart water meter can digitally send meter readings to a water supplier for more accurate water bills, and for better planning and conservation of water by providers.

13.3.3 Data sources

Data on smart water meters should be sourced from local or regional water providers, or relevant city departments or ministries that may hold data on local smart water meters.

14 Population and Social Conditions

14.1 Percentage of public buildings that are accessible by persons with disabilities

14.1.1 General

Those implementing this International Standard shall report on this indicator in accordance with the following requirements.

NOTE 1 Public buildings that are accessible by persons with disabilities create an inclusive city by removing barriers for persons b affected by mobility challenges.

NOTE 2 Public buildings are government owned or leased buildings such as government offices, public hospitals and public schools.

14.1.2 Indicator requirements

The percentage of public buildings that are accessible by persons with disabilities shall be calculated as number of public buildings within the city that are accessible by persons with disabilities (numerator) divided by total number of public buildings in the city (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

The definition of an accessible public building shall be based on the national standard that has to be followed to identify, remove and prevent barriers so that people with disabilities have more opportunities in everyday life. In relation to public buildings it will typically include requirements regarding:

- Accessible parking spaces
- Accessible main entrance
- Automatic doors
- Sufficient light
- Accessible washrooms
- Elevators to all floors

14.1.3 Data sources

Information should be obtained from the local authorities, officials, or the Ministry or Department responsible for public buildings.

14.2 Percentage of municipal budget allocated for provision of mobility aids, devices, and assistive technologies to citizens with disabilities

14.2.1 General

Those implementing this International Standard shall report on this indicator in accordance with the following requirements.

NOTE Ensuring a city is accessible for all its citizens and visitors promotes an equitable and inclusive society. Allocating a portion of the municipal for provision of mobility aids, devices, and assistive technologies to citizens with disabilities helps to maintain the accessibility of the city year-over-year to all its citizens and visitors.

14.2.2 Indicator requirements

The percentage of the municipal budget allocated for provision of mobility aids, devices, and assistive technologies to citizens with disabilities shall be calculated as the sum of the cost of providing mobility aids, devices, and assistive technologies the city has to spend in one fiscal year (numerator) divided by the total city budget allocated for a given year (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

14.2.3 Data sources

Data for the amount of the municipal budget allocated for provision of mobility aids, devices, and assistive technologies to citizens with disabilities should be sourced from the municipal budget and audited financial documents, or departments or ministries overseeing municipal spending on the provision of mobility aids, devices, and assistive technologies to citizens with disabilities

14.3 Number of persons with disabilities that have real-time ICT-based interactive mapping applications per 100 000 population

14.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Ensuring a city is accessible for all its citizens and visitors promotes an equitable and inclusive society. Providing citizens with real-time ICT-based interactive mapping applications and technologies allows them to better plan their travels throughout the city and to identify potential accessibility obstacles that may be encountered before they begin their travels giving them the opportunity to plan an alternative route of travel.

14.3.2 Indicator requirements

The number of persons with disabilities that have real-time ICT-based interactive mapping applications per 100 000 population shall be calculated as the number of persons with disabilities that have real-time ICT-based interactive mapping applications (numerator) divided by one 100 000th of the city's total population. The result shall be expressed as the number of persons with disabilities that have real-time ICT-based interactive mapping applications per 100 000 population.

Persons with disabilities shall refer to persons that:

- have a mental or physical impairment; and
- have an impairment that adversely effects their ability to carry out normal day-to-day activities

This may include the persons who are visually impaired/blind, quadriplegic, hearing impaired/deaf, and/or utilize walking aids, such as canes or walkers.

In defining 'normal day-to-day activities', one of the following functions must be compromised:

- Mobility,
- Manual dexterity,
- Physical coordination,
- Ability to lift, carry or move everyday objects,
- Speech, hearing or eyesight; and
- Memory or ability to concentrate, learn or understand.

Ultimately, persons with disabilities include those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.

A real-time ICT-based system shall refer to any form of technology that provides instantaneous information such as mobile applications. More specifically, an ICT system is a set-up consisting of hardware, software, data and the people who use them. An ICT system commonly includes communications technology, such as the internet. It should be noted that ICT and computers are not the same thing - computers are the hardware that is often part of an ICT system.

ICT-based interactive mapping applications shall refer to a Geographic Information System (GIS) map and contain locations on the map that respond when the mouse, web-cursor or touch pad moves over it, off of it, or clicks it. Real-time ICT-based interactive mapping applications may include radio frequency identification readers that map a person's route or GIS-based interactive mapping applications.

A real-time ICT-based interactive mapping application for persons with disabilities may include an application that provides up-to-date information on points of access around the city that accommodate persons with disabilities when utilizing the public transport and pedestrian sidewalk networks, as well, when accessing buildings or public spaces around the city.

14.3.3 Data sources

Data on the number of persons with disabilities that have real-time ICT-based interactive mapping applications should be sourced from relevant city departments that created the applications or the distributor the applications.

14.4 Percentage of marked pedestrian crosswalks equipped with accessible pedestrian signals

14.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Accessible pedestrian signals enable persons with disabilities to safely cross intersections, allowing those with disabilities to easier perform their daily activities.

14.4.2 Indicator requirements

The percentage of marked pedestrian crosswalks equipped with accessible pedestrian signals shall be calculated as the number of marked pedestrian crosswalks equipped with accessible pedestrian signals (numerator) divided by the total number of marked pedestrian crosswalks (denominator). The result shall then be multiplied by 100 and expressed as the percentage of marked pedestrian crosswalks equipped with accessible pedestrian signals.

Accessible pedestrian signals shall refer to devices that communicate the intervals that a crossing is a safe or unsafe to enter using either non-visual communication, usually through audible, or vibrotactile (i.e. vibrations), or visual methods. They must adhere to national disability standards, if applicable.

14.4.3 Data sources

Data on the percentage of marked pedestrian crosswalks equipped with accessible pedestrian signals should be sourced from city departments or ministries that oversee public pathways and traffic signals.

15 Recreation

15.1 Percentage of public recreation services that can be booked online

15.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Online recreation booking offers increased accessibility and awareness for the public, as well as data sources for public recreation participation. It creates virtually no ecological footprint compared to paper registration distribution and collection, and easier record creation or modification.

NOTE 2 This indicator reflects the "living together" and "living environment and working" issues as defined in ISO 37101. It can allow an evaluation of the contribution to ""social cohesion "resilience and well-being" purpose of the city as defined in ISO 37101.

15.1.2 Indicator requirements

The percentage of public recreation services that can be booked online shall be calculated as the number of public recreation services that can be booked online (numerator) divided by total number of public recreation services that a city offers (denominator). The result shall then be multiplied by 100 and expressed as the percentage of public recreation services that can be booked online.

Recreation services shall refer to services that operate facilities or provide services that enable people to participate in sports or recreational activities or pursue amusement, hobbies and leisure-time interests. Recreational services could include the city providing public recreation space, which is defined broadly to mean land and buildings open to the public for recreation, such as swimming, sports and skating activities facilities, and fitness centres. Also, city recreation services could include city-run programs and camp, and facility rentals for recreation.

