



BSI Standards Publication

Sustainable cities and communities — Environmental, social and governance (ESG) indicators for cities

National foreword

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**Sustainable cities and
communities — Environmental,
social and governance (ESG)
indicators for cities**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by Technical Committee ISO/TC 268, *Sustainable cities and communities*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

On a global scale, environmental, social and governance (ESG) principles are at the core of the discussion on responsible leadership in governments and private industries alike. Cities can leverage these principles to foster a more sustainable and inclusive prosperity for their citizens guided by data-driven management for sound governance into the future. However, a critical weakness has been identified in this field: a lack of standards and codes on how to measure ESG with comparable data, governed by standardized criteria and a trusted measurement platform. This lack of standardization has created a sense of skepticism in ESG assessments and organizations are seeking new guidance on how best to measure ESG performance.

It is within this global context of an evolving ESG ecosystem that cities are stepping up – understanding the need for standardization across ESG principles to ensure much-needed successes in municipal programming, planning and service delivery. To be successful in adopting ESG programs and strategies, city leaders need to be equipped with standardized criteria to build trusted measurement platforms. With standardized city-level data, city managers, planners, mayors and sector leaders will be better able to assess and track advances in a city's ESG profile. A subset of these key performance indicators (KPIs) can also be applied to measure results in regions, counties, provinces, states, countries and other geographic levels.

Worldwide, cities are already utilizing ISO 37120, ISO 37122 and ISO 37123 for cities to build standardized data sets to support their work in delivering services to their residents, in advancing quality of life, and in building smarter and more resilient futures for their cities. These municipal leaders recognize the importance of standardized data to support and validate their commitments to ESG. [Figure 1](#) shows the relationship between the ISO 37120, ISO 37122 and ISO 37123 standards for cities.

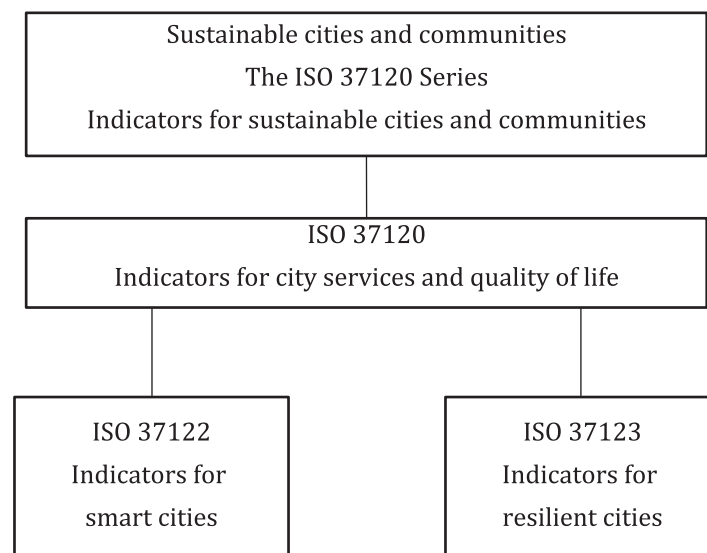


Figure 1 — Relationship between ISO 37120, ISO 37122 and ISO 37123

While KPIs (252 in total plus a set of profile indicators) exist across ISO 37120, ISO 37122 and ISO 37123 for cities that can support ESG measurements in cities, there are also gaps within these indicators. This document is designed to draw on both a sub-set of KPIs in ISO 37120, ISO 37122 and ISO 37123 for cities (see [Annex A](#)) and also to include new KPIs developed with full definitions and methodologies to fill these critical gaps, making this document a comprehensive ESG measurement platform for cities. This document includes a core set of fully numeric KPIs that will help city leaders worldwide to direct ESG-informed and ESG-driven municipal programming, planning and service delivery. This document, in conjunction with ISO 37120, ISO 37122 and ISO 37123 is intended to provide a complete set of indicators to better assess and track advances in a city's ESG profile.

Cities of all sizes and in line with their own purposes can use their ESG profile for setting benchmarks and milestones for their growth and development. Cities, governments and researchers can also make use of the ESG profiles for inter-city comparison. This document is a flexible tool designed to support cities across

objectives. Furthermore, indicators can be useful tools for other levels of government, including regional and other upper-tier governments when considering ESG objectives.

This document is developed with the understanding that cities are increasingly on the frontline in delivering services that improve quality of life for citizens, that protect the environment, consider equity and social needs, and prioritize social responsibility, underpinned by a strong model of governance and enduring legislation. This document will equip city leaders with data to nurture prosperous, inclusive, and liveable cities, with a high quality of life for residents, now and in the future.

Sustainable cities and communities — Environmental, social and governance (ESG) indicators for cities

1 Scope

This document specifies and establishes definitions and methodologies for a set of indicators to inform an environmental, social and governance (ESG) profile for cities.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 city

municipality

local government

urban or rural community falling under a specific administrative boundary

3.2 city population

number of residents living in a particular city or municipality, typically determined by census every 5 or 10 years

Note 1 to entry: City populations determined by census exclude temporary residents but include residents temporarily absent.

3.3 community

group of people with an arrangement of responsibilities, activities and relationships

Note 1 to entry: In many, but not all, contexts, a community has a defined geographical boundary.

Note 2 to entry: A city is a type of community.

3.4 disaster

serious disruption to a city or community due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to human, material, economic and/or environmental losses and impacts

Note 1 to entry: Disasters can be frequent or infrequent, depending on the probability of occurrence and the return period of the relevant hazard.

