European Commission

Green City Accord

Clean and Healthy Cities for Europe

GCA Mandatory Indicators Guidebook

Version of August 2024

Green City Accord

GCA Mandatory Indicators Guidebook

Contents

Introduction

The following guidebook provides further information on the 'mandatory' indicators for each of the five areas covered by the Green City Accord (GCA): air, water, nature & biodiversity, waste & circular economy, and noise.

Reporting as a core component of the Green City Accord

Signatory cities are required to report on their progress in each of the five different areas of the GCA mentioned above.

The main purpose of reporting is for cities to:

- Provide evidence on how they are progressing towards the five goals of the GCA;
- Enable them to compare their progress to their fellow cities.

Mandatory indicators

An overview of the full set of mandatory indicators can be found on the next page.

A limited set of 15 mandatory indicators - 3 indicators per area have been selected. The indicators were tested with a group of interested cities.

Use of mandatory indicators

The mandatory indicators are to be used in:

- Establishing the baseline – covering both the starting point in each area, as well as the targets to be achieved by 2030 - within two years after signing the GCA (For cities having signed in 2020 and 2021, the baseline report should be delivered by June 2023.)
- Reporting changes compared to the baseline every three years. (For cities having signed in 2020 and 2021, the first progress report will be due by June 2026.)

Overview of mandatory indicators

Air	— $PM_{2.5}$ concentration levels [highest annual mean observed at (sub) urban background stations] — PM_{10} daily concentration levels [highest number of days exceeding the WHO recommendation of 45 µg/m³ per year, observed at any (sub) urban background or traffic station] — NO_2 concentration levels (highest annual mean observed at traffic stations)
Water	— Domestic water consumption (litres/capita/day) — Infrastructure Leakage Index (ILI) — Percentage of urban wastewater meeting the requirements of the UWWTD (regarding collection and secondary treatment)
Nature & Biodiversity	— Percentage of protected natural areas on public land in municipality — Percentage of tree canopy cover within the city — Change in number of bird species in urban/built-up areas in the city
Waste & Circular Economy	— Municipal waste generated per capita (tons) — Recycling rate of municipal waste (%) — Percentage of municipal waste landfilled
Noise	— Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB — Percentage of the population exposed to night-time noise (Lnight) ≥ 50 dB — Percentage of (adult) population with High Sleep Disturbance

1. Air

Green City Accord Goal: A significant improvement in air quality in our cities, moving us closer to respecting the World Health Organization's New Air Quality Guidelines[1], while ending exceedances of EU air quality standards as soon as possible.

Overview of Indicators

- 1.1 $PM_{2.5}$ concentration levels [highest annual mean observed at (sub) urban background stations]
- 1.2 PM_{10} daily concentration levels [highest number of days exceeding the WHO recommendation of 45 µg/m³ per year, observed at any (sub) urban background or traffic station]
- 1.3 NO_2 concentration levels [highest annual mean observed at traffic stations]

1.1 $PM_{2.5}$ concentration levels [highest annual mean observed at (sub) urban background stations]

What does it measure?

The indicator '$PM_{2.5}$ concentration levels [highest annual mean observed at (sub) urban background stations]' was established according to existing air quality legislation and reflects ongoing local and national monitoring processes reported at the EU level. The indicator is provided by the EU Ambient Air Quality Directive (EUAAQ) (2008/50/EC and 2004/107/EC).

$PM_{2.5}$ represents the smaller fraction of particulate matter which contains particles with a maximum diameter of 2.5 micrometres (µm), also known as fine particulate patter ($PM_{2.5}$).

Did You Know?

According to the European Environment Agency, in 2020, 96% of the urban population was exposed to concentrations of fine particulate matter ($PM_{2.5}$) above the WHO guideline of 5 µg/m³.

(EEA, 2020)

The $PM_{2.5}$ concentration indicator allows cities to monitor whether or not they have met the EUAAQ Directive or the World Health Organization (WHO) Air Quality Guidelines, in addition to helping them assess exposure levels.

[1] The WHO New Air Quality Guidelines released in September 2021 recommend new air quality levels for 6 pollutants, where evidence has advanced the most on health effects from exposure: particulate matter ($PM_{2.5}$ and PM_{10}), ozone (O_3), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO).

The minimum requirements set by the EU and WHO are:

- EU limit value: 25 µg/m^3
- WHO Air Quality Guidelines: 5 µg/m^3

How do you calculate it?

Data has to be reported from the station (out of all (sub)urban stations) with the highest annual mean $PM_{2.5}$ concentration recorded in a particular year.

Data can be obtained:

1) From air quality monitoring reports in different stations on a municipal or regional level and
2) Based on measurements made in urban and suburban background locations established for this purpose.

When a city is not able to report this value due to the non-existence of monitoring stations within city boundaries, they may report PM2.5 values from the closest regional/national station where concentration values are available.

Did You Know?

According to the European Environment Agency, in 2020, 11% of urban citizens were still exposed to PM_{10} above the EU daily limit value.

1.2 PM_{10} daily concentration levels [highest number of days exceeding the WHO recommendation of 45 µg/m³ per year, observed at any (sub) urban background or traffic station]

What does it measure?