15.1.3 Data sources

The percentage of public recreation services that can be booked online should be sourced from relevant city departments or ministries that oversee public recreation, or departments that are responsible for online administration.

15.2 Number of municipal smart kiosks installed per 100 000 population

15.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Installing smart kiosks in a city is one method of modernization and digitization that a city can take. Smart kiosks can provide users free public WiFi, calling, direct access to contact the city's emergency line, device charging, and wayfinding. Cities also can place environmental sensors to passively learn more about street use while providing services for citizens.

NOTE 2 This indicator reflects the “living together” and “living environment and working” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion “resilience and well-being” purpose of the city as defined in ISO 37101.

15.2.2 Indicator requirements

The number of municipal smart kiosks installed per 100 000 population shall be calculated as the total number of municipal smart kiosks (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of municipal smart kiosks installed per 100 000 population.

A smart kiosk shall refer to an automated free-standing information dispensing computer appliance capable of engaging in public interactions with multiple people and are located in public spaces accessible to citizens. Smart kiosks provide a user-friendly interface (i.e., touchscreen) with support for multiple payment methods that can handle the plethora of everyday transactions, from paying parking tickets to wayfinding. Smart kiosks may also serve as information points providing insights to local events, special offers or optimum commute connections. Smart kiosks provide a one-stop service point to satisfy the needs of today’s smart communities. At a smart kiosk citizens can, for example, use their own electronic device to connect to free Wi-Fi, access online city services, maps and directions and make emergency calls.

A municipal smart kiosk shall refer those smart kiosks that are owned and operated by the municipality.

15.2.3 Data sources

Data on smart kiosks should be sourced through urban planning departments, or through municipal information technology departments.

16 Safety

16.1 Percentage of the city area covered by digital surveillance cameras

16.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE The presence of surveillance cameras is a deterrent against crime and mischief. In the case incidents do occur, video surveillance offers an accurate representation of the events, as well as key information to solving cases. Digital cameras are more reliable than film, have a higher capacity, have better picture quality, and create files that can be distribute easier and are harder to tamper with.

16.1.2 Indicator requirements

The percentage of the city area covered by digital surveillance cameras shall be calculated as the amount of city land area covered by digital video surveillance cameras in square kilometres (numerator) divided by the city’s total land area (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city area covered by digital surveillance cameras.

Digital surveillance cameras, or sometimes referred to as Internet Protocol (IP) cameras, shall refer to video cameras that can send and receive data via a computer network, as opposed to sending a feed to a Digital Video Recorder (DVR) (i.e. disk/USB drive).

This indicator shall include digital surveillance accessible by the city, such as any digital video surveillance the city or law enforcement can directly access, without the permission of or request from private camera owners.

16.1.3 Data sources

Data on the percentage of the city area covered by digital surveillance cameras should be sourced from local law enforcement and safety departments, ministries or agencies.

16.2 Percentage of city population registered with a public safety alert system

16.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Cities have a duty to protect the public and much of this duty is accomplished by first responders such as police, fire and ambulance services. Smart technologies are revolutionizing how cities locate, mitigate and prevent safety issues. Public safety alert systems are timely and reliable systems that people can consult for information in the event of natural or man-made disasters, and can help mitigate the outcomes of events that threaten the safety of the public.

16.2.2 Indicator requirements

The percentage of city population registered with a public safety alert system shall be calculated as the number of people registered with a public safety alert system (numerator) divided by the city's total population. The result shall then be multiplied by 100 and expressed as the percentage of city population registered with a public safety alert system.

A public safety alert system shall refer to a system that records and releases information to the public in near real-time (i.e. instantaneously when a public safety threat takes place) on the public safety operations of the city and the welfare and protection of the general public in the city via text message, email or pre-recorded voice message. An alert system may be in the form mobile or online applications.

Public safety operations of a city may consist of several diverse and critically important units, staffed by specially trained sworn and civilian members. Public safety units may include Emergency Management & Public Order, Specialized Emergency Response (Emergency Task Force, Marine, Police Dog Services) and Traffic Services. Public safety units offer specialized skill sets in support of divisional front line officers and day-to-day policing activities, thereby contributing to the safety of our communities.

In some instances, public safety alerts may be reported by more than one alert system application. People registered with more than one public safety alert system shall be counted once towards the calculation of this indicator. In addition, the calculation shall only include those people that reside in the city and exclude those that would not be included in the city's total population count, such that they reside beyond the city's administrative boundaries.

16.2.3 Data sources

Data on the number of people registered with a public safety alert system should be sourced from relevant city departments that oversee public safety alert systems.

16.3 Annual number of social media posts by municipal public safety officials per 100 000 population

16.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Social media is an important communication and engagement medium for municipalities, and enables municipalities to reach broad audiences with relatively limited resources. Social media tools can help municipalities communicate with the public during times of emergencies and build situational awareness amongst the public. This facilitates trust between public safety services, such as the police service, and the citizens they are sworn to protect.

16.3.2 Indicator requirements

The annual number of social media posts by municipal public safety officials per 100 000 population shall be calculated as the number of social media posts by municipal public safety officials (numerator) divided by the one 100 000th of the city's total population (denominator). The result shall be expressed as the annual number of social media posts by municipal public safety officials per 100 000 population.

Public safety officials shall refer to those people employed in the public safety operations departments of the city. Public safety operations of a city consists of several diverse and critically important units, staffed by specially trained sworn and civilian members. Public safety units may include Emergency Management & Public Order, Specialized Emergency Response (Emergency Task Force, Marine, Police Dog Services) and Traffic Services. Public safety units offer specialized skill sets in support of divisional front line officers and day-to-day policing activities, thereby contributing to the safety of our communities.

The social media posts counted in this indicator shall include posts that pertain to notifications of public safety threats or events, such as events of terrorism or crime. Social media posts may include posts made on social networks such as a public safety official's Twitter, LinkedIn and Facebook pages.

16.3.3 Data sources

Data on the number of social media posts by municipal public safety officials should be sourced from relevant city public safety operation services and the social media accounts of public safety officials.

17 Solid Waste

17.1 Percentage of the city population that has waste drop-off centres equipped with telemetering

17.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Many cities have to limit traffic in the city and simplify garbage collection organization. Or many cities have streets that are narrow, sub-standard and limited providing only limited access to households and neighbourhoods. In cities of less developed countries, roads and pathways are not always accessible to garbage trucks for collection. Developing waste drop-off centers with telemetering where citizens bring their waste is a local solution that may help cities reach this objective of limiting traffic in the city, overcome limited access, and simplifying garbage collection and disposal. Telemetering aids in the optimization of garbage truck rounds by informing drop-off centre garbage collection trucks on the level of waste currently held in drop-off centre containers, which may help garbage collection trucks work more efficiently by knowing what drop-off centres need to be prioritized and emptied because they are at full capacity.

NOTE 2 This indicator reflects the "Community infrastructures", "Economy and sustainable production and consumption" and "Mobility" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "Responsible resource use" and "Preservation and improvement of environment" purposes of the city as defined in ISO 37101.

