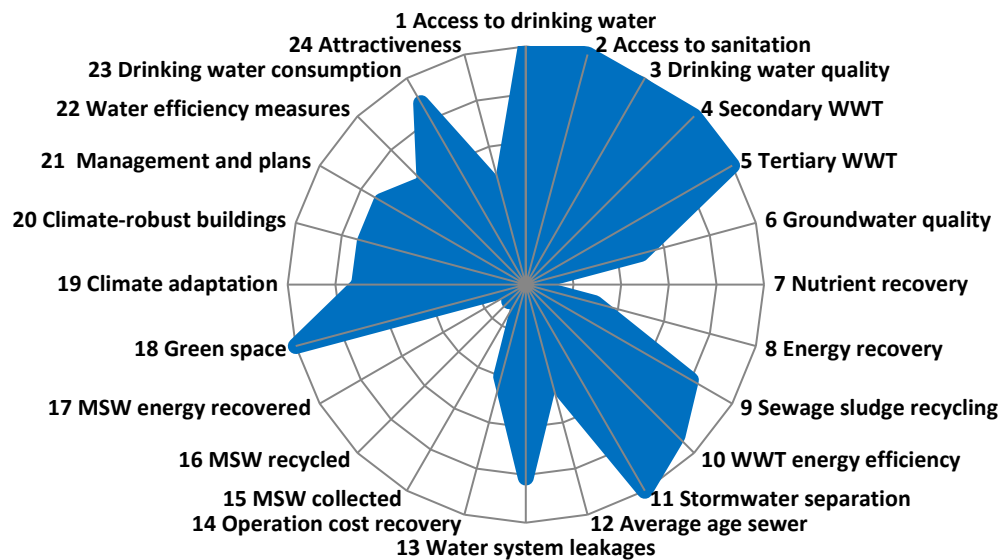


## INDICATORS OF THE CITY BLUEPRINT FRAMEWORK (Version June 2021)



*City Blueprint spider diagram of Cape Town*

### Key publications

Van Leeuwen, C.J., Frijns, J., van Wezel, A., van de Ven, F.H.M. 2012. *City Blueprints: 24 indicators to assess the sustainability of the urban water cycle*. *Water Resources Management* 26: 2177–2197 ([open access](#))

Koop, S.H.A. and Van Leeuwen C.J. (2015a). *Assessment of the Sustainability of Water Resources Management: A Critical Review of the City Blueprint Approach*. *Water Resources Management*. 29:5649–5670 ([open access](#))

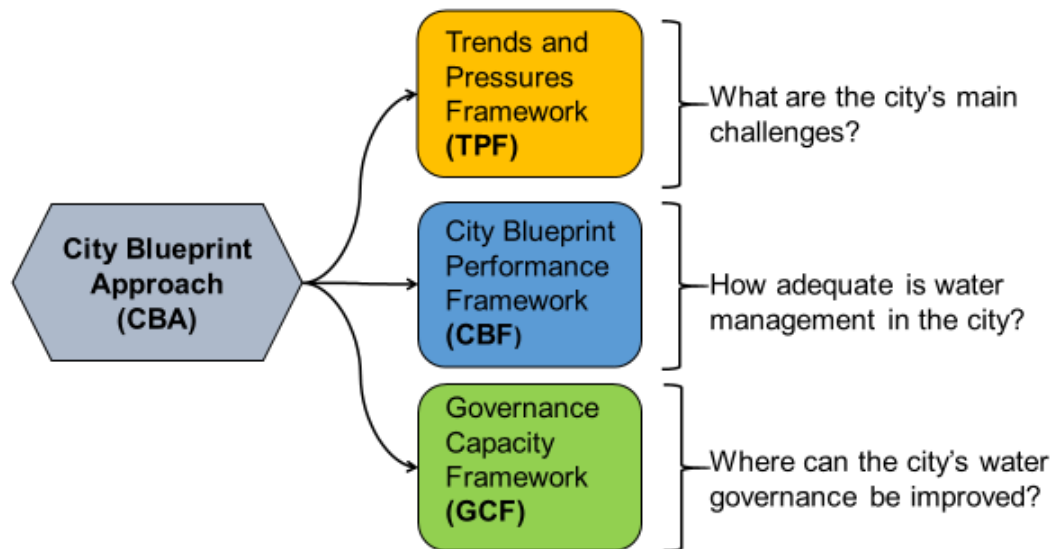
Koop, S.H.A. and Van Leeuwen C.J. (2015b). *Application of the Improved City Blueprint Framework in 45 municipalities and regions*. *Water Resources Management*, 29(13), 4629-4647 ([open access](#))

Koop, S.H.A. and Van Leeuwen, C.J. (2017). *The challenges of water, waste and climate change in cities*. *Environment, Development and Sustainability*, 19, 385–418 ([open access](#))

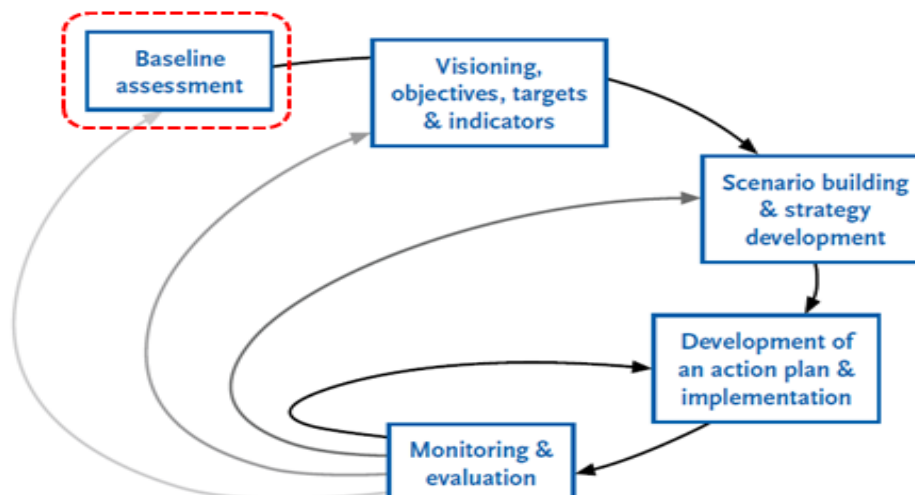
Koop, S.H.A., Koetsier, L., Doornhof, A., Reinstra, O., Van Leeuwen, C.J., Brouwer, S., Dieperink, C., Driessen, P..P.J. (2017) *Assessing the Governance Capacity of Cities to Address Challenges of Water, Waste, and Climate Change*. *Water Resources Management*. 31(11), 3427-3443 ([open access](#))