3.5

drinking water

water intended for human consumption

Note 1 to entry: The term "potable water" is used instead of "drinking water" in ISO 37120 because it was published before ISO 24513. Both terms can be used interchangeably, but "potable water" is deprecated according to ISO 24513.

[SOURCE: ISO 24513:2019, 3.2.2.1, modified — Note 1 to entry replaced.]

3.6

full-time enrolment

enrolment in an education programme whose intended study load amounts to at least 75 % of the normal full-time annual study load

3.7

gigajoule

measure of the energy that is equivalent to 1×10^9 Joules (J), where 1 J is the amount of energy required to send an electrical current of one ampere through a resistance of one ohm for one second

Note 1 to entry: One gigajoule (GJ) is equivalent to 277,8 kilowatt hours (kWh).

3.8

hazard

phenomenon, human activity or process that can cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation

Note 1 to entry: Hazards include biological, environmental, geological, hydro-meteorological and technological processes and phenomena. Biological hazards include pathogenic microorganisms, toxins and bioactive substances (e.g. bacteria, viruses, parasites, venomous wildlife and insects, poisonous plants, mosquitoes carrying disease-causing agents). Environmental hazards can be chemical, natural, radiological or biological, and are created by environmental degradation, physical or chemical pollution in the air, water and soil. However, many of the processes and phenomena that fall into this category can be "drivers" of hazard and risk rather than hazards themselves (e.g. soil degradation, deforestation, biodiversity loss, sea level rise). With respect to drinking water, 'hazard' can be understood as a microbiological, chemical, physical or radiological agent that causes harm to human health. Geological or geophysical hazards originate from internal earth processes (e.g. earthquakes, volcanic activity, landslides, rockslides, mud flows). Hydro-meteorological hazards are of atmospheric, hydrological or oceanographic origin (e.g. cyclones, typhoons, hurricanes, floods, drought, heatwaves, cold spells, coastal storm surges). Hydro-meteorological conditions can also be a factor in other hazards such as landslides, wildland fires and epidemics. Technological hazards originate from industrial or technological conditions, dangerous procedures, infrastructure failures or specific human activities (e.g. industrial pollution, nuclear radiation, toxic waste, dam failures, transport accidents, factory explosions, fires, chemical spills).

3.9

hazard map

map developed to illuminate areas that are affected or vulnerable to a particular hazard (e.g. earthquakes, landslides, rockslides)

3.10

hazardous waste

waste that is potentially harmful to human beings, property, or the environment

[SOURCE: ISO 18113-1:2022, 3.1.27, modified — Examples and notes to entry removed.]

3.11

high-risk hazard

hazard for which there is a likelihood of extreme event(s) based on hazard maps created by the city that can significantly either affect many properties in the city or have a major impact on the city, or both

3.12

indicator

quantitative, qualitative or descriptive measure

[SOURCE: ISO 15392:2019, 3.18]

3.13

labour force

all employable persons within a specified geographic area

Note 1 to entry: This typically includes all working-age adults between the ages of 15 and 64, but the specific age varies by country.

3.14

natural hazard

geological or meteorological phenomena that can cause damage to physical infrastructure or loss of life in cities

3.15

primary education

education that is considered to be the first stage of basic education

Note 1 to entry: Primary education typically covers six years of full-time schooling with the legal age of entrance normally being not younger than 5 years or older than 7 years. Primary education typically lasts until ages 10 years to 12 years. Primary education refers to children aged 5 years to 12 years or 1st grade through to 5th or 6th grade of school, as defined by local education systems.

3.16

public building

government owned or leased building that functions as a municipal and administrative office, library, recreation centre, hospital, school, fire station or police station

Note 1 to entry: Ownership of buildings (public or private) is variously defined according to region and political system. The restrictive definition used here permits global comparability across cities.

3.17

resilience

adaptive capacity of an organization in a complex and changing environment

Note 1 to entry: The Intergovernmental Panel on Climate Change (IPCC) defines resilience as “the ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures and functions.”

Note 2 to entry: Resilience is the ability of an organization to resist being affected by an event or the ability to return to an acceptable level of performance in an acceptable period of time after being affected by an event.

[SOURCE: ISO Guide 73:2009, 3.8.1.7, modified — Notes 1 and 2 to entry have been added.]

3.18

resilient city

city able to prepare for, recover from and adapt to shocks and stresses

Note 1 to entry: A resilient city can resist, absorb, accommodate, adapt to, transform and recover from the effects of disasters and shocks in a timely and efficient manner, including through the preservation and restoration of essential basic structures and services in a sustainable way, and through risk-management practices. It involves stakeholders and especially citizens in disaster risk reduction through co-creation processes; reduces vulnerability and exposure to natural and human-made disasters; and increases its capacity to respond to disasters, shocks and other unforeseen chronic stresses through enhanced preparedness.

Note 2 to entry: A resilient city is still able to thrive regardless of the hazards, shocks and stresses it faces. It has a focus on lesson learning, continuous improvement and building back better after disasters.

3.19

risk

effect of uncertainty on objectives

Note 1 to entry: An effect is a deviation from the expected — positive or negative.

Note 2 to entry: Uncertainty is the state, even partial, of deficiency of information related to understanding or knowledge of an event, its consequence or likelihood.