17.1.2 Indicator requirements

The percentage of the city population that has waste drop-off centers equipped with telemetering shall be calculated as the number of people living in the city that have waste drop-off centres for garbage disposal equipped with telemetering devices (numerator) divided by the city's total population (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city population that has waste drop-off centers equipped with telemetering.

A waste drop-off centre shall refer to a place where people bring waste in accordance with sorting criteria. Drop-off centres can, for example, be placed near a public road or on a parking facility. People

who use a drop-off centre do not have a private waste container. Collection trucks will collect the bins at the drop-off centre.

Waste drop-off centres and garbage collection vehicles that are equipped with telemetering to optimize garbage collection rounds based on information about bins filling. Telemetering shall refer to measurement with the aid of intermediate means which permit the measurement to be interpreted at a distance from the primary detector. The distinctive feature of telemetering is the nature of the translating means, which includes provision for converting the measurand into a representative quantity of another kind that can be transmitted conveniently for measurement at a distance. Therefore, if a waste drop-off centre has telemetering, the amount of garbage in a waste drop-off centre can be transmitted to garbage collection trucks remotely.

Note: Drop-off center collection is defined as follows: it is a collection mode where the community gives to the population a network of bins that are spread on the city area and are available for all citizens with an open access. The citizen has not a proper bin. He has to dispose himself the sorted materials on a site which is organized by the communities: a container on the public road, on parking facilities or commercial centers, on a district collection point.

Collection trucks will collect the bins in the allocated points in the city. When trucks are equipped with telemetering to optimize their rounds depending on bins filling, this can be considered as an access for citizens to drop-off collection with telemetering

17.1.3 Data source

Data on the percentage of the city population that has waste drop-off centres equipped with telemetering should be sourced from city departments that oversee garbage/waste drop-off centres.

17.2 Percentage of the city population that has a door-to-door garbage collection with an individual telemetering of household waste quantities

17.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Many cities have to limit traffic in the city and simplify garbage collection vehicles shift organization. Developing telemetering is a way to optimize collection rounds to limit traffic and adapt the number of vehicles to the real quantity of waste to be collected. Benefits are a more fluent traffic with its consequences on the reduction of GHG emissions, a better design of collection rounds and a better allocation of human resources to collection rounds with corresponding savings.

NOTE 2 This indicator reflects the “Community infrastructures”, “Economy and sustainable production and consumption” and “Mobility” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “Responsible resource use” and “Preservation and improvement of environment” purposes of the city as defined in ISO 37101.

17.2.2 Indicator requirements

The percentage of the city population that has a door-to-door garbage collection with an individual telemetering of household waste quantities shall be calculated as the number of people living in the city where there is a door-to-door household garbage collection equipped with telemetering (numerator) divided by the city’s total population (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city population that has a door-to-door garbage collection with an individual telemetering of household waste quantities.

Door-to door garage collection corresponds to a collection organization where the container is allocated to an identifiable group of users. The point of collection of selected waste is located in proximity to the user’s home.

Individual waste collection containers and garbage collection vehicles that are equipped with telemetering to optimize garbage collection rounds based on information about bins filling can be considered as door-to-door garbage collection with an individual telemetering of household waste quantities. Telemetering shall refer to measurement with the aid of intermediate means which permit the measurement to be interpreted at a distance from the primary detector. The distinctive feature of telemetering is the nature of the translating means, which includes provision for converting the measurand into a representative quantity of another kind that can be transmitted conveniently for measurement at a distance.

17.2.3 Data sources

Data on the percentage of the city population that has door-to-door garbage collection equipped with telemetering data should be sourced from relevant city departments that oversee waste collection services and door-to-door garbage collection.

17.3 Percentage of total amount of waste in the city that is used to generate energy

17.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Waste which has significant organic matter content can be a source of energy either directly by recovering heat from energy from waste plant (incinerator) or by producing energy from the digestion of waste or other new technologies using this energy for cogeneration, bio methane production for injection in the gas network, or for fuel production.

In a context where energy consumption from fossil energy resources has to be decreased for sustainable development purposes, it is advantageous to use this source of heat, electricity, gas or fuel for other services across the city (i.e., heating of swimming pools, fuels for city vehicle fleet, energy sales to local industries etc.). In case of disadvantages of fossil energy tariffs, it is also a way for the city to achieve a level of energy independence.

NOTE 2 This indicator reflects the “Community infrastructures”, “Economy and sustainable production and consumption”, issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “Responsible resource use” and “Preservation and improvement of environment” and “resilience” purposes of the city as defined in ISO 37101.

17.3.2 Indicator requirements

Percentage of total amount of waste in the city that is used to generate energy shall be calculated as the total amount of waste utilized to generate energy (numerator) divided by the total amount of waste generated in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of total quantity of waste in the city that is used to generate energy.

Energy generated from the waste treatment plant shall be expressed in gigajoules (GJ) per year.

Note: the total amount of waste utilized to generate energy shall refer to waste treatment having a positive net energy production rate

17.3.3 Data sources

Data on the quantity of waste in the city can be derived from ISO 37120 indicator “collected municipal solid waste per capita” multiplied by the population of the city.

Data on the total amount of waste in the city that is used to generate energy should be sourced from local utilities, or relevant city departments that oversee waste treatment and related energy generation.

18 Telecommunication

18.1 Percentage of the city population with access to computers or other electronic devices with internet access in libraries and other public buildings

18.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 As governments, business, employers, and citizens move to digital platforms, accessibility to computers or other electronic devices becomes increasingly important. Without access to reliable electronic devices, one may not be able to search key databases such as jobs advertisements, government services, etc.

NOTE 2 This indicator reflects the "education and capacity building" issue as defined in ISO 37101. It can allow an evaluation of the contribution to the "social cohesion" and "well-being" and "attractiveness" purpose of the city as defined in ISO 37101.

18.1.2 Indicator requirements

The percentage of the city population with access to computers or other electronic devices with internet access in libraries and other public buildings shall be calculated as the number of people with access to computers or other electronic devices (i.e. laptops, personal computers, tablets, and smart phones) with internet access in libraries and other public buildings (numerator) divided by the city's total population (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city population with access to computers or other electronic devices with internet access in libraries and other public buildings.

18.1.3 Data sources

Data on the number of people with access to computers or electronic devices with internet access should be sourced through relevant city departments, or through surveys.

18.2 Percentage of the city population with access to sufficient speed broadband

18.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Sufficient broadband and broadband speed helps enable individuals to exercise their right to freedom of opinion and expression, and promotes the progress of society through wider access to information. It has most recently become a fundamental human right as identified by the United Nations, and provides citizens with the opportunity to explore the plethora of information that is available on the World Wide Web.

NOTE 2 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to ""social cohesion and "attractiveness" purposes of the city as defined in ISO 37101.

18.2.2 Indicator requirements

The percentage of the city population with access to sufficient speed broadband shall be calculated as the total number of people in the city with access to sufficient speed broadband (numerator) divided by the city's total population (denominator). The total shall then be multiplied by 100 and expressed as the percentage of the city population with access to sufficient speed broadband.