The indicator PM_{10} daily concentration levels [highest number of days exceeding the WHO recommendation of 45 µg/m³ per year, observed at any (sub) urban background or traffic station]' was established considering the specifications of the EU Ambient Air Quality Directive (EUAAQ) (2008/50/EC and 2004/107/EC) and the WHO Air Quality Guidelines.

Coarse particulate matter (PM_{10}) is an air pollutant consisting of small particles with an aerodynamic diameter less than or equal to a nominal 10 micrometres (µm).

The PM_{10} daily observed concentration indicator allows cities to monitor if they meet the EUAAQ Directive or the WHO Air Quality Guidelines.

The minimum requirements set by the EU and WHO for observed daily concentrations are:

- EU limit value: 50 µg/m3, 24-hour mean
- WHO Air Quality Guidelines: 45 µg/m3 24-hour mean

How do you calculate it?

This air quality management indicator corresponds to the highest number of not-necessarily-consecutive days in a year where the PM_{10} concentration level recorded at stations at urban and sub-urban background locations has exceeded the WHO recommendation of 45 µg/m^3.

Data can be obtained from:

1) Air quality monitoring reports from different stations on a municipal or regional level; and
2) Based on measurements made at urban and suburban background locations established for this purpose.

1.3 NO_2 concentration levels (highest annual mean observed at traffic stations)

What does it measure?

The indicator 'NO_2 concentration levels (highest annual mean observed at traffic stations)' was established according to existing air quality legislation and reflects ongoing local and national monitoring processes reported at the EU level. The indicator is provided by the EU Ambient Air Quality Directive (2008/50/EC and 2004/107/EC).

Nitrogen dioxide (NO_2) and nitrogen oxide (NO_x) emission concentrations are recognised as indicators that have the potential to help assess the effectiveness of sustainable transport policies on a local level. Thus, the measurement of NO_2 concentrations at traffic stations is beneficial.

The minimum requirements set by the EU and WHO for observed daily concentrations are:

- EU limit value: 40 µg/m^3
- WHO Air Quality Guidelines: 10 µg/m^3

How do you calculate it?

Data has to be reported from the traffic station (out of all stations) with the highest annual mean of nitrogen dioxide (NO_2) concentration recorded in a particular year.

Data can be obtained:

- From air quality monitoring reports at different stations on a municipal and regional level; and

- Based on measurements made at urban and suburban background locations established for this purpose.

2. Water

Green City Accord Goal: Significant progress in improving the quality of water bodies and the efficiency of water use.

Overview of Indicators

- 2.1 Domestic water consumption (litres/capita/day)
- 2.2 Infrastructure Leakage Index (ILI)
- 2.3 Percentage of urban wastewater meeting the requirements of the Urban Waste Water Treatment Directive (UWWTD) (regarding collection and secondary treatment)

2.1 Domestic Water consumption (litres/capita/day)

What does it measure?

The indicator 'domestic water consumption (litres/capita/day)' measures the average consumption of water (in litres) per day per person, for all domestic uses (excluding the industrial usage).

How do you calculate it?

The average water use can be determined based on the measured supplied water volume. Records on volume of water supplied, consumed and, ultimately, paid by the domestic end-users, can be requested from the local public utility company or entity. The average domestic water consumption can be calculated by taking the sum of all consumption quantities registered by the water supplier(s) on an annual basis (e.g. quantities on invoices, but also including quantities supplied free of a charge to households (if any), but excluding industry consumption) in litres/year, then dividing it by 365 to arrive at

Did You Know?

According to the European Environment Agency, in 2018, Europeans have an average water consumption of 144 litres of freshwater per per day, representing almost three times the standard required for basic human needs.

the daily rate, then dividing it by the number of city inhabitants[2].

Formula:

$$\textbf{water consumption litres/capita/day} = \frac{\textbf{domestic water consumption}}{365} \div \textbf{number of inhabitants}$$

2.2 Infrastructure Leakage Index (ILI)

What does it measure?

The International Water Association (IWA) uses the Infrastructure Leakage Index (ILI) as a performance indicator for water leakage. The ILI adjusts for service pressure and length of the network to produce comparable results.

ILI measures how effectively infrastructure activities - such as repairs, active leakage control, and pipeline/assets management - are being managed at current operating pressure. As a ratio, the ILI[3] has no units and thus facilitates comparisons between utilities and countries that use different measurement units and systems.

Aware of the wide diversity of water balance formats and methods, practitioners have identified an urgent requirement for a common international terminology. ILI is seen as a helpful water loss performance indicator, because it accommodates the fact that real loss will always exist, even in the very best and well managed distribution system. It gives the most rational technical basis for comparisons of water loss between utilities, which can be used by the operators to measure their progress in water loss reduction. The IWA workgroup states that the is systems with an ILI indicator value around 1.0 have very low water loss, while a value above 5.0 would mean a high leaking system.

How do you calculate it?

The Infrastructure Leakage Index (ILI) is the ratio of the Current Annual Real Losses (CARL in m^3/year) to the Unavoidable Annual Real Losses (UARL in m^3/year):

ILI=CARL/UARL

URAL, i.e. those losses whose removal is economically unjustified, is calculated by summing up the following three components:

[2] If the city has no registration system for their inhabitants, then the number has to be calculated/estimated by the city administration.
[3] As a ratio the ILI is less sensitive to fluctuations in consumption than non-revenue water expressed in percentage.