Note 3 to entry: Risk is often characterized by reference to potential “events” (as defined in ISO Guide 73:2009, 3.5.1.3) and “consequences” (as defined in ISO Guide 73:2009, 3.6.1.3), or a combination of these.

Note 4 to entry: Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated “likelihood” (as defined in ISO Guide 73:2009, 3.6.1.1) of occurrence.

[SOURCE: ISO 37100:2016, 3.4.12]

3.20

secondary education

education that is considered to be the second stage of basic education and marks the end of compulsory education where it exists

Note 1 to entry: Students usually enter between the ages of 10 years and 13 years (age 12 being the most common). Secondary education usually ends 12 years or 13 years after the beginning of primary education (or around age 18). However, this can range from 11 years to 14 years after beginning school (or around age 17 years to 20 years).

3.21

shock

natural or human-made event that causes a disaster

EXAMPLE Flood, earthquake, volcanic eruption, hurricane, wildfire, pandemic, chemical spill or explosion, terrorism, power outage, financial crisis, cyber-attack and conflict.

3.22

stress

underlying human and natural pressure or tension that causes persistent negative impacts in a city relating to environmental degradation (e.g. poor air and water quality), social inequality (e.g. chronic poverty and housing shortages) and economic instability (e.g. rapid inflation and persistent unemployment)

3.23

solid waste

non-soluble, discarded solid materials, including sewage sludge, municipal garbage, industrial wastes, agricultural refuse, demolition wastes and mining residues

3.24

tertiary education

education provided by universities and other higher education institutions following secondary education

3.25

vulnerability

susceptibility of individuals, households, businesses, assets or systems in a city to the impacts of hazards, as determined by physical, social, economic and environmental factors, processes and conditions

4 ESG reporting for cities — General

Cities across the world are increasingly becoming centres for economic growth and innovation pivotal to the global economy, places of diverse populations, and crucial platforms for driving a more sustainable development trajectory, all requiring strong governance frameworks.

ESG factors are gaining importance worldwide. Corporations of all sizes are increasingly rated on their impact and performance on ESG factors. However, the existing frameworks for measuring ESG performance are multiple and varied and hence not globally standardized. Going forward, both private and public organizations will be defined by how they handle ESG-related risks and opportunities. There is a gap at the city level of governments worldwide in considering how to construct an ESG profile. Within a city, ESG factors are critical to its long-term sustainability and a solid, measurable framework to gauge these factors is now critical.

KPIs and globally comparative data are essential to drive positive impacts in cities, across key ESG priorities. This document supports cities in filling this gap.

5 ESG indicators

5.1 General

This document draws on a sub-set or “pooling” of selected KPIs from across ISO 37120, ISO 37122 and ISO 37123 that have been mapped to each of the three elements of ESG: “environmental”, “social” and “governance”. This document also includes additional KPIs that have been identified through a gap analysis for ESG.

This document suggests an integrated approach to an ESG framework allowing for the evaluation of opportunities and risks across activities and processes relevant to each of the three thematic domains. Each of the E, S, and G are inherently tied to one another, with criteria and objectives of each reflected in all three domains and contributing to citizen quality of life and state of the city in general. Below is a description of the KPIs that comprise ESG: “environmental”, “social” and “governance”.

5.2 E — Environmental

KPIs under the “environmental” domain of an ESG framework allow for the evaluation and monitoring of a broad range of environmental objectives generally linked to resource management and stewardship; climate change and resilience; and attributes of land, water, and air. These KPIs enable the measurement of energy consumption and types of production; waste disposal, diversion, and reuse; and commitment to evolving the use of resources driven by sustainability practices. Topics for consideration under this domain can include, but are not limited to, pollution, greenhouse gas (GHG) emissions, biodiversity, extreme climate, and materials and waste. Indicators under this thematic domain also provide a critical and quantitative framework to evaluate the efficacy of activities aimed toward the prevention, mitigation, and recovery from the shocks and stresses of climate change and climate change related events. The KPIs further facilitate the establishment of a systematic relationship between the way that land is used and environmental sustainability – more broadly – by evaluating land-use planning and characteristics, emissions, and air quality. Finally, KPIs under this thematic domain evaluate the impact of infrastructure on the climate and natural environment.

5.3 S — Social

KPIs under the “social” domain of an ESG framework allow for the evaluation of access by residents to systems and services that facilitate personal and community health and safety, inclusion, wellbeing, and capacity for success and flourishing. The KPIs measure access to, and quality of, healthcare and healthcare systems, safety and the ability of emergency services to provide timely and effective service, and the ways in which safety and health institutions are situated to address emerging and changing needs. Indicators under this thematic domain also serve as tools to evaluate access to systems by people, groups of people, and identities that have historically faced exclusion from these systems. Topics for consideration under this domain can include, but are not limited to, health, wellbeing, crime, disaster resilience, safety, diversity, decent labour, and equality. The KPIs can further determine quality of access to services that dictate wellbeing including housing, transit, and more generalized contributors towards a higher quality of life. Finally, KPIs under this thematic domain evaluate the ability of individuals and groups to access training and skills that propel economic growth and wellbeing, the institutions that provide these services, and the outcomes of these provisions.