Broadband may be defined as a data transmission capacity associated with a particular speed of transmission and the provision of high-speed Internet access. Broadband provides support to applications such as web-browsing, video services IP TV, and so forth. Broadly speaking, broadband infrastructure is the underlying communication infrastructure that is deployed to enable the provision of broadband services, that is, Internet access at a certain speed/bandwidth.

Sufficient speed broadband shall refer to a network capable of speeds of at least 256 kbit/s in both directions, uploading and downloading. This speed is sufficient for internet surfing, emails, etc. Sufficient broadband corresponds to basic broadband.

Sufficient speed shall take into consideration the potential demands from service providers and their recipients on the network.

18.2.3 Data sources

Data on the number of people with access to sufficient speed broadband data should be sourced from local broadband service providers, or relevant departments or ministries that oversee broadband services.

18.3 Percentage of city area under a white zone/dead spot/not covered by telecommunication connectivity

18.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Access to telecommunication not only implies an ability to communicate without barriers, but access to services such as the Internet. White zones and dead spots are a hindrance to telecommunication. As such, the prevalence of their existence may correlate to a population with reduced access to telecommunications and Internet.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” purposes of the city as defined in ISO 37101.

18.3.2 Indicator requirements

The percentage of city area under a white zone/dead spot/not covered by telecommunication connectivity shall be calculated as the total city land area classified as being under a white zone/dead spot/not covered by telecommunication connectivity in square kilometres (numerator) divided by the city’s total land area in square kilometres (denominator). The result shall then be multiplied by 100 and expressed as the percentage of city area under a white zone/dead spot/not covered by telecommunication connectivity.

A white zone/dead spot/not covered by telecommunication connectivity shall be defined as an area without telecommunication (i.e. internet, telephone and mobile) connectivity and function, typically due to radio interference or range issues.

18.3.3 Data sources

Data on the city area under a white zone/dead/not covered by telecommunication connectivity spot should be sourced from local internet service providers, or relevant city departments or ministries that oversee the building of telecommunication infrastructure.

18.4 Percentage of city area with publicly available internet connectivity

18.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 A public internet connection allows people to connect to the internet that may not have mobile data plans or regular internet access - enabling them to take advantage of the enormous economic and social benefits the Internet can offer. In addition, publicly accessible internet can help enable municipalities to passively track users for future planning purposes.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” purposes of the city as defined in ISO 37101.

18.4.2 Indicator requirements

The percentage of city area with publicly available internet connectivity shall be calculated as the total land area of the city serviced with internet connectivity in square kilometres (numerator) divided by the city’s total land area in square kilometres (denominator). The total shall then be multiplied by 100 and expressed as the percentage of city area with publicly available internet connectivity.

Publicly available internet connectivity shall refer to internet connectivity services provided by the city to the public and shall be accessible by anyone within city limits regardless of if they are a resident or visitor of the city.

Publicly available places for internet connectivity shall be defined by location, not by routers. For example, if multiple routers exist within a park, the park would be considered as only one place.

18.4.3 Data sources

Data on the city area with publicly available internet connectivity should be sourced from departments or ministries responsible for a city’s information technology and managing publicly accessible internet figures, or can be estimated utilizing GIS tools.

19 Transportation

19.1 Percentage of city streets and thoroughfares covered by real-time online traffic alerts and information

19.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 The prominence and growth of online civic tools has created a culture of sharing civic data in real-time, including online traffic alerts and information. This data can be user-driven by utilizing geospatial crowdsourcing of mobile data, or collected through sensors or cameras installed by road and transportation authorities. The application of such technologies enables authorities to efficiently plan for future conditions, and for users to effectively travel through city streets and thoroughfares.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” purposes of the city as defined in ISO 37101.

19.1.2 Indicator requirements

The percentage of city streets and thoroughfares covered by real-time online traffic alerts and information shall be calculated as the number of street and thoroughfare kilometres within the city covered by real-time online traffic alerts and information (numerator) divided by the total number of street and thoroughfare kilometres within city limits (denominator). The result shall then be multiplied by 100 and expressed as the percentage of city streets and thoroughfares covered by real-time online traffic alerts and information.

Streets and thoroughfares shall refer to all local roads, streets and major and minor arterial roads of the city.

A real-time information system shall refer to any information processing system which has to respond to externally generated input stimuli within a finite and specified period. In the context of online traffic alerts and information, real-time corresponds to the traffic information that is instantaneously available and reflects the current traffic levels at any given time.

19.1.3 Data sources

Data on streets and thoroughfares covered by real-time online traffic alerts and information should be sourced from relevant city departments, or institutions that manage and disseminate online content pertaining to traffic of a particular region.

19.2 Number of users of sharing economy transportation per capita

19.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Cities are increasingly utilizing sharing economy transportation to supplement existing mobility needs. The extent to which policymakers and planners are aware of the number of users of sharing economy transportation in the city will allow for better development of plans and reconfiguration of a city's transportation system to accommodate for these changes.

NOTE 2 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to ""social cohesion and "attractiveness" and "well-being" purposes of the city as defined in ISO 37101.

19.2.2 Indicator requirements

The number of users of sharing economy transportation per capita shall be calculated as the total number of users actively using sharing economy transportation (numerator) divided by the city's total population (denominator). The result shall be expressed as the number of users of the sharing economy transportation per capita.

The sharing economy consists of marketplaces and platforms that allow individuals and organizations to buy and sell goods and services directly from one another, and share or lend goods or assets on a short-term or time-share basis. Sharing economy transportation for this indicator shall refer to any transportation modes in which individuals are able to utilize assets owned by another individual or organization, such as ride sharing services and automobile sharing service.

19.2.3 Data sources

Data on the number of users of sharing economy transportation data should be sourced from relevant city departments, or sharing economy transportation service organizations.

19.3 Percentage of vehicles registered in the city that are low-emission vehicles

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE Low-emission vehicles provide an alternative to traditional vehicles operating through internal combustion which expel noxious gasses such as unburned hydrocarbons. Low emission vehicles have the potential to improve local air quality.

19.3.1 Indicator requirements

The percentage of vehicles registered in the city that are low-emission vehicles shall be calculated as the total number of registered and approved low-emission vehicles registered in the city (numerator) divided by the total number of registered vehicles in the city (denominator). The result shall be multiplied by 100 and expressed as a percentage of vehicles registered in the city that are low-emission vehicles.

Low-emission vehicles (LEVs) shall refer to vehicles that emit low levels of emissions and may include electric, hybrid, and hydrogen fuel cell driven vehicles. LEVs shall be certified under appropriate exhaust emissions standards and the vehicle must meet other special requirements applicable to conventional or clean-fuel vehicles and their fuels.

Regarding the term “low-emission” the need to consider the energy source needs to be highlighted.

e.g. electricity provided by coal powered plants should not be considered as clean

19.3.2 Data sources

The number of registered and approved low-emission vehicles should be sourced from city departments, or institutions that oversee vehicle registration.