## 1. Introduction City Blueprint Approach

The **City Blueprint Approach** is a diagnosis tool and consist of three complementary frameworks. The main challenges of cities are assessed with (1) the *Trends and Pressures Framework (TPF)*. How cities are managing their water cycle is done with (2) the *City Blueprint Framework (CBF)*. Where cities can improve their water governance is done with (3) the *Governance Capacity Framework (GCF)*.



The City Blueprint Approach is a method to assess the sustainability of Integrated Water Resources Management (IWRM) in municipalities and regions. It is a baseline assessment and a first step in the strategic planning process in cities, depicted in the red box below.



## 2. The City Blueprint Approach

### Short history:

The City Blueprint Approach has been developed in a learning-by-doing fashion. The first version of the City Blueprint Framework (CBF) was published in 2012. A first review and update led to two separate frameworks, i.e. the Trends and Pressures Framework (TPF) and the first revision of the CBF (Koop and Van Leeuwen 2015a). In 2017 Koop et al. (2017) developed the Governance Capacity Framework (GCF). In 2019 further discussions about the need to include the World Bank Governance indicators and Air pollution in the TPF led to a revision and simplification of TPF. As a consequence a minor revision was introduced in the CBF (regrouping and deletion of one indicator).

### Description

The CBF framework consists of 24 indicators divided over 7 main categories (I Basic water services, II water quality, III waste water treatment, IV Water infrastructure, V Solid waste, VI Climate robustness and VII Plans and actions. An overview of the CBF indicators is presented below.

Category	Indicator	Score
I Basic water services	1 Access to drinking water	
	2 Access to sanitation	
	3 Drinking water quality	
II Water Quality	4 Secondary WWT	
	5 Tertiary WWT	
	6 Groundwater quality	
III Wastewater treatment	7 Nutrient recovery	
	8 Energy recovery	
	9 Sewage sludge recycling	
	10 WWT energy efficiency	
IV Water infrastructure	11 Stormwater separation	
	12 Average age sewer	
	13 Water system leakages	
	14 Operation cost recovery	
V Solid waste	15 MSW collected	
	16 MSW recycled	
	17 MSW energy recovered	
VI Climate adaptation	18 Green space	
	19 Climate adaptation	
	20 Climate-robust buildings	
VII Plans and actions	21 Management & action plans	
	22 Water efficiency measures	
	23 Drinking water consumption	
	24 Attractiveness	

### 3. Application of the Framework

The 24 City Blueprint indicators are standardized to a scale of 0-10 in which 10 points implies an excellent score and 0 points is a poor score. This is done by comparing the values from an international range, using natural boundaries of 0 and 100% or by using ordinal classes. Often the min-max method is applied:

$$\frac{\text{value} - \text{minimum value}}{\text{maximum value} - \text{minimum value}} \times 10 = \text{Indicator score}$$

The seven steps in the process to be followed are:

1. Municipalities and regions are contacted to participate or they contact KWR Water Research Institute (KWR) without any obligation at: [city.blueprint@kwrwater.nl](mailto:city.blueprint@kwrwater.nl) or +31 306069649 to perform a City Blueprint analysis of their municipality or region.
2. If a decision has been taken, the city appoints a coordinator for the information collection. This coordinator contacts the stakeholders in the municipality/region to provide the necessary information for the municipality or region.
3. The coordinator completes the City Blueprint Framework (CBF) questionnaire for 24 indicators. This will take a few days. The questionnaire (or an identical word file) is then used to collect the information, step by step (indicator by indicator).
4. For each indicator scoring information is gathered. The information, the sources (websites, documents or publications, and if necessary the page number(s) are provided and included in the CBF questionnaire word file (copy paste).
5. For each indicator, the scores are calculated as explained in Section 4 of this document.
6. After the completion of this questionnaire a radar chart of all 24 indicators (the City Blueprint) and the Blue City Index (BCI) can be provided. These indicators and the BCI vary from 0 (concern) to 10 (no concern). The City Blueprint spider diagram and the calculation of the BCI can be obtained by introducing the scores for the 24 indicators in an excel file for the calculation of the BCI.
7. Please contact KWR. KWR will review the information and provide the calculation and contact you again to discuss the results. After mutual agreement the information can be used to make reports and/or can be added to the City Blueprint Database at KWR Water Research Institute. KWR will then also provide the results of the TPF indicators.

#### Further information:

- <https://www.ipr.northwestern.edu/our-work/research-tools-apps/water-insecurity/>
- <http://www.watershare.eu/>

#### 4. Assessment method

##### Category I: Basic water services

#### Indicator 1: Access to drinking water

**Principal:** The proportion of the population with access to affordable safe drinking water. A lower Indicator score is given where the percentage is lower.