5.4 G — Governance

KPIs under the “governance” domain of an ESG framework can help to evaluate the capacity of governments to understand and improve approaches to service delivery, growth and development, models for inclusive and fair, transparent governance, and preparedness for risks and opportunities. They consider physical, social, and online infrastructure dedicated to service delivery as well as the implementation, security, and effectiveness of government services and systems. They allow for the evaluation of fiscal management and responsibility of municipal governments as well provide foundations for continued investment in and growth of cities. Topics for consideration under this domain can include, but are not limited to, government finance, quality of public services, and citizen engagement. Further, these KPIs measure the way in which cities foster or inhibit participation by residents and address the barriers to good governance and effective

citizenship faced by various persons and groups of persons. Finally, indicators under this thematic category enable cities to understand the ways in which their processes and initiatives identify and address threats to good governance as well as opportunities for continued growth and improvement.

6 Environmental indicators

6.1 Final energy consumption of public buildings per year (GJ/m²)

6.1.1 General

This indicator is derived from ISO 37120:2018, 7.5.

This indicator shall be reported in accordance with the following requirements.

NOTE Buildings are the largest energy consumers in most cities. Reduced and efficient energy consumption can create substantial savings and can enhance security of the energy supply. Reducing the energy consumption of a building can also reduce GHG emissions and its ecological footprint, which can help combat climate change and promote a low-carbon economy.

6.1.2 Indicator requirements

Final energy consumption of public buildings per year shall be calculated as the final energy consumption of public buildings (GJ) within a city (numerator) divided by total floor space of these buildings in square metres (m²) (denominator). The result shall be expressed as the final energy consumption of public buildings per year in gigajoules (GJ) per square metre (m²).

Final energy consumption shall include both thermal and electrical energy consumption. Only city-owned or operated buildings shall be considered. Total floor space, and not just the footprint of the building, shall be considered toward the denominator.

6.2 Total residential electrical energy use per capita (kWh/year)

6.2.1 General

This indicator is derived from ISO 37120:2014¹⁾, 7.1.

This indicator shall be reported in accordance with the following requirements.

NOTE An understanding of how much electricity is currently being consumed is needed in order to effectively manage generation, consumption, and conservation of electricity. Residential areas are one of the major consumers of electricity and its associated resource use. All forms of electricity generation have some environmental impact.

6.2.2 Indicator requirements

Total residential electrical energy use per capita (kWh/year) shall be calculated as the total residential electrical usage of a city in kilowatt hours (numerator) divided by the total population of the city (denominator). The result shall be expressed as the total residential electrical energy use per capita in kilowatt hours/year.

6.2.3 Data sources

Data should be gathered from electricity providers. Electricity consumption statistics are typically collected in three categories: residential, commercial, and industrial.

NOTE Electricity providers typically report electricity consumption statistics by customer and not resident or they report consumption by sector (residential, commercial, and industrial) in bulk and then report more detailed statistics as averages.

1) Withdrawn.

6.3 Percentage of total electricity consumption from renewable sources

6.3.1 General

This indicator shall be reported in accordance with the following requirements.

NOTE The promotion of renewable energy sources is a high priority for sustainable development, for reasons such as the security and diversification of energy supply and for environmental protection.

6.3.2 Indicator requirements

The percentage of total electricity consumption from renewable sources shall be calculated as the total consumption of electricity generated from renewable sources (numerator) divided by the city's total electricity consumption (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Consumption from renewable sources should include geothermal, solar, wind, hydro, tide and wave energy, and combustibles, such as biomass.

6.4 Electricity consumption of public street lighting per kilometre of lighted street (kWh/year)

6.4.1 General

This indicator is derived from ISO 37120:2018, 7.6.

This indicator shall be reported in accordance with the following requirements.

NOTE Street lighting can comprise 15 % to 50 % of public electricity. Improving the efficiency of street lighting is also one of the most important and cost-effective steps that a city can take to improve energy efficiency. Improving the quality and efficiency of public street lighting has multiple co-benefits, including reduced maintenance costs, improved public safety and reduced crime rates, improved road and traffic safety, improved air quality, enhanced city attractiveness and community identity and increased economic productivity.

6.4.2 Indicator requirements

Electricity consumption of public street lighting shall be calculated as the total electricity consumption of public street lighting (numerator) divided by the total distance of streets where streetlights are present (denominator). The result shall be expressed as electricity consumption of public street lighting in kilowatt hours per kilometre per year.

The denominator shall be calculated using the centreline distance of the street. Lighted streets shall include other lighted areas within the city such as pathways, which should be reflected in both numerator and denominator. Only city-owned or -operated street lighting shall be considered toward both numerator and denominator.

For the purposes of this document, the street lighting should meet locally or nationally defined standards for illumination or the requirements set by the International Commission on Illumination, or both.^[66]

NOTE Local or national regulations/standards can apply to street lighting.

6.5 Square metres of city owned/operated green roof space as a percentage of all roof space of all city-owned/operated buildings

6.5.1 General

This indicator shall be reported in accordance with the following requirements.

NOTE Green roof space reduces the temperatures of the roof surface and surrounding area. Benefits of green roof space include, but are not limited to, reduced building energy use, improved air quality, reduced air pollution and reduced GHG emissions. These spaces offer increased benefits per square metre installed.

6.5.2 Indicator requirements

Square metres of green roof space as a percentage of all roof space of city-owned/operated buildings shall be calculated as the total square metres of green roof space of city-owned/operated buildings (numerator) divided by the total square metres of roof space of city-owned/operated buildings (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Square metres of green roof space refers to the square metres of vegetated roofing system which is functionally integrated onto a roof area. This can include, but is not limited to:

- extensive green roofs (natural low maintenance);
- intensive green roofs (high maintenance, parks and gardens including urban agriculture);
- simple/semi-intensive green roofs (moderate maintenance, grass/herbs/shrubs).