19.4 Number of bicycles available through bicycle sharing services per 100 000 population

19.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Bicycle sharing or a bike-share scheme is a service in which bicycles are made available for shared use to individuals on a short-term basis. Generally, individuals are able to borrow and return the bike at different locations. Bicycle sharing promotes greater rates of bicycle use in cities by reducing traditional barriers to ridership, including costs, bicycle theft, and repair. Bicycle sharing provides an alternative or addition to traditional transportation methods such as public transportation or driving. This indicator provides municipalities with a measure of the availability of bicycles in the bicycle share system.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” and “well-being” purposes of the city as defined in ISO 37101.

19.4.2 Indicator requirements

The number of bicycles available through bicycle sharing services per 100 000 population shall be calculated as the total number of bicycles available through bicycle sharing services in the city (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the number of bicycles available through bicycle sharing services per 100 000 population.

Bicycle sharing services shall refer to a bicycle sharing system with bicycles available through self-serve docking stations, or person operated docking stations, located throughout a city, where bicycles can be rented as needed. Users should be able to rent and return bicycles to any docking station within the bicycle sharing system.

19.4.3 Data sources

Data on the number of bicycles available through bicycle sharing services in the city should be sourced from relevant city departments that oversee and/or collect data on bicycle shares.

19.5 Percentage of public transport lines equipped with a real-time ICT-based system

19.5.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Real-time information on public transport lines that can be shared with citizens can help people in the city avoid traffic congestion or wait for a service that isn't going to arrive. Real-time service alerts keep citizens well-informed of what's happening with the city’s public transport lines.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” and “well-being” purposes of the city as defined in ISO 37101.

19.5.2 Indicator requirements

The percentage of public transport lines equipped with a real-time ICT-based system shall be calculated as the number of public transport lines that are equipped with a real-time ICT-based system to provide people with real-time operation information (numerator) divided by the total number of public transport lines within the city limits (denominator). The result shall then be multiplied by 100 and expressed as the percentage of public transport lines equipped with a real-time ICT-based system.

A public transport line shall refer to a portion of the public transport network where a public transport vehicle departs and arrives from two points of the public transport network in one single continuous trip, and follows a timetable with driving and stopping times, which should be the same at all times; and the computation of this indicator shall include both rail-based and road-based public transport. A public transport line shall be distinguished from a public transport route when computing this indicator, such that a public transport route may include multiple public transport lines.

A real-time ICT-based system shall refer to any information processing system which has to respond to externally generated input stimuli within a finite and specified period, and provides instantaneous information to users. In the context of public transport lines, a real-time ICT-based system shall be a system that provides timely information to users on usage and current volume of users utilizing public transport lines, so that transportation can be planned accordingly in the most efficient manner. The information provided should not only limited to users of a specific transport line, but be available to public to allow citizens to choose transportation modes.

19.5.3 Data sources

Data on the percentage of public transport lines equipped with a real-time ICT-based system should be sourced from relevant city departments that oversee public transport and monitor traffic.

19.6 Percentage of the city public transport network covered by a unified payment system

19.6.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 An integrated payment system is one that allows for standardized payment across multiple public transportation operators. Such systems encourage multiple modal transportation across transportation modes such as bus, LRT, subway, and trains, etc., and reduces the need for public transport users to stop and pay at multiple transfer points during a single trip. A unified payment system for public transport users is not limited to a specific transport line or mode, but covers all types of public transportation modes.

NOTE 2 This indicator reflects the “community infrastructure” issues as defined in ISO 37101. It can allow an evaluation of the contribution to “social cohesion and “attractiveness” and “well-being” purposes of the city as defined in ISO 37101.

19.6.2 Indicator requirements

The percentage of the city public transport network covered by a unified payment system shall be calculated as the number of kilometres of the city public transport network covered by a unified payment system (numerator) divided by the total kilometres of a city’s public transport network (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city public transport network covered by a unified payment system.

A city’s public transport network shall cover the transportation infrastructure within the public right-of-way, including the public realm that provide public transportation services. Public transport refers to travel services provided locally by the city that allow a number of people to travel together along set routes, the most common public transport vehicles that form a public transport network can include

transportation services provided and/or managed by the city, such as buses, boats, subways, trains, shared bicycles, shared vehicles, etc.

A unified payment system shall refer to an integrated mobility payments system that allows transit users to plan, book, and pay for multiple modes of transit to get them from point A to point B. A unified payment system should include an ICT/technology-based user interface such as smart cards or mobile ticketing, and unified pricing structures, such that a transit user need not pay at multiple points of transfer when making a single trip.

19.6.3 Data sources

Data on the percentage of city public transport network covered by a unified payment system should be sourced from relevant city departments that are responsible for a city's transit system.

19.7 Percentage of public parking spaces equipped with e-payment systems

19.7.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 E-payment systems offer easier methods of payment for the public, as an e-payment system is not dependent on cash or cheques and lessens time in line ups to make payment. An e-payment system also creates the opportunity for smart pricing, depending on time of day or frequency of use.

NOTE 2 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "social cohesion and "attractiveness" and "well-being" purposes of the city as defined in ISO 37101.

19.7.2 Indicator requirements

The percentage of public parking spaces equipped with e-payment systems shall be calculated as the number of public parking spaces equipped with an e-payment system as a payment method (numerator) divided by the total number of public parking spaces in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of public parking spaces equipped with e-payment systems.

Public parking lots shall be counted by their capacity, and street parking shall be counted by individual paid spaces.

An e-payment system shall refer to a way of making transactions or paying for goods and services through an electronic medium without the use of check or cash, such as a credit card or online or mobile application.

19.7.3 Data sources

The percentage of public parking spaces equipped with e-payment systems should be sourced from city departments that oversee public parking, as well as any organizations (public or private) that oversee the e-payment systems in the city relevant to public parking.

19.8 Percentage of public parking spaces equipped with real-time ICT-based availability systems

19.8.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Real-time ICT-based systems help to distribute information on parking space availability, hours of operation, fee guidelines and accessibility options. In addition, real-time ICT- based systems help people to more

efficiently identify available public parking spaces, thus, helping to reduce fuel use and vehicle emissions that are associated with people looking for parking.

NOTE 2 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "social cohesion and "attractiveness" and "well-being" purposes of the city as defined in ISO 37101.

19.8.2 Indicator requirements

The percentage of public parking spaces equipped with real-time ICT-based availability systems shall be calculated as the number of public parking spaces that are equipped with real-time ICT-based availability systems (numerator) divided by the total number of public parking spaces in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of public parking spaces with real-time ICT-based availability systems.

Public parking lots shall be counted by their capacity (i.e. number of public spaces), and street parking shall be counted by individual paid spaces.

Real-time ICT-based availability systems for public parking spaces shall include any form of technology that provides instantaneous information, such as through mobile and/or online applications, on the availability of public parking spaces (i.e. number of public parking spaces available).

19.8.3 Data sources

Data on the number of public parking spaces with real-time ICT-based availability systems should be sourced from city departments that oversee public parking.