#### How to calculate

X = Percentage (%) of total urban population with access to potable drinking water.

$$\text{Indicator 1} = \frac{X}{10}$$

#### Where to get the data

Many cities will have easy access to this data, which should be presented as %. Where city data are not known, a national figure may be used. Data have been reported and updated by WHO/UNICEF: Progress on Sanitation and Drinking Water :

- [https://www.unwater.org/publication\\_categories/whounicef-joint-monitoring-programme-for-water-supply-sanitation-hygiene-jmp/](https://www.unwater.org/publication_categories/whounicef-joint-monitoring-programme-for-water-supply-sanitation-hygiene-jmp/)
- [https://www.who.int/water\\_sanitation\\_health/publications/2013/jmp\\_report/en/](https://www.who.int/water_sanitation_health/publications/2013/jmp_report/en/)
- [https://www.who.int/water\\_sanitation\\_health/publications/jmp-2015-update/en/](https://www.who.int/water_sanitation_health/publications/jmp-2015-update/en/)
- [https://www.who.int/water\\_sanitation\\_health/publications/jmp-2017/en/](https://www.who.int/water_sanitation_health/publications/jmp-2017/en/)
- [https://www.who.int/water\\_sanitation\\_health/publications/jmp-2019-full-report.pdf](https://www.who.int/water_sanitation_health/publications/jmp-2019-full-report.pdf)
- <https://www.who.int/publications/i/item/9789280651423>

#### Example Venlo

X = Access to drinking water = 100%

Score of indicator 1 is:  $\frac{100}{10} = 10$

## Indicator 2: Access to sanitation

**Principal:** A measure of the percentage of the population covered by wastewater collection and treatment. A lower Indicator score is given where the percentage is lower.

### How to calculate

X = Percentage (%) of total urban population with access to proper sanitation facilities.

$$\text{Indicator 2} = \frac{X}{10}$$

### Where to get the data

Many cities will have easy access to this data, which should be presented as %. Where city data are not known, a national figure may be used.

If needed, you estimate local data by national data provided by the OECD:

<https://www.oecd.org/environment/environment-at-a-glance/> ; Go to [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment\\_data-00604-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment_data-00604-en) and find the most recent data for each country (total public sewerage %).

Other sources:

- UN: <https://unstats.un.org/unsd/environment/wastewater.htm>;
- FAO: <http://www.fao.org/nr/water/aquastat/data/query/results.html>
- Eurostat: [http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env\\_ww\\_con&lang=en](http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_ww_con&lang=en)

### Example Rotterdam

X = Access to sanitation = 97.3%

$$\frac{97.3}{10} = 9.7$$

**Indicator 3: Drinking water quality**

**Principal:** A measure of the level of compliance with local drinking water regulations. A lower Indicator score is given where compliance is lower.

**How to calculate**

The result is expressed as a percentage of the samples meeting the applicable standards.

X = Total number of samples meeting standards

Y = Total number of samples

$$\text{Indicator 3} = \frac{X}{Y} * 10$$

**Where to get the data**

The city should normally have the data required to calculate.

**Example**

Number of samples meeting standards: 999

Total number of samples: 1010

Score =  $(999/1010) \times 10 = 9.89$

## Category II: Water quality

### Indicator 4: Secondary WWT

**Principal:** Measure of the urban population connected to secondary waste water treatment plants. The focus on secondary treatment is chosen because primary treatment is considered rather insufficient for BOD and nutrient removal.

#### How to calculate

**X** = Percentage of population connected to secondary sewage treatment. We assume that there is only tertiary treatment after secondary treatment has been done.

Definition secondary WWT: Secondary treatment: process generally involving biological treatment with a secondary settlement or other process, with a BOD removal of at least 70% and a COD removal of at least 75% (OECD, 2013).

$$\text{Indicator 4} = X/10$$

#### Where to get the data

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 9 January 2015. There are more recent updates on the OECD website: <https://www.oecd.org/environment/environment-at-a-glance/> Go to [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment\\_data-00604-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment_data-00604-en) and find the most recent data for each country

Alternative: search for "Sanitation status (name city)"

IWA Water Wiki. Information resource & hub for the global water community

<http://www.iwawaterwiki.org/xwiki/bin/view/Main/Search?text=Ho+Chi+Minh+City+sanitation+status&space> Accessed 19 January 2015

#### Example Amsterdam

Amsterdam has 1% of only secondary treatment and 98% of tertiary treatment. The score for the coverage of secondary WWT becomes:  $[1\% + 98\%] / 10 = 9.9$

#### Literature

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 9 January 2015, and Sato et al., (2013): [https://inweh.unu.edu/wp-content/uploads/2019/03/2013-AGWAT\\_Sato-et-al\\_Global-Wastewater-Data.pdf](https://inweh.unu.edu/wp-content/uploads/2019/03/2013-AGWAT_Sato-et-al_Global-Wastewater-Data.pdf)



## Indicator 5: Tertiary WWT

**Principal:** Measure for the urban population connected to tertiary waste water treatment plants. This treatment step is important for water quality because much nutrients and chemical compounds are removed from the water before it enters the surface water.

### How to calculate

X = Percentage of population connected to tertiary sewage treatment.

$$\text{Indicator 5} = X/10$$

### Definitions

Tertiary treatment: Tertiary treatment: treatment of nitrogen or phosphorous or any other pollutants affecting the quality or a specific use of water (microbiological pollution, color, etc.) (OECD, 2013).