- Leaks unavoidable on main lines and lines without connections, expressed as 18 dm^3/km/day/m of pressure;
- Leaks unavoidable at connections to edge of street, expressed as 0.8 dm^3/connection/day/m of pressure;
- Leaks unavoidable at edge of street to customer meter, expressed as 25 dm^3/km/da/m of pressure.

The UARL indicator is determined by the formula:

$UARL=(18\times(Lm+Lr)+0.80\times Np+25\times Lp)\times P\times 0.365$ (m^3/year)

Whereas, given the formula above:

- Lm is the length of the mains pipelines (km);
- Lr is the length of the connection pipelines (km);
- Lp is the total length in km of underground connection pipes measured from the edge of the street to the customer (km);
- Np is the number of service connections;
- P is the average operating pressure of the system, and 0.365 is the conversion factor (m^3/year).

Did You Know?

According to the European Environment Agency, a 3-millimetre-wide hole in a pipe can lead to a loss of 340 litres of water per day — roughly equivalent to a household's consumption!

2.3 Percentage of urban wastewater meeting the requirements of the Urban Waste Water Treatment Directive (UWWTD) (regarding collection and secondary treatment)

What does it measure?

The Urban Waste Water Treatment Directive (UWWTD, 91/271/EEC) establishes the minimum requirements for urban waste water[4] collection and treatment in Europe.

[4] **Urban waste water** means domestic waste water or the mixture of domestic waste water with industrial waste water and/or run-off rain water.
Domestic waste water means waste water from residential settlements and services which originates predominantly from the human metabolism and from household activities Article 2(3).
Industrial waste water means any waste water which is discharged from premises used for carrying on any trade or industry, other than domestic waste water and run-off rain water.

The indicator 'Percentage of urban wastewater meeting the requirements of the UWWTD (regarding collection[5] and secondary treatment[6])' measures a city's capacity to comply with the existing requirements of the UWWTD regarding collection (Article 3) and secondary treatment (Article 4).

The UWWTD has a role to play in steering the EU toward the zero-pollution ambition enshrined in the European Green Deal. The treatment of urban waste water from homes and workplaces is fundamental to ensuring public health and environmental protection. The main objective of the UWWTD is to protect the environment, specifically surface waters, from the adverse effects of waste water discharges — such as oxygen-consuming organic pollution, which degrades aquatic life — and microbiological contamination with pathogens. This is achieved through the collection and treatment of waste water in settlements and areas where population and economic activity are sufficiently concentrated (agglomerations) with the polluting load generated expressed as a population equivalent (p.e.). The UWWTD covers agglomerations over 2,000 p.e..

Did You Know?

Following the publication of the 2nd River Basin Management Plans (RBMP) performed since 2015, only 40% of the European Union's surface water bodies achieved good ecological status.

(EC, 2022; CIRCABC, 2015)

In most cases, it stipulates that waste water must be subject to biological treatment (secondary treatment), but in catchments with particularly sensitive waters - such as those suffering from eutrophication - more stringent (tertiary) waste water treatment may be required to substantially reduce nitrogen and phosphorus pollution.

The installation of waste water treatment facilities first requires the set-up of a wastewater collecting system, followed by the provision of facilities to treat the collected waste water.

The UWWTD also has an important role to play in the circular economy through the reuse of treated waste water and sewage sludge[7].

How do you calculate it?

This indicator is calculated by taking the percentage of wastewater load compliant with the requirements of the Urban Waste Water Treatment Directive (UWWTD) regarding collection (Article 3 of UWWTD) and secondary treatment (Article 4 of UWWTD). As a minimum,

[5] The UWWTD defines **Collection System** as a system of conduits which collects and conducts urban waste water.
[6]The UWWTD defines **Secondary treatment** as the treatment of urban waste water by a process generally involving biological treatment with a secondary settlement. Secondary treatment, also known as biological treatment, removes the remaining organic matter, suspended solids and some of the bacteria, viruses and parasites, and to some extent nutrients and chemical substances.
[7] Additional requirements in the Sewage Sludge Directive

cities should report the percentage of urban wastewater meeting the requirements of the UWWTD, in accordance with the established procedure[8,9].

3. Nature & Biodiversity

Green City Accord Goal: Considerable progress in conserving and enhancing urban biodiversity, including through an increase in the extent and quality of green areas in cities, and by halting the loss of and restoring urban ecosystems.

Overview of Indicators

- 3.1 Percentage of protected natural areas on public land in municipality
- 3.2 Percentage of tree canopy cover in municipality
- 3.3 Change in number of bird species in urban/built-up areas in the city

3.1 Percentage of protected natural areas in municipality

What does it measure?

The 'Percentage of protected natural areas in the municipality" assesses the share of protected natural areas in the municipality.

Urban ecosystems - which consist of cities and the surrounding socio-ecological systems where most people live - are almost completely artificial, but they may include all other ecosystem types (forests, lakes, rivers and agricultural areas can all be part of urban fringe) and they are strongly influenced by human activities.[10] Urban protected areas[11], such as NATURA 2000

Did You Know?