19.9 Percentage of traffic lights that are intelligent/smart

19.9.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Intelligent/smart traffic lights are defined as any traffic light systems that utilize a combination of traffic lights, sensors and algorithms to control both vehicle and pedestrian traffic in an optimal manner. They may also predict the path of emergency responders to reduce response time.

NOTE 2 Automobile technology has begun implementing anti-idling systems, which can work more efficiently if they can communicate with intelligent/smart traffic lights to predict light changes and reduce emissions.

NOTE 3 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "social cohesion and "attractiveness" and "well-being" purposes of the city as defined in ISO 37101.

19.9.2 Indicator requirements

The percentage of traffic lights that are intelligent/smart shall be calculated as the number of traffic lights in the city that are intelligent/smart (numerator) divided by the total number of traffic lights in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of traffic lights that are intelligent/smart.

Intelligent/smart traffic lights shall be defined as any traffic light systems that utilize a combination of traffic lights, sensors and other information and communication technologies, and algorithms to control both vehicle and pedestrian traffic.

Multiple traffic lights at the same intersection for traffic heading in the same direction shall be counted as a single traffic light.

19.9.3 Data sources

Data on the percentage of traffic lights that are intelligent/smart should be sourced from relevant city departments that oversee transportation and street lights.

19.10 City area mapped by real-time interactive street maps as a percentage of city's total land area

19.10.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Real-time interactive street maps provide people with up-to-date information when commuting throughout the city, or planning travels around the city, allowing people to more efficiently plan travel, as well as identify points of access that accommodate persons with disabilities accessibility.

NOTE 2 This indicator reflects the "community infrastructure" issues as defined in ISO 37101. It can allow an evaluation of the contribution to "social cohesion and "attractiveness" and "well-being" purposes of the city as defined in ISO 37101.

19.10.2 Indicator requirements

City area mapped by real-time interactive street maps as a percentage of city's total land area shall be calculated as the total city area mapped by real-time interactive street maps (numerator) divided by the city's total land area (denominator). The result shall then be multiplied by 100 and expressed as city area mapped by real-time interactive street maps as a percentage of city's total land area.

Real-time interactive street maps shall refer to street maps generated by a Geographic Information System (GIS) and contain locations on the map that respond when the mouse, web-cursor or touch pad moves over it, off of it, or clicks it. The locations may correspond to business locations or buildings that are accessible to persons with disabilities. Real-time shall refer to the instantaneous updating of information on the interactive street map to reflect the most up-to-date changes to an area, such as road construction or a business location change. Street maps should cover the city's pedestrian and sidewalk network and public transport network.

19.10.3 Data sources

Data on the area mapped by real-time interactive street maps should be sourced from relevant city departments that oversee the pedestrian or sidewalk network, and transport network.

20 Urban/Local Agriculture and Food Security

20.1 Annual percentage of municipal budget spent on urban agriculture initiatives

20.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Urban agriculture can make an important contribution to household food security, especially in times of crisis or food shortages. In addition, locally produced food requires less transportation and refrigeration, thus, can help conserve energy.

NOTE 2 This indicator reflects the "health and care in the community" issue as defined in ISO 37101. It can allow an evaluation of the contribution to "well -being" purposes of the city as defined in ISO 37101.

20.1.2 Indicator requirements

The annual percentage of municipal budget spent on urban agriculture initiatives shall be calculated as the total amount of the city budget spent on urban agriculture initiatives for a given year (numerator) divided by the city's total municipal budget for the same year (denominator). The result shall then be multiplied by 100 and expressed as the annual percentage of municipal budget spent on urban agriculture initiatives.

Urban agriculture (UA) shall be defined as the growing of plants and food products from different types of crops (grains, root crops, vegetables, mushrooms, fruits). UA may also include trees managed for producing fruit, and small-scale aquaculture. In many cities globally, the raising of animals (poultry, rabbits, goats, sheep, cattle, pigs, guinea pigs, etc.) within city limits is prohibited by law so will not be included in this indicator. UA initiatives or programs shall refer to any activity connected to the above definition of UA or supporting UA activities, such as city grants available to UA producers and businesses that may support the development innovative technologies for urban agriculture (i.e. mobile applications to monitor crop yield) or simply provide UA producers and businesses with resources to support operations in general.

20.1.3 Data sources

Data on amount of municipal budget spent on Urban Agriculture initiatives should be sourced from financial audited statements of the city's budget, or relevant city departments that oversee finance.

20.1.4 Data interpretation

Supporting urban agriculture enables local production with short supply chains in the cities, thus, playing a role in the future of environmental and socio-economic sustainability in smart cities.

20.2 Annual total collected municipal food waste sent to a processing facility for composting per capita (in tonnes)

20.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Although food is essential for life and organic materials are critical for healthy soils, significant amounts of food waste and other organic materials end up going to disposal. There is growing recognition, both within cities and globally, that food and organic wastes are a growing problem and current waste management practices are not sustainable. The negative impact this waste has on a city's economy and environment is significant. There are environmental consequences to sending food and organic materials to disposal. The environmental benefits of recycling and composting food waste can be significant. Composting transforms food waste into something usable: fertilizer, which can then be used in agriculture and food production, enhancing food productivity and promoting smart, sustainable growth.

NOTE 2 This indicator reflects the "sustainable production and consumption" issue as defined in ISO 37101. It can allow an evaluation of the contribution to "responsible resource use" and "resilience" purposes of the city as defined in ISO 37101.

20.2.2 Indicator requirements

The annual total collected municipal food waste sent to a processing facility for composting per capita (in tonnes) shall be calculated as the total amount of food waste (household and commercial) collected in tonnes (numerator) divided by the city's total population (denominator). The result shall be expressed as the annual total collected municipal food waste sent to a processing facility for composting per capita in tonnes.

Composting shall refer to a natural biological process, carried out under controlled aerobic conditions (requires oxygen). In this process, various microorganisms, including bacteria and fungi, break down

organic matter into simpler substances and converts waste to a useable organic soil amendment or mulch by providing adequate aeration, moisture, particle size, fertilizers and lime. The effectiveness of the composting process is dependent upon the environmental conditions present within the composting system i.e. oxygen, temperature, moisture, material disturbance, organic matter and the size and activity of microbial populations. Thus, a processing facility for composting shall refer to a facility that carries out composting.

Food waste refers to discarding of unconsumed food that is safe and nutritious for human consumption along the entire food supply chain, from primary production to end user (residential and commercial) consumer. Food waste is recognized as a distinct part of food loss because the drivers that generate it and the solutions to it are different from those of food losses. Food waste shall refer to any food, and inedible parts of food, removed from the food supply chain to be recovered or disposed.

20.2.3 Data sources

Data on municipal food waste collected should be sourced from relevant city departments that are responsible for garbage collection, recycling, sanitation and/or composting services.

20.2.4 Data interpretation

A city with a high annual total collected municipal food waste sent to a processing facility for composting per capita (in tonnes) is indicative of a city that is diverting and reducing the amount of waste that needs to be disposed of, and in turn, mitigating the environmental impacts associated with municipal solid waste. As well, the city is converting food waste into a product that is useful for agriculture and improving soil for greater food growth productivity.