The roof space of city-owned/operated buildings refers to the total roof space of public buildings that are municipally owned or operated.

6.6 Number of electric vehicle (EV) charging station ports per registered electric vehicle (EV)

6.6.1 General

This indicator is derived from ISO 37122:2019, 7.10.

This indicator shall be reported in accordance with the following requirements.

NOTE Unlike conventional vehicles that use gasoline or diesel-powered engines, electric vehicles (EVs) are powered by electricity from batteries. EVs therefore emit fewer GHGs and tailpipe pollutants than conventional vehicles. EVs are also cheaper to operate because fuel costs are minimal or nil. However, with limited motor and battery capacity (meaning shorter travel range), electric cars need regular and convenient access to vehicle (i.e. battery) charging stations.

6.6.2 Indicator requirements

The number of EV charging station ports per registered EV shall be calculated as the total number of EV charging station ports in the city (numerator) divided by the total number of registered EVs in the city (denominator). The result shall be expressed as the number of EV charging station ports per registered EV.

EV shall refer to any means by which something or someone is carried or conveyed with an engine and wheels (including cars, buses, motorcycles and auto rickshaws, but not trains) and which runs fully or partially on a battery-powered electric motor. EVs, therefore, require “plugging in” to an electricity source to recharge their batteries. There are two types of EVs:

- 1) “hybrid” vehicles that are powered from a gasoline or diesel engine as well as an electric motor;
- 2) “battery electric” vehicles that are powered exclusively from a battery and require no liquid fuels.

Only hybrid vehicles that connect directly to a power source shall be counted toward the denominator. Only privately-owned vehicles shall be included. All ports shall be considered if they are open to the public.

Charging station ports shall refer to publicly accessible equipment, also called “electric vehicle supply equipment” (EVSE) that supplies electric energy for recharging battery EVs. Stations can have multiple ports, which shall each be counted separately, representing the number of vehicles that can be charged at one time. Charging stations are often provided in municipal parking locations by electric utility companies or at retail shopping centres by private companies. Some charging stations have advanced features such as smart metering, cellular capability and network connectivity.

Registered vehicle shall refer to any vehicle that has been officially listed or recorded with a government authority and that displays either a vehicle registration plate or a vehicle registration certificate, or both.

6.6.3 Data sources

Data for this indicator should be obtained from municipal or state departments or ministries responsible for transportation and vehicle registration in the city.

6.7 Number of hydrogen fuel cell vehicle charging nozzles per personal hydrogen fuel cell vehicle

6.7.1 General

This indicator shall be reported in accordance with the following requirements.

6.7.2 Indicator requirements

The number of hydrogen fuel cell vehicle charging nozzles per personal hydrogen fuel cell vehicle shall be calculated as the number of nozzles to fuel hydrogen fuel cell vehicles in the city (numerator) divided by the number of registered personal hydrogen fuel cell vehicles in the city (denominator). The result shall be expressed as the number of hydrogen fuel cell vehicle charging nozzles per personal hydrogen fuel cell vehicle.

Hydrogen fuel cell vehicles shall be defined as vehicles that generate electricity using oxygen from the air and compressed hydrogen and have compressed hydrogen stored on board the vehicle.

A nozzle is used to connect the hydrogen refuelling station with the hydrogen fuel cell vehicle. There can be more than one nozzle at each station. Stations shall not be counted in place of nozzles.

Personal hydrogen fuel cell vehicles refer to privately owned vehicles not used for commercial purposes.

6.8 Fine particulate matter (PM_{2,5}) concentration

6.8.1 General

This indicator is derived from ISO 37120:2018, 8.1.

This indicator shall be reported in accordance with the following requirements.

NOTE 1 Fine particulate matter (PM) can cause major health problems in cities. According to the World Health Organization (WHO), any concentration of PM is harmful to human health. PM is carcinogenic and harms the circulatory system as well as the respiratory system. As with many other air pollutants, there is a connection with questions of environmental justice, since underprivileged citizens can often suffer from stronger exposure. The evidence on PM and its public health impact is consistent in showing adverse health effects at exposures that are currently experienced by urban populations in both developed and developing countries. The range of health effects is broad, but predominantly associated with the respiratory and cardiovascular systems.

NOTE 2 The PM_{2,5} annual air quality guideline (AQG) level has been lowered by the WHO from 10 µg/m³ to 5 µg/m³. This reflects the new evidence of effects on mortality occurring at concentrations below 10 µg/m³.

6.8.2 Indicator requirements

Fine particulate matter (PM_{2,5}) concentration shall be calculated as the total mass of collected particles that are 2,5 µm or less in diameter (numerator) divided by the volume of air sampled in standard cubic metres (µg/m³) (denominator). The result shall be expressed as the concentration of PM_{2,5} in micrograms per standard cubic metre (µg/m³).

The method for measurement shall involve the use of an air sampler which draws ambient air at a constant flow rate into a specially shaped inlet where the suspended PM is inertially separated into one or more size fractions within the PM_{2,5} size range. The 24 h (daily) measurements of PM_{2,5} concentrations are forwarded to a database where yearly summaries for each monitoring station are computed.

Since data for PM_{2,5} are not readily available, levels are often calculated on the basis of PM₁₀ emission, and this is reported as a separate indicator. Cities should describe the location of each monitoring station to convey the local representativeness of the measured values (e.g. airport, city centre, industrial park). Ideally, multiple station locations should be used to determine a spatial average for the city.