According to the 2020 'State of Nature in the EU' report 81% of EU protected habitats and 63% of EU protected species are in "poor" or "bad" conservation status.

[8] https://environment.ec.europa.eu/topics/water/urban-wastewater_en#implementation
[9] The data for 2020 at city level is provided here: https://tableau-public.discomap.eea.europa.eu/views/uwwtd_RegisterCompliancy/Agglomerations?%3Aembed=y&%3AisGuestRedirectFromVizportal=y). If more recent data is not available, please refer to it.
[10] See Maes et al., 2020.
[11] IUCN classifies 6 different types of protected areas according to their management system (Trzyna, 2014): strict nature reserves, wilderness areas, national parks, natural monument or feature, habitat/species management area, protected landscape/seascape, protected with sustainable use of natural resources. Urban

sites, have a higher variety of naturalness, ranging from natural virgin systems with only natural elements,[12] to highly altered systems with extensive human activities.

How do you calculate it?

To calculate this indicator, use the following equation:

Percentage of protected natural areas in the municipality[13]= (Total of protected areas in km^2) ÷ (Total area of municipality in km^2) × 100

The use of official data is strongly recommended. For protected areas, park authorities can be requested for polygons or raster maps[14].

3.2 Percentage of tree canopy cover within the municipality

What does it measure?

The indicator 'percentage of tree canopy cover within the city' assesses the proportion of grown trees in relation to the municipal area.[15]

Trees are a vital part of urban infrastructure and offer a multitude of benefits[16]. The EU Forest Strategy, combining biodiversity and climate neutrality targets, includes a roadmap for planting at least 3 billion additional trees in the EU by 2030 in full respect of ecological principles. Cities have to step up their efforts to help fulfil this target. The indicator tree canopy cover was chosen to reflect progress in urban tree planting actions.

How do you calculate it?

To calculate this indicator, use the following equation:

(Total area covered by tree canopy in km^2) ÷ (Total area of municipality in km^2) × 100

---

protected areas are at the edge of larger population centres, ranging from towns to megacities, including peri-urban areas immediately surrounding urban areas and urban fringes. They include terrestrial, marine (i.e. wetlands, lakes, etc) and coastal ecosystems, Natura 2000 sites, biosphere reserves, Special Protection Areas (SPAs) as result of the European Birds Directive, Special Areas of Conservation (SACs) following the Habitats Directive.

[12] See Trzyna, 2014

[13] This is a status indicator, meaning that not much change can be expected given the strong competition over land-use in densely built-up urban area, resulting in a low chance that more land will be made available for protected natural areas therein.

[14] Natura 2000 data are available at: Natura 2000 data or Nationally designated areas (CDDA)

[15] 'urban tree canopy cover' means the total area of tree cover within cities and towns and suburbs, calculated on the basis of the Tree Cover Density data provided by the Copernicus Land Monitoring Service as established by Regulation (EU) 2021/696 of the European Parliament and of the Council, and, if available, other appropriate supplementary data.

[16] Such as cooling, filtering air, carbon sequestration, habitats and biodiversity, energy savings, stormwater attenuation, noise reduction etc.

It is highly recommended to use the tree cover density maps with 2018 reference year, 10 m or 100 m resolution of the EEA Urban Atlas.

3.3 Change in number of bird species in urban/built-up areas in the city

What does it measure?

The indicator 'Change in number of species of birds in urban/built-up areas in the city' is a trend indicator that provides an overview of changes in species diversity within the taxonomic groups of birds and butterflies (optional) as a proxy for habitat quality. It is important to focus on densely built-up areas where the number of species is inevitably lower than in natural ecosystems. A change can occur through the re-introduction or extinction of species.

This trend indicator looks at changes in species diversity over time rather than at absolute numbers, recognising species recovery, re-introduction, and restoration efforts whilst acknowledging that is not easy to recover or re-introduce species successfully over a short period of time.[17]

This indicator primarily aims at awareness-raising through citizen science while collecting valuable data,[18] official methods of observation are more accurate, however.

How is it calculated?

All GCA signatories are requested to list the number of species of birds (and optionally butterflies) prevalent in their city. Possible sources of data include government agencies in charge of biodiversity, city municipalities, urban planning agencies, biodiversity centres, nature groups, universities, publications, etc.

The reporting tool will calculate the percentage value from the entered data, thus cities only need to have the two required datapoints ready.

The result of the first assessment will be taken as the baseline (time 1.) for subsequent monitoring (time 2.). Through additional data points, signatory cities and towns will be able to calculate the percentage change in species for the respective taxonomic groups.

[17] See UN Convention on Biological Diversity (CBD), 2014.
[18] In case cities decide to make use of citizen science tools they should be aware of the drawbacks in data quality and lack of data representativeness since the number of entries is based on citizens' proactivity. Thus, changes over time could be due to an increase or decrease of social interest.

Cities can choose between two ways of collecting data for this indicator:

The basic version is to use a citizen science tool that includes bird/butterfly sightings registered by citizens[19]. The number of species will be assessed based on registered sightings and provides coordinates of these sightings. This version does not allow for a focus on built-up areas, but looks at city boundaries.