21 Urban Planning

21.1 Annual number of citizens engaged in the planning process per 100 000 population

21.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Citizen engagement is considered a key attribute in the planning and policy process. Successful citizen engagement improves planning and policy. The community will feel more included in the greater plan of the municipality, since the community will have their input considered in the municipal government plan,

NOTE 2 This indicator reflects the “governance, empowerment and engagement” issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “resilience” and “responsible resource use” and “attractiveness” purpose of the city as defined in ISO 37101.

21.1.2 Indicator requirements

The annual number of citizens engaged in the planning process per 100 000 population shall be calculated as the total number of citizens participating, or engaged in the planning process on an annual basis (numerator) divided by one 100 000th of the city’s total population (denominator). The result shall be expressed as the annual number of citizens engaged in the planning process per 100 000 population.

The planning process shall refer to the official plan and other city plans.

The definition of citizen engagement includes in-person attendance or involvement at events such as, community consultations, public hearings, pop-up city hall sessions and other participatory practices, for example, online hearings and webinars, etc. Citizen engagement may also include virtual attendance or involvement through social media or formal engagement tools such as online or paper surveys.

21.1.3 Data sources

Data on citizen engagement should be sourced from attendance records of planning process engagements, hearings, and events (both online and in-person) frequently noted within planning reports and policy as a prerequisite for approval.

21.2 Average time for building permit approval (days)

21.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE The development application and building permit approval process can hinder development feasibility and profitability. This indicator allows municipalities to compare their development application and building permit approval times with other municipalities to improve their internal processes.

21.2.2 Indicator requirements

The average time for building permit approval shall be calculated as the sum in days of building permits from start to completion (numerator) divided by the total number of building permits (denominator). The result shall be expressed as the average time for building permit approval in days.

Building permit approvals shall include permits for new commercial buildings, commercial building renovations and non-residential construction projects, as well as large residential projects and small residential projects in, for example, detached, semi-detached and townhouse construction and renovation projects.

21.2.3 Data sources

Data on the average time for building permit approval should be sourced from relevant city departments that oversee building permit approval.

21.2.4 Data interpretation

Cities with a relatively low average time for building permit approval may have a more efficient permit approval system in place. However, it should be noted that there may be difficulties in comparing cities directly when considering differences in regulatory environments in which building permit approvals take place and the potential for less stringent or more stringent building permit requirements.

21.3 Percentage of the city population living at medium-to-high population densities

21.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Population density is the number of people living in a particular urban area and is an important aspect of how cities function. Urban planners advocate higher population densities because of the widely held theory that cities operate more efficiently when residents live in denser urban surroundings. A higher population density can contribute to smart growth, given that other aspects, such as automobile dependency is less of an issue. The growth is smart because it is meant to be sustainable and long-lasting, and not be solely dependent on automobile use.

NOTE 2 This indicator reflects the “community infrastructure” and “biodiversity and ecosystem services” issues as defined in ISO 37101. It can allow an evaluation of the contribution to ““social cohesion and “attractiveness” and “well-being” purposes of the city as defined in ISO 37101.

21.3.2 Indicator requirements

The percentage of the city population living at medium-to-high urban densities shall be calculated as the number of people living in a medium-to-high population density area (numerator) divided by the city's total population (denominator). The result shall then be multiplied by 100 and expressed as the percentage of the city population living at medium-to-high population densities.

A medium-to-high population density shall be defined as a population density that is more than 12,500 persons per square mile, or approximately 12,500 persons per 2.6 square kilometres.

21.3.3 Data sources

Data on population density should be sourced from relevant city departments that oversee urban planning and population statistics.

22 Wastewater

22.1 Percentage of treated wastewater being reused

22.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Wastewater reuse is a key point to save water in areas where scarcity is increasing and lack of water may occur during the year. It is a solution consistent with circular economy principles that help to face climate changes and adaptation challenges. It is also a way to prevent discharge of untreated wastewater in the environment.

NOTE 2 This indicator reflects the "Community infrastructures;" "Economy and sustainable production and consumption;" and "biodiversity and ecosystems services" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "Responsible resource use" and "Preservation and improvement of environment" and "resilience" purposes of the city as defined in ISO 37101.

22.1.2 Indicator requirements

The percentage of treated wastewater being reused shall be calculated as the total annual volume of treated wastewater that is reused (numerator) divided by the total annual volume of treated wastewater (denominator). The result shall be multiplied by 100 and expressed as the percentage of treated wastewater being reused.

NOTE Treated wastewater that is reused shall refer to wastewater that is reused either following secondary biological treatment ("controlled" reused) or following conventional tertiary treatment (filtration, UV disinfection, chlorination, ozonation) or a high quality treatment after membrane treatment (MBR, ultrafiltration, ultrafiltration/reverse osmosis microfiltration/reverse osmosis) for agricultural irrigation, urban irrigation (green areas) or other more "noble use."

[Source : ISO 24511]

22.1.3 Data sources

Data on the percentage of wastewater being reused should be sourced from city departments, ministries or institutions that are responsible for wastewater and wastewater network management. Data may also be sourced from local utility providers, if applicable.

22.2 Percentage of sludge that is reused (dry matter tonnes)

22.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Sludge may have significant content of minerals (i.e. N, P), oligo-elements and organic matter that can be reused either for agricultural fertilizing and soil improving or for calorific value in energy from waste plants or digestion facilities to produce biomethane reusable for gas injection or fuels production. Sludge reuse include fruitful solution for circular economy development and inadequate discharge or disposal of sludge in the environment. For some type of sludge, it can help to face the decrease of mineral resource such as phosphorus where a lack is the expected in the coming years. Production of new phosphorus resources such as struvite is key solutions for the future.

NOTE 2 This indicator reflects the "Community infrastructures", "Economy and sustainable production and consumption", "biodiversity and ecosystems services" issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "Responsible resource use" and "Preservation and improvement of environment" and "resilience" purposes of the city as defined in ISO 37101.

22.2.2 Indicator requirements

The percentage of sludge that is reused shall be calculated as the total annual quantity of sludge that is reused in dry matter tons (numerator) divided by the total annual quantity of sludge produced and measured at site outlets in the city in dry matter tons (denominator). The result shall then be multiplied by 100 and expressed as the percentage of sludge that is reused in dry matter tons.

NOTE Quantity of sludge measured at site outlets is expressed in dry matter tons (including additives). The quantity reused per year includes all uses except landfilling and incineration without heat recovery.

Sludge shall refer to residues obtained after wastewater treatment or sanitation. Sludge characteristics are different from one source to another. It depends from type of initial effluents and type of treatment applied. Solid waste and sand from screening are not included in this definition.

NOTE Sludge considered in the calculation of this indicator are from:

- storm water handling;
- night soil;
- urban wastewater collecting systems;
- urban wastewater treatment plants;
- treating industrial wastewater similar to urban wastewater
- water supply treatment plants;
- but excluding hazardous sludge from industry.