### Where to get the data

OECD (Organization for Economic Co-operation and Development), 2013. Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. Available on world wide web [https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 [Accessed on November 7, 2014] and

There are updates on the OECD website:

<https://www.oecd.org/environment/environment-at-a-glance/> Go to [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment\\_data-00604-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics/wastewater-treatment_data-00604-en) and find the most recent data for each country

Search for "Sanitation status (name city)"

IWA Water Wiki. Information resource & hub for the global water community

<http://www.iwawaterwiki.org/xwiki/bin/view/Main/Search?text=Ho+Chi+Minh+City+sanitation+status&space> Accessed 19 January 2015

### Example Amsterdam

Amsterdam has 98% of their waste water treated with tertiary treatment. The score for the coverage of secondary and tertiary treatment becomes:  $98 / 10 = 9.8$

### Literature

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 9 January 2015 . NB see updates on OECD website

## Indicator 6: Groundwater quality

**Principal:** Measure of relative groundwater quality. A lower Indicator score is given for poorer quality.

### How to calculate

Base the calculation on national or regional data where city-level data are not available. A limitation is that in any country, city water quality is typically worse than the national average.

For EU countries, data are available to estimate a measure of national groundwater quality. An EU database shows the number of groundwater samples of 'good chemical status' out of a total number of samples.

X = Number of samples of 'good chemical status'

Y = Number of samples of 'poor chemical status'

$$\text{Indicator 6} = X / (X+Y) \times 10$$

Note: for non-EU countries, an alternative method should be applied, depending what data are available.

### Where to get the data

From the 'Ground Water Viewer' of the European Environment Agency (EEA).

EEA (2012) WISE WFD Database. [http://www.eea.europa.eu/data-and-maps/data/wise\\_wfd](http://www.eea.europa.eu/data-and-maps/data/wise_wfd) Accessed on 15 June 2015.

There is a new version available here: <https://www.eea.europa.eu/data-and-maps/data/wise-wfd-2>

Here is the table: <https://www.eea.europa.eu/themes/water/european-waters/water-quality-and-water-assessment/water-assessments/groundwater-quantitative-and-chemical-status>

Here is a map: <https://www.eea.europa.eu/data-and-maps/figures/chemical-status-of-groundwater-bodies-2>

### Example Amsterdam

X = Good chemical status: 14

Y = Poor chemical status: 9

$$\text{Indicator score} = [14 / (14 + 9)] \times 10 = 6.1$$

### Category III: Wastewater treatment

#### Indicator 7: Nutrient recovery

**Principal:** Measure of the level of nutrient recovery from the wastewater system.

#### How to calculate

A. Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Mm<sup>3</sup> year<sup>-1</sup>)

B. Total volume of wastewater passing the wastewater treatment plants (Mm<sup>3</sup> year<sup>-1</sup>)

$$\text{Indicator 7} = \frac{A}{B} * \frac{\% \text{ secondary WWT coverage}}{100} * 10$$

#### Where to get the data

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 7 January 2015, or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

#### Improvement in calculation method

Previously, in the city blueprint only water that entered the WWT facilities was considered as total volume of water. Hereby disregarding the city's wastewater that is not treated at all. Therefore the City Blueprint scores are now multiplied by the share of WWT coverage. In this way the concept of urban metabolism is better represented. To measure the full potential of nutrient abstraction from all wastewater the above equation is applied.

**Indicator 8: Energy recovery**

**Principal:** Measure of energy recovery from the wastewater system.

**How to calculate**

- A) Total volume of wastewater treated with techniques to recover energy (Mm<sup>3</sup>/year).  
 B) Total volume of water produced by the city (Mm<sup>3</sup>/year).

$$[ A / B ] * 10 = \text{score}$$

Often only the total volume of wastewater that enters the treatment facilities is known together with wastewater treatment coverage's (% of water going to the treatment facilities). In this case:

- C) Total volume of wastewater treated with techniques to recover energy (Mm<sup>3</sup>/year).  
 D) Total volume of wastewater treated in wastewater treatment plants (Mm<sup>3</sup>/year).

$$\text{Indicator 8} = \frac{C}{D} * \frac{\% \text{ secondary WWT coverage}}{100} * 10$$

**Where to get the data**

Data needs to be provided locally. For WWT coverage's:  
 OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 9 January 2015 or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

**Improvement in calculation method**

Previously, in the city blueprint only water that entered the WWT facilities was considered as total volume of water. Hereby disregarding the city's wastewater that is not treated at all. Therefore the City Blueprint scores are now multiplied by the share of WWT coverage. In this way the concept of urban metabolism is better represented.

### Indicator 9: Sewage sludge recycling

**Principal:** A measure of the proportion of sewage sludge recycled or re-used. For example, it may be thermally processed and/or applied in agriculture.

The decision whether or not to apply sewage sludge in agriculture depends on the levels of organic and inorganic micro-contaminants. Often, sewage sludge is contaminated and in many countries it is not allowed to apply sewage sludge in agriculture. Instead, the sludge is burned in waste destruction installations or as biomass in power plants for the generation of electricity.

#### How to calculate

- A. Dry weight of sludge produced in wastewater treatment plants serving the city
  - B. Dry weight of sludge going to landfill
  - C. Dry weight of sludge thermally processed
  - D. Dry weight of sludge disposed in agriculture
  - E. Dry weight of sludge disposed by other means
- (As a check, A should = B + C + D +E)

$$\text{Indicator 9} = \frac{C+D}{A} * \frac{\% \text{ secondary WWT coverage}}{100} * 10$$

To measure the full potential of nutrient and energy recovery, it is specifically chosen to multiply the first term in the equation above with the percentage of secondary WWT coverage as secondary WWT produces much more sewage sludge than primary WWT.

#### Where to get the data

Data needs to be provided locally. For WWT coverage's:

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. DOI: 10.1787/9789264185715-en. [http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](http://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) p. 96 Accessed 9 January 2015 or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

#### Improvement in calculation method

Previously, in the city blueprint only water that entered the WWT facilities was considered as total volume of water. Hereby disregarding the city's wastewater that is not treated at all. To measure the full potential of nutrient and energy recovery from wastewater by using wastewater abstracted sewage sludge, secondary WWT is incorporated in the calculation and not primary WWT. In this way the concept of urban metabolism is better represented.