The second option is to collect the data in select built-up area(s) of the city (ideally where an intervention has taken place) using structured local field surveys. *It is important to stick to the same boundaries of assessment, once the assessment method is chosen.*

Did You Know?

According to the IUCN Red List of Threatened Species over half of Europe's endemic trees, including the horse-chestnut, Heberdenia excelsa and the sorbus, are at risk of extinction.

(IUCN, 2019)

Using the data acquired, indicator 3.3 is calculated as:

((number of species assessed at II. occasion – number of species assessed at I. occasion)/number of species assessed at I. occasion) x 100

This equation will provide the percentage of change in species from the previous survey to the most recent survey.

[19] www.inaturalist.org or any other tool with reliable data on a city level

4. Waste & Circular Economy

Green City Accord Goal: Advance towards the circular economy by securing a significant improvement in waste management, with a reduction of municipal waste generation and landfilling, and a substantial increase in re-use, repair and recycling.

Overview of Indicators

- 4.1 Municipal waste generated per capita (tons)
- 4.2 Recycling rate of municipal waste (%)
- 4.3 Percentage of municipal waste landfilled

4.1 Municipal waste generated per capita (tons)

What does it measure?

The indicator 'Municipal waste generated per capita (tons)' measures the weight of municipal waste generated by households, including waste prepared for export before treatment.

The amount of municipal waste generated consists of household and similar waste collected by or on behalf of municipal authorities. For areas not covered by a municipal waste collection scheme the reported quantities need to be estimated.

Did You Know?

The average EU citizen produces around 505kg of municipal waste a year, only 48% of which is recycled.

Municipal waste is defined in Article 3(2) of European Council Directive 2008/98/EC on waste as "mixed waste and separately collected waste from households, including paper and cardboard, glass, metals, plastics, bio- waste, wood, textiles, packaging, waste electrical and electronic equipment, waste batteries and accumulators, and bulky waste, including mattresses and furniture" and "mixed waste and separately collected waste from other sources, where such waste is similar in nature and composition to waste from households. It excludes waste from production, agriculture, forestry, fishing, septic tanks and sewage network and treatment, including sewage sludge, end-of-life vehicles or construction and demolition waste."

How do you calculate it?

The amount of waste generated in a municipality can be estimated from collected waste (through sampling) according to the methodology specified in the 2.7.1 Sampling standards section of the Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD.

This data can be obtained from the local administration's waste department, in charge of waste collection, or from companies contracted by the municipality to handle waste collection.

If an alternative methodology was used to estimate the amount of generated waste, please indicate it in the comments section.

The indicator can be expressed as "tons of municipal waste generated per capita per year" and to allow for comparison between cities, quantities should be reported in absolute and in per capita terms.

If data is not available on generated waste, please indicate the amount of waste collected.

If data is available, the amount of waste generated per different waste fractions should be added in the B10.4 comments section of the reporting tool. This will help make collected data more comparable. If data is not available for some fractions, assumptions can be made by cities, whilst they should be communicated transparently.[20]

4.2 Recycling rate of municipal waste (%)

What does it measure?

The indicator 'Recycling rate of municipal waste (%)' measures the share of the total municipal waste generated that is recycled. See Eurostat definition for more details.

Recycling includes material recycling and the reprocessing of organic material (composting and anaerobic digestion) but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations. Recycling typically generates secondary raw materials which may then be reprocessed into new products.

20 For more details on compiling and reporting municipal waste data, see the Guidance for the compilation and reporting of data on municipal waste.

The ratio is expressed in percent (%) as both terms are measured in the same unit, namely tonnes. The recycling rate of municipal waste provides a good indication of the quality of the overall waste management system.

This indicator is widely known and used and is clearly connected to EU policy objectives. Member States are required to achieve the following targets: 55% by 2025, 60% by 2030; and 65% by 2035.

How do you calculate it?

To calculate this indicator, the ratio of prepared for re-use and recycled municipal waste and total municipal waste generation must be obtained and expressed as a percentage (%).

In many Member States, different waste streams are treated by different companies – e.g. paper may be recycled through a different contractor than plastics. Mixed municipal waste treatment could be handled by yet another entity (also relevant for landfilling targets).

GCA signatories should therefore strive to get as much data on the different recyclables within their municipality, and, where necessary, communicate openly on gaps and uncertainties due to lack of data. This is particularly relevant for waste streams for which the treatment is beyond the control (and knowledge) of the city administration so that the local recycling rate coincides, in principle, with the regional or national recycling rate for a given waste stream (this is for instance often the case with plastic packaging recycling).

In conclusion, signatories are asked to use local original data on recycled quantities as much as possible and to fill in the gaps, where needed, with regional or local recycling rates, which then need to be applied to local waste quantities (i.e. those reported for municipal waste generated - see above - including waste prepared for export outside of municipal and/or national borders, to avoid trade-offs induced by the boundary challenge).

Rates should be reported as disaggregated as possible, meaning that figures should be reported for all waste streams defined under municipal waste (see description and references above).[21]

[21] For more details on reporting, see the EU Guide for the compilation and reporting of data on municipal waste and the EC Guide on Municipal Waste Collection as well as the EU Recycling Rate of Municipal Waste indicator definition.