6.9 Percentage of designated natural protection areas

6.9.1 General

This indicator is derived from ISO 37120:2018, 8.4.

This indicator shall be reported in accordance with the following requirements.

NOTE 1 Natural areas play an important role in conserving biodiversity and maintaining ecological processes and natural cycles which serve to benefit the natural and human environment. Natural areas also serve as potential economic hubs by drawing in recreational users into and around the area.

NOTE 2 A protected area is a clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services (International Union for Conservation of Nature)^[79].

6.9.2 Indicator requirements

The percentage of areas designated for natural protection shall be calculated as the total land area of designated natural protection and/or biodiversity (numerator) divided by the total land area of the city (denominator). The result shall be multiplied by 100 and expressed as a percentage.

Areas designated either for natural protection or biodiversity, or both, shall refer to areas under municipal, communal, natural and/or local protection/biodiversity schemes. Bodies of water can be considered toward both numerator and denominator. Archaeological sites shall be excluded.

6.10 Greenhouse gas (GHG) emissions measured in tonnes per capita

6.10.1 General

This indicator shall be reported in accordance with the following requirements.

NOTE The GHG emissions from all activities within the city are an indicator of the adverse contribution the city is making to climate change.

6.10.2 Indicator requirements

The GHG emissions measured in tonnes per capita shall be measured as the total amount of GHGs in tonnes (equivalent carbon dioxide units) generated over a calendar year by all activities within the city, including indirect emissions outside the city boundaries (numerator) divided by the current population of the city (denominator). The result shall be expressed as the total GHG emissions per capita in tonnes.

The total aggregate tonnage (expressed as equivalent carbon dioxide units of GHG) of GHG emissions shall be calculated for all activities within the cities for the preceding 12 months.

The Global Protocol for Community-Scale GHG Emissions (GPC) refers to a multi-stakeholder consensus-based protocol for developing internationally recognized and accepted community-scale GHG accounting and reporting. This protocol defines the basic emissions sources and categories within sectors for a community-scale GHG inventory, in order to standardize GHG inventories between communities and within a community over time. The protocol provides accounting methodologies and step-by-step guidance on data collection, quantification and reporting recommendations for each source of emissions.

Both emissions sources and sector categorizations reflect the unique nature of cities and their primary emissions sources. These include emissions from:

- a) stationary units;
- b) mobile units;
- c) waste;
- d) industrial process and product use sectors.

For further specifications, refer to the full GPC methodology. Local governments shall be expected to provide information (i.e. quantified emissions) for each of these emission sources.

In order to address the issue of inter-city sources of emissions that transcend more than one jurisdictional body, the GPC integrates the GHG Protocol Scope definitions, as follows:

- Scope 2 emissions: energy-related indirect emissions that occur as a consequence of consumption of grid-supplied electricity, heating and/or cooling, within the community's geopolitical boundary.
- Scope 3 emissions: all other indirect emissions that occur as a result of activities within the community's geopolitical boundary.

NOTE 1 Guidance is available through the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories²⁾.

NOTE 2 GHGs are gases in the atmosphere that absorb infrared radiation that would otherwise escape to space, thereby contributing to rising surface temperatures. There are six major GHGs: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF₆). The warming potential for these gases varies from several years to decades to centuries.

See ISO 14064-1, ISO 14064-2 and ISO 14064-3 on GHGs for further guidance.

6.11 Number of real-time remote air quality monitoring stations per square kilometre (km²)

6.11.1 General

This indicator is derived from ISO 37122:2019, 8.2.

This indicator shall be reported in accordance with the following requirements.

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

6.11.2 Indicator requirements

The number of real-time remote air quality monitoring stations per square kilometre (km²) shall be calculated as the total number of real-time remote air quality monitoring stations in the city (numerator) divided by the city's land area (denominator). The result shall be expressed as the number of real-time remote air quality monitoring stations per km².

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 (PM_{2,5}), carbon dioxide (CO₂) and sulfur dioxide (SO₂).

A real-time remote system shall refer to any form of technology that provides instantaneous information such as mobile applications. More specifically, a remote system consists of hardware, software, data and the people who use them. A remote system commonly includes communications technology, such as the Internet.

2) https://www.ghgprotocol.org/sites/default/files/ghgp/standards/GHGP_GPC_0.pdf

6.11.3 Data sources

The number of real-time remote air quality monitoring stations should be sourced from city departments or ministries that oversee the air quality of the city, though sources can vary between cities and may also include privately owned monitoring stations.

6.12 Percentage of city land area covered by tree canopy

6.12.1 General

This indicator is derived from ISO 37123:2019, 8.8.

This indicator shall be reported in accordance with the following requirements.

NOTE A city's tree canopy coverage can have numerous benefits, including reduction of daytime air temperatures in hot seasons, improving air quality and strengthening social ties among neighbours. These factors can strengthen resilience while also help to attract businesses and residents.

6.12.2 Indicator requirements

The percentage of city area covered by tree canopy shall be calculated as the city land area covered by tree canopy (numerator) divided by the city's total land area (denominator). The result shall be multiplied by 100 and expressed as the percentage of city land area covered by tree canopy.

Tree canopy shall refer to the layered biomass of tree leaves, branches and stems that obscures the underlying ground surface when viewed from above.

6.12.3 Data sources

Data on tree canopy coverage should be sourced from local or regional conservation organizations or a ministry/department of environment, land use or urban planning. In addition, data should be sourced using geographic information system (GIS) tools and methods.