#### Example Scotland

**A** total sludge produced is 20030 tonnes dry DS/year (dry substance per year); **B** n.a.; **C** zero tonnes DS/year is thermally processed; **D** 19520 tonnes DS/year is processed in agriculture; % secondary WWT coverage in Scotland is 97%.

Score is: [ ( 0 + 19520 ) / 20030 ] x 0.97 x 10 = 9.45.

### Indicator 10: Energy efficiency WWT

**Principal:** A measure of the energy efficiency of the wastewater treatment. A lower Indicator score is given where efficiency measures are more limited.

#### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment based on the plans, measures and their implementation to improve the efficiency of wastewater treatment. Self-assessment based on information from public sources (national/regional/local policy document, reports and websites of actors (e.g. water companies, cities, provincial or national authorities)).

#### Indicator 10 =

Indicator score	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national
4	the topic is addressed in a chapter at the national and local
5	a local policy plan is provided in a publicly available
6	as 5 and the topic is also addressed at the local
7	plans are implemented and clearly communicated to the
8	as 7 plus subsidies are made available to implement the
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a very high priority
10	as 9 and the activity is in place for = 3 years

#### Where to get the data

Local data sources can provide an adequate estimate.

## Category IV: Infrastructure

### Indicator 11: Stormwater separation

**Principal:** A measure of the proportion of the wastewater system for which sanitary sewage and storm water flows are separated. In principal, a separate system is better than a combined system as extreme weather events may lead to sewer overflows into surface water. These sewer overflows are a major source of pollution. Also flooding vulnerability is larger if stormwater separation ratio is low. A lower Indicator score is given where the proportion of combined sewers is greater.

#### How to calculate

- A. Total length of combined sewers managed by the utility (km)
- B. Total length of stormwater sewers managed by the utility (km)
- C. Total length of sanitary sewers managed by the utility (km)

$$\text{Indicator 11} = \frac{B+C}{A+B+C} \times 10$$

#### Where to get the data

Local data sources can provide an adequate estimate.

#### Example Amsterdam

- A. Total length of combined sewers = 523 km
- B. Total length of stormwater sewers = 1669 km
- C. Total length of sanitary sewers = 866 km

$$\frac{1669+866}{523+1669+866} \times 10 = 8.3$$

### **Indicator 12: Average age sewer**

**Principal:** The age of the infrastructure for wastewater collection and distribution system is an important measure for the financial state of the UWCS.

#### **How to calculate**

The average age of the infrastructure is an indication of the commitment to regular system maintenance and replacement. The method compares the average age of the system to an arbitrarily maximum age of 60 years. Moreover, it is assumed that an age of <10 years receives a maximum score since younger systems generally well maintained.

**X** = Average age sewer

$$\text{Indicator 12} = \frac{60-X}{60-10} \times 10$$

NB. All values of  $x > 60$  will lead to an indicator score of 0.

#### **Where to get the data**

Local data sources can provide an adequate estimate.

#### **Improvement in calculation method**

Previously, in the City Blueprint the average age was set on 100 years. Infrastructure refurbishment requirements obviously depend on age but this depends highly on subsoil, material used, *etcetera*. The differences in scores for this indicator appeared to be minimal because most sewers are much younger than the maximum age. Together with literature based estimates the average maximum age has now been set at 60 years. Moreover, it is assumed that a sewer with an age of <10 years is generally well maintained and should therefore receive a maximum score.

#### **Example Amsterdam**

The average age of the sewer system in Amsterdam is 28 years.

$$\frac{60-28}{60-10} \times 10 = 6.4 \text{ points.}$$



### Indicator 13: Water system leakages

**Principal:** A measure of the percentage of water lost in the distribution system due to leaks (typically arising from poor maintenance and/or system age).

#### How to calculate

Leakage rates of 50% or more are taken as maximum value and thus scored zero. A best score of 10 is given when the water system leakage is zero.

X = Water system leakages (%)

$$\text{Indicator 13} = \frac{50-X}{50-0} \times 10$$

All values of  $x > 50$  will lead to an indicator score of 0

#### Where to get the data

The data can be obtained from national data bases or local data sources (e.g. from utilities operating in the specific municipality).

Furthermore, many of these data have also been reported in a series of documents about the Green City Index:

[https://www.siemens.com/entry/cc/features/greencityindex\\_international/all/en/pdf/gci\\_report\\_summary.pdf](https://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/gci_report_summary.pdf).

The European Green City Index report (Siemens, 2009) provides data for 31 cities. Siemens, A. G., 2009. European Green City Index. Assessing the environmental impact of Europe's major cities. Munich, Germany

[https://www.siemens.com/entry/cc/features/greencityindex\\_international/all/en/pdf/report\\_en.pdf](https://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/report_en.pdf).

The green city index report for Africa can be found here:

[https://www.siemens.com/entry/cc/features/greencityindex\\_international/all/en/pdf/report\\_africa\\_en.pdf](https://www.siemens.com/entry/cc/features/greencityindex_international/all/en/pdf/report_africa_en.pdf)

#### Example Amsterdam

Amsterdam has a water system leakages value of 3.5%.

$$\frac{50-3.5}{50-0} \times 10 = 9.3 \text{ points.}$$

### Indicator 14: Operating costs recovery (ratio)

**Principal:** Measure of revenue and cost balance of operating costs of water services. A higher ratio means that there is more money available to invest in water services, e.g. infrastructure maintenance or infrastructure separation.

#### How to calculate

Only the operational cost and revenues for Domestic water supply and sanitation services are included.