NOTE Sludge definition: mixture of water and solids separated from various types of water as a result of natural or artificial processes [Source: EN 12832]

NOTE The definition of sludge may refer in the future to the definition given by ISO TC 275 terminology Working Group (on-going)

22.2.3 Data sources

Data on the annual quantity of sludge reused and the total annual quantity of sludge produced in the city should be sourced from relevant city departments, ministries or institutions that are responsible for solid waste, wastewater and sewage system management. Data may also be sourced from local utility providers, if applicable.

22.3 Energy derived from wastewater as a percentage of total energy consumption of the city

22.3.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Wastewater which has significant organic matter content can be a source of energy either directly by recovering heat from wastewater within the wastewater network, or by producing energy from the digestion of wastewater or sludge or other new technologies using this energy for cogeneration, bio methane production for injection in the gas network, or for fuel production.

In a context where energy consumption from fossil energy resources has to be decreased for sustainable development purposes, it is advantageous to use this source of heat, electricity, gas or fuel for other services across the city (i.e., heating of swimming pools, fuels for city vehicle fleet, energy sales to local industries etc.). In case of disadvantages of fossil energy tariffs, it is also a way for the city to achieve a level of energy independence.

NOTE 2 This indicator reflects the “Community infrastructures”, and “Biodiversity and ecosystem services”, and “Economy and sustainable production and consumption”, issues as defined in ISO 37101. It can allow an evaluation of the contribution to the “Responsible resource use” and “Preservation and improvement of environment” and “resilience” purposes of the city as defined in ISO 37101.

22.3.2 Indicator requirements

Energy derived from wastewater as a percentage of total energy consumption of the city shall be calculated as the sum of the total annual quantity of energy derived from the network of wastewater and wastewater treatment plants (numerator) divided by the total energy consumption of the city (denominator). The result shall then be multiplied by 100 and expressed as energy derived from wastewater as a percentage of total energy consumption of the city

Energy derived from the wastewater network and wastewater treatment plants, and total energy consumption of the city shall be expressed in gigajoules (GJ) per year.

22.3.3 Data sources

Data on a city’s total energy consumption can be derived from the ISO 37120 indicator ‘Energy use per capita’ multiplied by the population number of the city. Data on the amount of energy derived from wastewater should be sourced from relevant city departments or wastewater utilities.

22.4 Percentage of total amount of wastewater in the city that is used to generate energy

22.4.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE 1 Wastewater which has significant organic matter content can be a source of energy either directly by recovering heat from wastewater within the wastewater network, or by producing energy from the digestion of wastewater or sludge or other new technologies using this energy for cogeneration, bio methane production for injection in the gas network, or for fuel production.

In a context where energy consumption from fossil energy resources has to be decreased for sustainable development purposes, it is advantageous to use this source of heat, electricity, gas or fuel for other services across the city (i.e., heating of swimming pools, fuels for city vehicle fleet, energy sales to local industries etc.). In case of disadvantages of fossil energy tariffs, it is also a way for the city to achieve a level of energy independence.

NOTE 2 This indicator reflects the "Community infrastructures", "Economy and sustainable production and consumption", issues as defined in ISO 37101. It can allow an evaluation of the contribution to the "Responsible resource use" and "Preservation and improvement of environment" and "resilience" purposes of the city as defined in ISO 37101.

22.4.2 Indicator requirements

Percentage of total amount of wastewater in the city that is used to generate energy shall be calculated as the total amount of wastewater utilized to generate energy (numerator) divided by the total amount of wastewater in the city (denominator). The result shall then be multiplied by 100 and expressed as the percentage of total quantity of wastewater in the city that is used to generate energy.

Energy generated from the wastewater network or treatment plant shall be expressed in gigajoules (GJ) per year.

22.4.3 Data sources

Data on the quantity of wastewater in the city in total and the total amount of wastewater in the city that is used to generate energy should be sourced from local utilities, or relevant city departments that oversee wastewater treatment and related energy generation.

23 Water

23.1 Number of real-time ICT-based drinking water quality monitoring stations per 100 000 population

23.1.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE A real-time ICT-based system for monitoring drinking water quality can help in informing city residents of drinking water quality and mitigate any health impacts that may occur due to poor drinking water quality. By using an ICT-based system in drinking water quality monitoring, this can provide real-time observation, such that the information is instantaneous at any given time, allowing for real-time data processing and analysis - giving people timely information on the safety of a city's drinking water quality.

23.1.2 Indicator requirements

The number of real-time ICT-based drinking water quality monitoring stations per 100 000 population shall be calculated as the total number of real-time ICT-based drinking water quality monitoring stations in the city (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of real-time ICT-based drinking water quality monitoring stations per 100 000 population.

A monitoring station shall refer to a physical structure or device that uses specialized equipment and analytical methods to track pollutant levels of the city's drinking water.

A real-time ICT-based system shall refer to any form of technology that provides instantaneous information such as mobile applications. More specifically, an ICT system is a set-up consisting of hardware, software, data and the people who use them. An ICT system commonly includes communications technology, such as the internet. It should be noted that ICT and computers are not the same thing - computers are the hardware that is often part of an ICT system.

23.1.3 Data sources

The number of real-time ICT-based drinking water quality monitoring stations should be sourced from relevant city departments that oversee the drinking water quality of the city.

23.2 Number of real-time ICT-based environmental water quality monitoring stations per 100 000 population

23.2.1 General

Those implementing this International Standard should report on this indicator in accordance with the following requirements.

NOTE A real-time ICT-based system for monitoring environmental water quality can help in reducing climate change impacts on the environment and water ecosystems. Using an ICT-based system in environmental water monitoring can provide real-time observation, such that the information is instantaneous at any given time, allowing for real-time data processing and analysis - giving the city and people timely information on the safety of a city's environmental water quality.

23.2.2 Indicator requirements

The number of real-time ICT-based environmental water quality monitoring stations per 100 000 population shall be calculated as the total number of real-time ICT-based environmental water quality monitoring stations in the city (numerator) divided by one 100 000th of the city's total population (denominator). The result shall be expressed as the number of real-time ICT-based environmental water quality monitoring stations per 100 000 population.

Environmental water shall refer to any water in a river or wetland that benefits the environment, for instance, water that is set aside in storage such as reservoirs and dams which is managed for plants and animals.

A monitoring station shall refer to a physical structure or device that uses specialized equipment and analytical methods to track pollutant levels of environmental water.

A real-time ICT-based system shall refer to any form of technology that provides instantaneous information such as mobile applications. More specifically, an ICT system is a set-up consisting of hardware, software, data and the people who use them. An ICT system commonly includes communications technology, such as the internet. It should be noted that ICT and computers are not the same thing - computers are the hardware that is often part of an ICT system.

23.2.3 Data sources

The number of real-time ICT-based environmental water quality monitoring stations should be sourced from relevant city departments that oversee the water quality of the city's natural water network and the environment of the city.

24 Reporting and record maintenance

Reports on city indicators should compile the data required in the individual test methods used.