4.3 Percentage of municipal waste landfilled

What does it measure?

The indicator 'Percentage of municipal waste landfilled' measures the share of municipal waste generated by households within the city jurisdiction that is landfilled. Landfilling is part of 'disposal' operations, which includes any waste treatment that is not primarily recovery, even where the operation has as a secondary consequence the reclamation of substances or energy. This category also includes 'incineration without energy recovery'.[22] Incineration with energy recovery in comparison is considered as a 'recovery' operation and is higher up in the waste hierarchy according to the Waste Framework Directive.

Landfilling quantities include the weight of waste that is landfilled after treatment, i.e. physical, thermal, chemical or, biological processes. For example, waste generated by incinerators that is not recovered or recycled after the incineration process.

By 2035, municipalities must not exceed a maximum of 10% of municipal waste landfilled and respect the ban on landfilling of separately collected waste.

Did You Know?

According to the European Commission, the development of a more circular economy in the EU could create up to an estimated 2 million new jobs by 2030.

How do you calculate it?

This indicator is expressed as "tons of municipal waste landfilled/tons of municipal waste generated." It can also be expressed in absolute terms per capita to allow for inter-city comparison.

Data on landfilling of municipal waste can be obtained from the local administration's waste department or from companies contracted by the municipality to handle waste collection or treatment. The amount of waste to be reported under landfilling is the amount that enters the landfilling operation facility. Data reported should be consistent with the EUROSTAT definition that delineates that all household waste deposited in a landfill, directly or after pre-treatment operations, constitutes municipal waste landfilled.

To adhere to the 'polluter pays principle,' GCA signatories must be sure to report the share of municipal waste generated in its own territory that is landfilled (and *not* overall landfill figures from a landfilling site which happens to be on the city territory; similarly, they

[22] Incineration with energy recovery is considered as a recovery operation and is higher up in the waste hierarchy in Article 4 of the Waste framework directive, Annex I of Directive 2008/98/EC, in relation to incineration without energy recovery which is a disposal operation.

should account for waste generated in the municipality that is processed elsewhere). Akin to the recycling rate calculation, signatories first need to determine whether or not incineration and landfilling of their waste is occurring on their municipal territory, and whether their facilities process waste from external sources. Local data may need to be complemented with regional data or proxies.

5. Noise

Green City Accord Goal: A significant reduction in noise pollution, moving us closer to the levels recommended by the World Health Organization.

Overview of Indicators

- 5.1 Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB
- 5.2 Percentage of the population exposed to night-time noise levels (Lnight) ≥ 50 dB
- 5.3 Percentage of (adult) population with High Sleep Disturbance

5.1 Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB

What does it measure?

The indicator 'Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB' was established by the Environmental Noise Directive (END), and requires national authorities to produce noise management action plans.[23] Lden represents the average noise level to which a citizen is exposed throughout the day, evening, and night over the period of one year. The directive considers a simple approach to report noise levels by limiting the reporting above 55 dB, thus setting it as the reporting threshold. The WHO designated alower threshold of 53 dB as the minimum to be ensured to adequately protect human health, after years of research. As cities have already established monitoring capacity related to the 55 dB threshold, the reporting tool requires submission of this indicator, with the option to also report on the 53 dB WHO value.

Did You Know?

The WHO classified traffic noise - including road, rail and air traffic - as the second most significant cause of ill health in Western Europe.

(WHO, 2018)

[23] Assessed (modelled) based on the method set out in Annex II of the Environmental Noise Directive (END) which was amended in 2015 and 2020.

How do you calculate it?

To calculate this indicator, use the following formula:

Percentage of the population exposed to average day-evening-night noise levels (Lden) ≥ 55 dB = the people exposed to average day-evening-night noise levels above 55dB ÷ the total population of the city.

5.2 Percentage of population exposed to night-time noise levels (Lnight) ≥ 50 dB

What does it measure?

The indicator 'Percentage of the population exposed to night-time noise (Lnight) ≥ 50 dB' was also established on the basis of the Environmental Noise Directive (END) and refers to an annual average period of exposure to noise at night. The directive considers exposure to night-time noise levels above 50 dB at night to be harmful to health, thus setting it as the reporting threshold. The WHO designates an even lower threshold of 45 dB.

How do you calculate it?

To calculate this indicator, use the following formula:

Percentage of the population exposed to night-time noise level (Lnight) ≥ 50 dB = the people exposed to night-time noise level above 50dB ÷ the total population of the city.

5.3 Percentage of (adult) population with High Sleep Disturbance

What does it measure?

The indicator 'percentage of (adult) population with High Sleep Disturbance (HSD)' is correlated with indicator 5.2, but provides further information on the health impacts of exposure to noise. Indicator 5.4 refers to sleep disturbance, which directly affects quality of life and may also lead to subsequent health impediments. The effects of sleep disturbance are also associated with cardiovascular disease.

How do you calculate it?