6.12.4 Data interpretation

Data should be considered through local context, as tree type and climate often impact canopy size and structure.

6.13 Annual expenditure allocated to ecosystem restoration in the city as a percentage of total city expenditures

6.13.1 General

This indicator is derived from ISO 37123:2019, 9.3.

This indicator shall be reported in accordance with the following requirements.

NOTE Ecosystem restoration is an effective way to strengthen ecological resilience and to mitigate hazards. It has multiple benefits, such as improved storm water management, water pollution control and reduced flooding and soil erosion.

6.13.2 Indicator requirements

Annual expenditure on ecosystem restoration as a percentage of total city expenditures shall be calculated as the total of all funds spent annually on ecosystem restoration assets for the specific purpose of enhancing the protective and other ecosystem services that enhance the resilience of the city (numerator) divided by the total city expenditures (denominator).

The result shall be multiplied by 100 and expressed as the expenditure on ecosystem restoration as a percentage of total city capital expenditures.

Ecosystem restoration shall refer to the process of recovering natural and semi-natural landscape elements (i.e. related to soil, water bodies and vegetation) that have been degraded, damaged or destroyed. Regular landscaping not for the purpose of ecosystem restoration shall not be considered toward the numerator. Bodies of water may be considered as objects of ecosystem restoration.

6.13.3 Data sources

Data on ecosystem restoration may be sourced from the city's capital and public works expenditures. Some elements of expenditure can also be sourced from the city's parks and conservation budgets. The total city expenditures used in this calculation should be sourced from the city's audited financial statements without amendment or variation.

6.13.4 Data interpretation

This indicator measures specific city expenditure to support and enhance the ecosystem services.

6.14 Percentage of city area impacted by either wildfire or forest fire, or both

6.14.1 General

This indicator shall be reported in accordance with the following requirements.

6.14.2 Indicator requirements

The percentage of city area impacted by either wildfire or forest fire, or both, shall be calculated as the total city land area impacted by either wildfire or forest fire, or both (numerator) divided by the city's total land area in square kilometres (km²)(denominator). The result shall then be multiplied by 100 and expressed as the percentage of city area impacted by either wildfire or forest fire, or both.

City area impacted by either wildfire or forest fire, or both refers to the portion of landscape that has been burned by unplanned, unwanted wildland and/or forest fire within the municipal boundary.

Fire severity (also known as burn severity) refers to the degree to which a site has been altered or disrupted by fire, with focus on the impact on the ecosystem, including vegetation burn severity and soil burn severity.

In the context of satellite-based post-fire burn severity mapping, this indicator shall include areas burned at high, medium/moderate, and low severity. The reporting of this indicator shall include unauthorized human-caused fires, escaped wildland fire events, escaped prescribed fire projects, and all other events that caused wildland fires.

The square kilometres (km²) of city land area impacted by either wildfire or forest fire, or both should be reported separately by severity in [Table 1](#).

Table 1 — City land area impacted by fire

	km ²
Impacted at a high severity	
Impacted at a medium/ moderate severity	
Impacted at a low severity	
Total	

6.14.3 Data interpretation

Fire severity is measured based on the Burned Area Emergency Response (BAER) fire severity table. This reports the aftermath impacts expressed as the percentage of vegetation killed, percentage of overstory tree mortality, and mineral soil impacts.

6.15 Percentage of households with smart energy meters

6.15.1 General

This indicator is derived from ISO 37122:2019, 12.1.

This indicator shall be reported in accordance with the following requirements.

This indicator has been placed under the "environment" domain as it fulfills the "...enable[ing] the measurement of energy consumption and types of production" element of "environment" as described in [Clause 5](#). However, indicators under the ESG framework can have relationships to one or more thematic domains, and it is recommended that local context be applied when considering indicator application.

NOTE Smart energy meters record and display the consumption of energy 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 energy. Also, smart meter data help consumers better understand and monitor energy usage.

6.15.2 Indicator requirements

The percentage of households with smart energy meters shall be calculated as the total number of households with smart energy 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 energy meters.

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

Where possible, the percentage of households with smart energy meters by type of energy should be reported separately in [Table 2](#).

Table 2 — Percentage of households with smart energy meters by type of energy

	Percentage (%) of households with smart energy meters (by type of energy)
Electricity	
Gas	
Heat networks (district heating)	

6.15.3 Data sources

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

6.16 Percentage of households with smart water meters

6.16.1 General

This indicator is derived from ISO 37122:2019, 12.2.

This indicator shall be reported in accordance with the following requirements.

This indicator has been placed under the "environment" domain as it fulfills the "...enable[ing] the measurement of energy consumption and types of production" element of "environment" as described in [Clause 5](#). However, indicators under the ESG framework can have relationships to one or more thematic domains, and local context should be applied when considering indicator application.

NOTE 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, smart meter data help consumers better understand and monitor water usage.

6.16.2 Indicator requirements

The percentage of households with smart water meters shall be calculated as the total number of 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 with online visualized real-time information or that is available through a real-time online application, so customers 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.

6.16.3 Data sources

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

6.17 Percentage recycled solid waste

6.17.1 General

This indicator is derived from ISO 37120:2018, 16.3.

This indicator shall be reported in accordance with the following requirements.