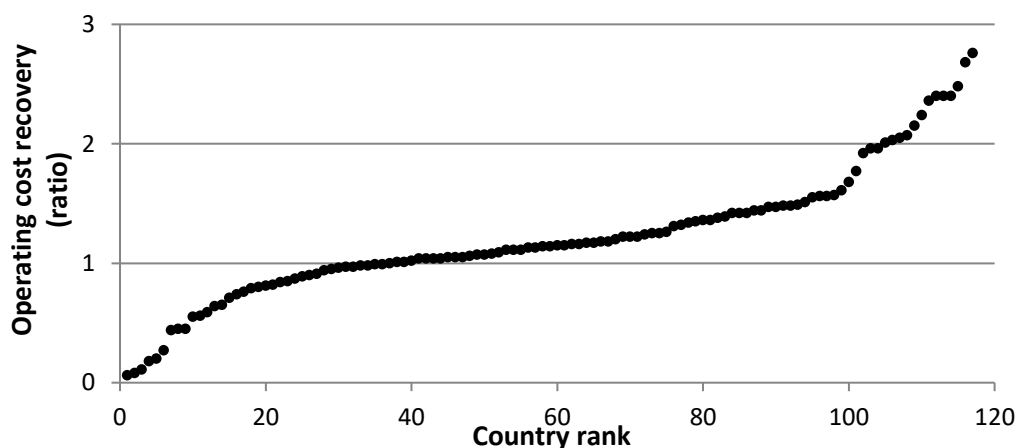
$$\text{Operating cost recovery (ratio)} = \frac{\text{Total annual operational revenues}}{\text{Total annual operating costs}}$$

Definitions:

Total annual operational revenues: Total annual income from tariffs and charges for drinking water and sanitation services (US\$ or any other currency/year).

Total annual operating costs: Total annual operational expenditures for drinking water and sanitation services (US\$ or any other currency/year).

If the ratio is >1 than there is no 100% coverage of operating costs. However, ratios <1 are often applied at utilities. This means that there is more than a 100% coverage in many cases (Figure 14.1).



**Fig. 14.1** Operating cost recovery ratio for all 117 countries available (ib-net.org). Note that the majority of the countries have more than 100% operating cost recovery (which is a ratio of 1).

Of the operating cost recovery ratio's for all countries available (shown in Figure 14.1) the highest and lowest 10% are averages and used as minimum and maximum value to rescale the operating cost recovery ratio's to a score between 0 and 10 points. The minimum and maximum are respectively 0.33 and 2.34.

**X** = Operating cost recovery (ratio)

$$\text{Score indicator 14} = \frac{X - 0.33}{2.34 - 0.33} \times 10$$

All values of  $x < 0.33$  will lead to an indicator score of 0.

### Where to get the data

From the city's water utility financial reports.

IBNET: The international benchmarking network for water and sanitation utilities

<http://www.ib-net.org/>; **City Level:** Explore detailed country maps with indicators information for each utility; **Where city data is not available:** The IB-net Water Supply and Sanitation Blue Book 2014 provides means for each country.

### Example London

Thames water has a financial report over every 6 months which is considered as a sufficient time period to calculate the operating cost recovery ratio.

Total annual operating cost revenues: 1023 £m (Thames water utilities, 2014)

Total operating costs: 655.8 £m (Thames water utilities, 2014)

$$\frac{1023}{655.8} = 1.56$$

The operating cost recovery (ratio) is 1.56 (156% operating cost are recovered).

When we standardized this to a 0-10 score in the city blueprint we get:

$$\frac{1.56 - 0.33}{2.34 - 0.33} \times 10 = 6.1$$

The score for operating cost recovery for London is: 6.1 points.

### Literature

Thames water utilities (2014) Investing in our future. Interim report and financial statements <http://www.thameswater.co.uk/tw/common/downloads/Thames-Water-utilities-Limited-Interim-Report-Financial-Statements-Period-30-Sep.pdf> Accessed 27 February 2015

<b>Category V: Solid waste treatment</b>
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**Indicator 15: Solid waste collected**

**Principal:** Represents waste collected from/ produced by households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that treat or dispose of waste at the same used for municipally collected waste (OECD, 2013). Abbreviation used is MSW (Municipal Solid Waste)

**How to calculate**

**X** = kg/cap/year of collected solid waste. The min-max method is applied. Here the lowest and highest 10% produced solid waste of all countries that are available is taken. These are respectively 136.4 kg/cap/year and 689.2 kg/cap/year.

$$\text{Indicator 15} = \left[ 1 - \frac{X-136.4}{689.2-136.4} \right] * 10$$

All values of  $x \leq 136.4$  lead to an indicator score of 10

**Where to get the data**

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. [https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

In non-EU cities local data of solid waste treatment are mostly available on local sites, municipal or company reports or look at the Waste Atlas <http://www.atlas.d-waste.com/>

Another source of information is the World Bank's [What a Waste 2.0 report](#) and <https://datacatalog.worldbank.org/dataset/what-waste-global-database>

**Example Malmö**

Malmö's average municipal waste production is 460 kg/cap/year. Applying the formula results in:

$$\left[ 1 - \frac{460-136.4}{689.2-136.4} \right] * 10 = 4.15 \text{ points.}$$

**Literature:** see websites above

**Indicator 16: Solid waste recycled**

**Principal:** Percentage of solid waste that is recycled or composted. Abbreviation used is MSW (Municipal Solid Waste)

**How to calculate**

This indicator represents the percentage of the total collected municipal waste that is recycled or composted. However, when solid waste is used for incineration with energy recovery, it is not possible to also use it for recycling while both practices are

sustainable. Therefore the % solid waste that is incinerated is subtracted from the total (100%) of collected municipal waste to obtain the potential percentage of solid waste that can be recycled (in numerator). Thus this indicator is calculated as shown below.

$$\text{Indicator 16} = \frac{\% \text{ recycled or composted}}{100\% - \% \text{ used for incineration with energy recovery}} \times 10$$