This indicator considers the absolute risk (AR) of the harmful effect of high sleep disturbance. This can be calculated by implementing the formulas 7, 8, 10 and 12 set out in the Commission Directive (EU) 2020/367 in an Excel worksheet and by using data acquired from indicator 5.2:

Population exposed to noise (similar to indicator 5.2, but considering absolute, not percentage numbers of people, and considering the adult population) X dose-effect relations (specifying how the health effect changes as a function of exposure levels bands related to road, rail or air sources) = the number of people affected by high sleep disturbance per exposure band and source. The results for road, rail and air values should then be added together to determine the total number of people exposed to the absolute risk of the harmful effect of high sleep disturbance. The proportion of these people with respect to the entire adult population of the city is therefore the required percentage.

Did You Know?

The European Environment Agency estimates that 22 million people suffer chronic high annoyance due to noise exposure and 6.5 million people suffer chronic high sleep disturbance.

(EEA, 2019)

Annex: References

Air

European Commission. Directorate-General for Environment (2008/50/EC and 2004/107/EC). EU Ambient Air Quality Directive.

https://ec.europa.eu/environment/air/quality/existing_leg.htm

European Environment Agency (2022). Exceedance of air quality standards in Europe. https://www.eea.europa.eu/ims/exceedance-of-air-quality-standards

European Environment Agency (2020). Vast majority of Europe's urban population remains exposed to unsafe levels of air pollution. https://www.eea.europa.eu/highlights/vast-majority-of-europes-urban

WHO Air Quality Guidelines (2021).

https://www.who.int/publications/i/item/9789240034228

Water

Canfora P., Antonopoulos I. S., Dri M., Gaudillat P., Schönberger H. (2019). Best Environmental Management Practice for the Public Administration Sector. JRC Science for Policy Report EUR 29705 EN. https://op.europa.eu/o/opportal-service/download-handler?identifier=6063f857-7789-11e9-9f05-01aa75ed71a1&format=pdf&language=en&productionSystem=cellar&part=

European Commission (2019). Evaluation of the Urban Waste Water Treatment Directive. https://ec.europa.eu/environment/water/water-urbanwaste/pdf/UWWTD%20Evaluation%20SWD%20448-701%20web.pdf

European Commission. CIRCABC (2015). Implementing the Water Framework Directive and the Floods Directive. https://circabc.europa.eu/faces/jsp/extension/wai/navigation/container.jsp

European Commission. Directorate-General for Environment (2022). Status of implementation of the WFD in the Member States. https://ec.europa.eu/environment/water/participation/map_mc/map.htm

European Commission. Directorate-General for Environment (n.d.). WFD Guidance Documents. https://ec.europa.eu/environment/water/water-framework/facts_figures/guidance_docs_en.htm

European Environment Agency. European waters — Assessment of status and pressures (2018, EEA Report, 7/2018). Close up — Water in the city. https://www.eea.europa.eu/signals/signals-2018-content-list/articles/close-up-2014-water-in

European Environment Agency (2019). Urban waste water treatment for 21st century challenges. https://www.eea.europa.eu/publications/urban-waste-water-treatment-for

European Green Capital Award 2023. Guidance Note (May 2020). https://ec.europa.eu/environment/europeangreencapital/wp-content/uploads/2020/EGCA_2023_Guidance_Note.pdf

Klosok-Bazan, I., Boguniewicz-Zablocka, J., Suda, A. et al. (2021). Assessment of leakage management in small water supplies using performance indicators. Environ Sci Pollut Res. https://doi.org/10.1007/s11356-021-13575-5

Simbeye, Ison (2010). Managing Non-Revenue Water. NRW-Sourcebook for Trainers. WAVE Pool. InWEnt. http://www.water-impact-guidebook.net/fileadmin/0_guidebook/resources_exercises/D-Good_Practices/47-NRW_resourcebook.pdf

Winarni, W. (2009). Civil Engineering Dimension, Vol. 11, No. 2, 126-134. https://www.researchgate.net/publication/26872179_Infrastructure_Leakage_Index_ILI_as_Water_Losses_Indicator

Nature & Biodiversity

Connop S., Nash, C. (2018). Blandscaping that Erases Local Ecological Diversity. https://www.thenatureofcities.com/2018/01/09/blandscaping-erases-local-ecological-diversity/

Dumitru, A.; Wendling, L. (2021). Evaluating the Impact of Nature-based Solutions: Appendix of Methods. https://ec.europa.eu/info/news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-may-06_en

Eggermont, H., Balian, E., Azevedo, J. M. N., Beumer, V., Brodin, T., Claudet, J., & Le Roux, X. (2015). GAIA-Ecological Perspectives for Science and Society, 24(4), 243-248.