NOTE Many cities generate more solid waste than they can dispose of. Even when municipal budgets are adequate for collection, the safe disposal of collected waste often remains a problem. Diverting recyclable materials from the waste stream is one strategy for addressing this municipal issue. Higher levels of municipal waste contribute to greater environmental problems and therefore levels of collection. Also, methods of disposal of municipal solid waste are an important component of municipal environmental management. Solid waste systems contribute in many ways to public health, the local economy, the environment, and the social understanding and education about the environment. A proper solid waste system can foster recycling practices that maximize the life cycle of landfills and create recycling micro-economies. It also provides alternative sources of energy that help reduce the consumption of electricity or petroleum-based fuels, or both.

6.17.2 Indicator requirements

The percentage of the city's solid waste that is recycled shall be calculated as the total amount of the city's solid waste that is recycled in tonnes (numerator) divided by the total amount of solid waste diverted or disposed of in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Recycled materials shall refer to those materials diverted from the waste stream with the exception of materials biologically treated and used as compost or biogas, or processing residue, recovered and processed into new products following local government permits and regulations.^[77]

Hazardous waste that is produced in the city and is recycled shall be reported separately.

The total amount of the city's solid waste that is recycled should be reported by type in [Table 3](#).

Table 3 — Recycled solid waste disposal by type

	Residential	Commercial and industrial	Total
Percentage of solid waste recycled			
Total annual amount of the city's solid waste that is recycled in tonnes			
Total annual amount of solid waste diverted or disposed of in tonnes			

6.17.3 Data sources

This information should be obtained from municipal bodies, public services and major private contractors dealing with solid waste collection and disposal. Data may be obtained from specific studies carried out on solid waste.

Information on selected disposal methods should be gathered from municipal facilities and operators, and parastatal and private companies dealing with solid waste treatment. Solid waste experts, as well as non-governmental organizations (NGOs) working in this area, may be consulted.

6.18 Percentage of solid waste disposed of in a sanitary landfill

6.18.1 General

This indicator is derived from ISO 37120:2018, 16.4.

This indicator shall be reported in accordance with the following requirements.

NOTE Many cities generate more solid waste than they can dispose of. Even when municipal budgets are adequate for collection, the safe disposal of collected waste often remains a problem. Open dumping and unsanitary landfills are sometimes the main disposal methods, particularly in lower-income cities. Sanitary landfills are the norm in only a limited number of cities worldwide.

6.18.2 Indicator requirements

The percentage of the city's solid waste that is disposed of in a sanitary landfill shall be calculated as the amount of the city's solid waste that is disposed of in a sanitary landfill in tonnes (numerator) divided by the total amount of solid waste diverted or disposed of in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

Sanitary landfill shall refer to a carefully designed structure which uses a clay liner or a synthetic liner in order to isolate solid waste from the surrounding environment. This isolation is accomplished with a bottom liner and daily covering of soil.

The city's solid waste that is disposed of in a sanitary landfill should be reported by type in [Table 4](#).

Table 4 — Solid waste disposal in a sanitary landfill by type

	Residential	Commercial and industrial	Total
Percentage of solid waste disposed of in a sanitary landfill			
Total annual amount of the city's solid waste that is disposed of in a sanitary landfill			
Total annual amount of solid waste diverted or disposed of in tonnes			

6.18.3 Data sources

This information should be obtained from municipal bodies, public services and major private contractors dealing with solid waste collection and disposal. Data may be obtained from specific studies carried out on solid waste.

Information on selected disposal methods should be gathered from municipal facilities and operators, and parastatal and private companies dealing with solid waste treatment. Solid waste experts, as well as NGOs working in this area, may be consulted.

When data are not available, an estimate of the proportion of waste to sanitary landfill and the proportion disposed to open dump should be provided.

6.19 Percentage of solid waste treated in energy-from-waste plants

6.19.1 General

This indicator is derived from ISO 37120:2018, 16.5.

This indicator shall be reported in accordance with the following requirements.

NOTE Many cities generate more solid waste than they can dispose of. Even when municipal budgets are adequate for collection, the safe disposal of collected waste often remains a problem. As sanitary landfill sites are limited, cities examine more sustainable alternatives for disposal, such as energy-from-waste plants.

6.19.2 Indicator requirements

The percentage of the city's solid waste that is treated in energy-from-waste plants shall be calculated as the total amount of the city's solid waste that is disposed of in energy-from-waste plants in tonnes (numerator) divided by the total amount of solid waste diverted or disposed of in the city in tonnes (denominator). The result shall then be multiplied by 100 and expressed as a percentage.

An energy-from-waste plant shall refer to a unit or facility used to generate either electrical or heat energy, or both, from incinerated wastes. The facility should have a net energy efficiency higher than or equal to 0,25, i.e. the produced energy is higher than or equal to 25 % of incoming energy.

The city's solid waste that is treated in energy-from-waste plants should be reported by type in [Table 5](#).

Table 5 — Solid waste treated in energy-from-waste plants by type

	Residential	Commercial and industrial	Total
Percentage of solid waste treated in energy from waste plants			
Total annual amount of the city's solid waste that is treated in energy from waste plants			
Total annual amount of solid waste diverted or disposed of in tonnes			

6.19.3 Data sources

This information should be obtained from municipal bodies, public services and major private contractors dealing with solid waste collection and disposal. Data may be obtained from specific studies carried out on solid waste.

Information on selected disposal methods should be gathered from municipal facilities and operators, parastatal and private companies dealing with solid waste treatment. Solid waste experts, as well as NGOs working in this area, may be consulted.