#### Where to get the data

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. [https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en)

or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

In non-EU cities local data of solid waste treatment are mostly available on local sites, municipal or company reports or look at the Waste Atlas <http://www.atlas.d-waste.com/>

Another source of information is the World Bank's [What a Waste 2.0 report](#) and <https://datacatalog.worldbank.org/dataset/what-waste-global-database>

#### Example Maastricht

Maastricht belongs to the Netherlands. In the Netherlands 61% of the solid waste is composted or recycled. Furthermore, 38% of the municipal solid waste is incinerated with energy recovery.

$$\frac{61\%}{100\% - 38\%} \times 10 = 9.8$$

## Indicator 17: Solid waste energy recovery

**Principal:** Percentage of solid waste that is incinerated with energy recovery.  
Abbreviation used is MSW (Municipal Solid Waste)

### How to calculate

This indicator represents the percentage of the total collected municipal waste that incinerated with energy recovery (techniques). However, when solid waste is recycled or composted, it is not possible to also use it for incineration with energy recovery, while both practices are sustainable. Therefore the % solid waste that is recycled or composted is subtracted from the total (100%) of collected municipal waste to obtain the potential percentage of solid waste that can be incinerated with energy recovery (in numerator). Thus this indicator is calculated as shown below.

$$\text{Indicator 17} = \frac{\% \text{ incinerated with energy recovery}}{100 - \% \text{ recycled or composted}} \times 10$$

### Where to get the data

OECD (2013) Organization for Economic Co-operation and Development: Environment at a glance 2013. OECD indicators. OECD Publishing. [https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013\\_9789264185715-en](https://www.oecd-ilibrary.org/environment/environment-at-a-glance-2013_9789264185715-en) or more recent OECD information that can be found here: [https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics\\_env-data-en](https://www.oecd-ilibrary.org/environment/data/oecd-environment-statistics_env-data-en)

In non-EU cities local data of solid waste treatment are mostly available on local sites, municipal or company reports or look at the Waste Atlas <http://www.atlas.d-waste.com/>

Another source of information is the World Bank's [What a Waste 2.0 report](#) and <https://datacatalog.worldbank.org/dataset/what-waste-global-database>

### Example Venlo

Venlo is a city in the Netherlands. In the Netherlands 38% of the solid waste is incinerated with energy recovery. Furthermore, 61% of the municipal solid waste is recycled or composted.

$$\frac{38\%}{100\% - 61\%} \times 10 = 9.7$$

## Category VI: Climate adaptation

### Indicator 18: Green space

**Principal:** Represents the share of green and blue area which is essential to combat the heat island effect in urban areas (area defined as built-up area lying less than 200 meters apart).

#### How to calculate

**City specific:** Numbers are provided in %

Share of green and blue areas is available for all European cities. The EEA city database presents data for many European cities. From these data the average of the lowest 10% is taken as minimum (16%) and the average of the highest 10% is taken as maximum (48%). The percentages for the EU cities are standardized according to the min-max method. For non-European cities percentages for green and blue area are mostly not available.

$$\text{Indicator 18} = \frac{X-16}{48-16} \times 10$$

where X = Share of blue and green area (%). All values of  $x < 16$  will lead to an indicator score of 0 and all values  $> 48$  will lead to an indicator score of 10.

#### Where to get the data

Soil sealing for cities in EU countries:

EEA (2012) European environmental agency: Urban adaptation to climate change.

Annex II. ISBN 978-92-9213-308-5 <http://www.eea.europa.eu/publications/urban-adaptation-to-climate-change> Accessed 7 September 2017. Open the excel file Annex II. City Data sensitivity and look for blue green urban area (%).

For non-EU cities: A reliable estimate can be obtained via satellite maps google. As follows: google City Name Satellite Map; e.g. Kampala Satellite Map. Zoom in and estimate the green space surface (%). According to the EEA these are green urban areas, sports and leisure facilities, agricultural areas, semi-natural areas and wetlands, forests, discontinuous low density urban fabric as a proxy for private gardens and water bodies. On the satellite image this is clearly visible by the trees and greens (parks). The green space is the total surface (100%) minus the sealed surface, i.e. normally all space occupied by buildings, streets, parking places, railway stations, etc., where water cannot penetrate the soil and subsoil.

#### Example Utrecht

For Utrecht the share of green and blue area is 21,8%. The mean highest 10% of green and blue area measured by the EEA is 48%. The mean lowest 10% of green space measured by the EEA is 16%. With min-max transformation the score for Utrecht becomes:

$$\frac{21.8-16}{48-16} \times 10 = 1,8 \text{ points}$$

## Indicator 19: Climate adaptation

**Principal:** A measure of the level of action taken to adapt to climate change threats. A lower Indicator score is given where actions or commitments are more limited.

### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment of the measures and their implementation to protect citizens against flooding and water scarcity related to climate change (e.g. green roofs, rainwater harvesting, safety plans etc.). Self-assessment based on information from public sources (national / regional / local policy document, reports and websites of actors (e.g. water companies, cities, provincial or national authorities)).

Indicator score	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national document
4	the topic is addressed in a chapter at the national and local level
5	a local policy plan is provided in a publicly available document
6	as 5 and the topic is also addressed at the local website
7	plans are implemented and clearly communicated to the public
8	as 7 plus subsidies are made available to implement the plans
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a <i>very high priority implemented at the level</i> of the local community.
10	as 9 and the activity is in place for = 3 years

### Where to get the data

Various data sources can be used for this assessment.



## Indicator 20: Climate robust buildings

**Principal:** A measure of whether there is a clear policy for buildings to be robust regarding their contribution to climate change concerns (principally energy use). A lower Indicator score is given where policies are weaker.

### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment of the policies in place to promote energy efficiency for heating and cooling of houses and buildings, including the use of geothermal energy. Assessment is based on information from public sources (national / regional / local policy documents, reports and websites of actors, e.g. water companies, cities, provincial or national authorities).

Indicator	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national document
4	the topic is addressed in a chapter at the national and local level
5	a local policy plan is provided in a publicly available document
6	as 5 and the topic is also addressed at the local website
7	plans are implemented and clearly communicated to the public
8	as 7 plus subsidies are made available to implement the plans
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a <i>very high priority implemented at the level</i> of the local community.
10	as 9 and the activity is in place for = 3 years

### Where to get the data

Various data sources can be used for this assessment, including local policy plans and reports.

## Category VII: Plans and actions

### Indicator 21: Management and action plans

**Principal:** A measure of the application of the concept of Integrated Water Resources Management (IWRM) in the city. A lower Indicator score is given where plans and actions are limited.

#### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment of local and regional commitments to adaptive, multifunctional, infrastructure and design for IWRM as demonstrated by the ambition of the action plans and the actual commitments by local authorities or utilities. The assessment should be based on information from public sources (national/regional/local policy document, reports and websites of actors (e.g. water companies, cities, provincial or national authorities)).

Indicator	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national document
4	the topic is addressed in a chapter at the national and local level
5	a local policy plan is provided in a publicly available document
6	as 5 and the topic is also addressed at the local website
7	plans are implemented and clearly communicated to the public
8	as 7 plus subsidies are made available to implement the plans
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a very high priority implemented at the level of the local community.
10	as 9 and the activity is in place for = 3 years

#### Where to get the data

Various data sources can be used for this assessment.

## Indicator 22: Water efficiency measures

**Principal:** Measure of the application of water efficiency measures by the range of water users across the city. A lower Indicator score is given where efficiency measures are more limited.

### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment based on information from public sources (national/regional/local policy document, reports and websites of actors (e.g. water companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the efficiency of water usage by e.g. water saving measures in taps, toilets, showers and baths, water efficient design, or behavioral changes.

Indicator	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national document
4	the topic is addressed in a chapter at the national and local level
5	a local policy plan is provided in a publicly available document
6	as 5 and the topic is also addressed at the local website
7	plans are implemented and clearly communicated to the public
8	as 7 plus subsidies are made available to implement the plans
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a <i>very high priority implemented at the level</i> of the local community.
10	as 9 and the activity is in place for = 3 years

### Where to get the data

Various data sources can be used for this assessment.

### Example Rotterdam

There is a clear policy program of the city of Rotterdam to reduce energy and water use in households, leading to the lowest water consumption in cities of Europe. Therefore the score for Rotterdam is 10.

### Indicator 23: Drinking water consumption

**Principal:** Measure of the average annual consumption of water per capita. A lower Indicator score is given where the volume per person is greater.

**Definition:** In this questionnaire we use authorized consumption as defined by the International Water Association (IWA). This is the total volume of metered and/or non-metered water that, during the assessment period (here: 1 year), is taken by registered customers, by the water supplier itself, or by others who are implicitly or explicitly authorized to do so by the water supplier, for residential, commercial, industrial or public purposes. It includes water exported. It is IWA code A14. This is then divided by the city population.

#### How to calculate

$X = \text{m}^3/\text{person}/\text{year}$  drinking water consumption

The volume is then normalized against maximum and minimum volumes for European cities. The minimum is for Rotterdam at 45.2 m<sup>3</sup>/person/yr. The maximum is for Kiev at 266 m<sup>3</sup>/person/year (European Green City Index).

$$\text{Indicator 23} = \left[ 1 - \frac{X-45.2}{266-45.2} \right] * 10$$

All values of  $x < 45.2$  will lead to an indicator score of 10 and all values of  $x > 266$  will lead to an indicator score of 0.

#### Where to get the data

Many cities will have easy access to data to calculate a volume consumed per person per year in cubic meters. Where city data are not known, there may be alternative sources of data, and perhaps a national figure.

#### Example Amsterdam:

$X = \text{Annual water consumption per capita (m}^3/\text{person)} = 53.47 \text{ m}^3$

$$\left[ 1 - \frac{53.47-45.2}{266-45.2} \right] * 10 = 9.6$$

## Indicator 24: Attractiveness

**Principal:** A measure of how surface water features are contributing to the attractiveness of the city and wellbeing of its inhabitants. A lower Indicator score is given where 'attractiveness' is less.

**Definition:** Examples of cities, that attract lot of tourists are Venice, Hamburg and Amsterdam. Water is a dominant feature of those cities. Often the property prices in the vicinity of canals and harbors are much higher than in other parts of the city where the presence of water is not so dominant. Private companies, the owners of the houses, and also the local authorities are often working together to increase the attractiveness of those cities.

### How to calculate

This measure is unlikely to already have a value applied. Instead, apply a self-assessment of how surface water is supporting the quality of the urban landscape as measured by the community sentiment/well-being within the city. The assessment should be based on information (policy documents, reports or research articles, or documents related to water-related tourism that deal with the sentiment of the citizens. Provide score between 0 (no role) to 10 (water plays a dominating role in the well-being of citizens).

Indicator	Assessment
0	no information is available on this subject
1	limited information is available in a national document
2	limited information is available in national and local documents
3	the topic is addressed in a chapter in a national document
4	the topic is addressed in a chapter at the national and local level
5	a local policy plan is provided in a publicly available document
6	as 5 and the topic is also addressed at the local website
7	plans are implemented and clearly communicated to the public
8	as 7 plus subsidies are made available to implement the plans
9	as 8 plus annual reports are provided on the progress of the implementation and/or any other activity indicating that this is a <i>very high priority implemented at the level</i> of the local community.
10	as 9 and the activity is in place for = 3 years

### Where to get the data

Various data sources can be used for this assessment.