Nature-based solutions: New Influence for Environmental Management and Research in Europe. https://www.biodiversa.org/898/download

European Commission. Directorate-General for Environment (n.d.). European Birds Directive. https://ec.europa.eu/environment/nature/legislation/birdsdirective/index_en.htm

European Commission. Directorate-General for Environment (n.d.). Habitats Directive. https://ec.europa.eu/environment/nature/legislation/habitatsdirective/index_en.htm

European Commission. Directorate-General for Environment (2008). Natura 2000 - Protecting Europe's biodiversity. https://ec.europa.eu/environment/nature/natura2000/index_en.htm

European Environment Agency. Copernicus Land Monitoring Service (2018). Tree Cover Density https://land.copernicus.eu/pan-european/high-resolution-layers/forests/tree-cover-density/status-maps/tree-cover-density-2018?tab=download

European Environment Agency (2020). Nationally designated areas (CDDA). https://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-16

European Environment Agency (2021). Natura 2000 data - the European network of protected sites. https://www.eea.europa.eu/data-and-maps/data/natura-13

European Environment Agency (2020). Report 10/2020. State of Nature in the EU. https://www.eea.europa.eu/publications/state-of-nature-in-the-eu-2020

Gann, G. D., McDonald, T., Walder, B., Aronson, J., Nelson, C. R., Jonson, J., Hallett, J. G., Eisenberg, C., Guariguata, M. R., Liu, J., Hua, F., Echeverría, C., Gonzales, E., Shaw, N., Decleer, K., Dixon, K. W. (2019). International principles and standards for the practice of ecological restoration. Restoration Ecology, 27, S1-S46. https://onlinelibrary.wiley.com/doi/pdf/10.1111/rec.13035

iNaturalist Network. Tool that includes bird/butterfly sightings registered by citizens. www.inaturalist.org

Maes, J. et al (2020) Mapping and Assessment of Ecosystems and their Services: An EU ecosystem assessment, EUR 30161 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-17833-0, doi:10.2760/757183, JRC120383. https://publications.jrc.ec.europa.eu/repository/handle/JRC120383

Rivers, M. (2019). IUCN Red List of Threatened Species. European Red List of trees. https://portals.iucn.org/library/node/48512

Secretariat of the Convention on Biological Diversity, CBD. (2014). User's Manual on the Singapore Index on Cities' Biodiversity. https://www.cbd.int/article/2021-singapore-index

Somarakis, G., Stagakis, S., & Chrysoulakis, N. (Eds.). (2019). ThinkNature Nature-Based Solutions Handbook. ThinkNature project funded by the EU Horizon 2020 research and innovation programme under grant agreement No. 730338. doi:10.26225/jerv-w202. https://platform.think-nature.eu/system/files/thinknature_handbook_final_print_0.pdf

Trzyna, T. (2014). Urban Protected Areas: Profiles and best practice guidelines. Best Practice Protected Area Guidelines Series No. 22, Gland, Switzerland: IUCN. https://platform.think-nature.eu/system/files/thinknature_handbook_final_print_0.pdf

UNESCO (n.d.). Biosphere reserves. http://www.unesco.org/new/en/natural-sciences/environment/ecological-sciences/biosphere-reserves/

Wilk, B., Rebollo, V., Hanania, S. (2019). A guide for pollinator-friendly cities: How can spatial planners and land-use managers create favourable urban environments for pollinators? https://www.iucn.org/sites/dev/files/local_authorities_guidance_document_en_compressed.pdf

Waste & Circular Economy

European Commission (2019). Guidance for the compilation and reporting of data on municipal waste according to Commission Implementing Decisions 2019/1004/EC and 2019/1885/EC, and the Joint Questionnaire of Eurostat and OECD. https://ec.europa.eu/eurostat/documents/342366/351811/Guidance+on+municipal+waste+data+collection/

European Parliament (2008). European Council Directive 2008/98/EC, Article 3(2). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32008L0098

European Parliament (2018). EU policy reference: Directive (EU) 2018/851. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0851&qid=1613132371644

EUROSTAT (2017). Guidance on municipal waste data collection. https://ec.europa.eu/eurostat/documents/342366/351811/Municipal+Waste+guidance/bd38a449-7d30-44b6-a39f-8a20a9e67af2

EUROSTAT (2021). Recycling rate of municipal waste. https://ec.europa.eu/eurostat/cache/metadata/en/cei_wm011_esmsip2.htm

EU Urban Agenda Partnership on Circular Economy. https://futurium.ec.europa.eu/en/urban-agenda/circular-economy

UK Waste & Resources Action Plan, WRAP, (2014). WRAP Study. http://www.wastecosmart.eu/en/news/wrap-study-circular-economy-could-create-3-million-jobs-in-eu

Noise

European Commission (2020). Official Journal of the European Union. Commission Directive (EU) 2020/367 of 4 March 2020 amending Annex III to Directive 2002/49/EC of the European Parliament and of the Council as regards the establishment of assessment methods for harmful effects of environmental noise. https://op.europa.eu/en/publication-detail/-/publication/14caf5ee-5ead-11ea-b735-01aa75ed71a1/language-en

European Commission. Directorate-General for Environment (2002). Environmental Noise Directive (END) (2002/49/EC) Art. 5, Art. 6; Annex II. https://ec.europa.eu/environment/noise/directive_en.htm

European Environment Agency (2019). Environmental noise in Europe — 2020. https://www.eea.europa.eu/publications/environmental-noise-in-europe

European Environment Agency (2019). Exposure of Europe's population to environmental noise. https://www.eea.europa.eu/data-and-maps/indicators/exposure-to-and-annoyance-by-2/assessment-4

World Health Organization (2018). Environmental Noise Guidelines for the European Region. https://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf