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Author(s):	Anna Strzelecka, Stef Koop, Bogumil Ulanicki, Kees van Leeuwen Ifigeneia Koutiva, Christos Makropoulos, C.Arena; N.Bazzurro; G.Capannelli; P-Castiglieri; A.Fortunato; S.Gianazzi; A.Marchese, Eetta Saarimäki, Mona Arnold, Cevza Melek Kazezyılmaz Alhan, Sezar Gülbaz
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Abstract	This report presents the results from application from Trends and Pressures Framework, City Blueprint Framework and City Amberprint Framework in four case study cities: Athens, Genoa, Helsinki and Istanbul. Additionally, linkages between indicators in the City Blueprint and water, waste, energy, transport and ICT were identified, also the linkages previously identified in D3.1 between the City Amberprint indicators and the five aspects were improved. The full report for each case study can be found in the following Annexes: Annex A – Athens report; Annex B – Genova report; Annex C – Helsinki report; Annex D – Istanbul report.

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Versioning and Contribution History

D3.2 V0.1 – Anna Strzelecka first draft 14.02.2016

D3.2 V0.2 – Anna Strzelecka and Bogumil Ulanicki refine and finalize the report. Each case study report was included as Annex 13.04.2016

D3.2 V0.3 – Anna Strzelecka including comments from Stef Koop, Peter Easton and Richard Elelman 14.04.2016

Executive Summary

The four case study cities: Athens, Genoa, Helsinki and Istanbul represent a good range of cities in terms of geographical spread, water resources, climate, population, average income and level of development. The lead partner in each case study applied previously developed tools to assess sustainability of water and waste aspects (The City Blueprint) and energy, transport and ICT aspects (The City Amberprint). Additionally, linkages between indicators in the City Blueprint and water, waste, energy, transport and ICT were identified, also the linkages previously identified in D3.1 between the City Amberprint indicators and the five aspects were improved.

The City Blueprint® Framework (CBF) and The Trends and Pressure Framework (TPF) were described in Task 2.2 and The City Amberprint Framework™ (CAF) was developed in Task 3.1. These findings will be later compared with the results from European Green Cities: Bristol, Copenhagen, Hamburg and Oslo in Task 3.3.

The full report for each case study can be found in the following Appendixes:

- Annex A – Athens report
- Annex B – Genova report
- Annex C – Helsinki report
- Annex D – Istanbul report

1 Introduction

The main purpose of this task was application of the previously developed methodologies to the four case study cities: Athens, Genoa, Istanbul and Oslo (Figure 1.1): They represent a good range of cities in terms of geographical spread, water resources, climate, population, average income and level of development. The lead partner in each case study applied previously developed tools to assess the sustainability of water and waste aspects (The City Blueprint) and energy, transport and ICT aspects (The City Amberprint). Additionally, linkages between the City Blueprint indicators and water, waste, energy, transport and ICT were identified, also the linkages previously identified in D3.1 between the City Amberprint indicators and the five aspects were improved.

Figure 1.1: Location of the four case study cities

The City Blueprint® Framework (CBF) and The Trends and Pressure Framework (TPF) were described in Task 2.2 and The City Amberprint Framework™ (CAF) was developed in Task 3.1. These findings will be later compared with the results from the European Green Cities: Bristol, Copenhagen, Hamburg and Oslo in Task 3.3. In this report the linkages are summarized together with the TPF, CBF and CAF scores. Detailed reports for each city can be found in the Annexes A to D for Athens, Genoa, Helsinki and Istanbul respectively.

The CBF is the first attempt to perform a baseline assessment of Integrated Water Resources Management (IWRM). The City Blueprint® consists of twenty five indicators divided over seven broad categories, see Table 2.5, and shows the indicator results in a spider diagram, see Figure 2.2. The City Blueprint allows for comparison with other leading cities and, thereby can promote city-to-city learning. The overall sustainability of the water and waste aspects is expressed as Blue City Index (BCI) which is the geometric mean of the all CBF indicators. The indicators are scored between 0 (there is a concern) to 10 (no concern). The qualitative indicators were “normalised” on a scale of 0 to 10, where 10 points were assigned to cases that met or exceeded certain criteria on environmental performance (Koop and Van Leeuwen 2015a).

The TPF (on which the city's IWRM has little influence) creates awareness of the most important stress factors that either hamper or, on the contrary, pose opportunity windows for IWRM. The Trends and Pressures indicators are standardized to a scale of 0-4 points, and the following classes have been used: 0 – 0.5 points (no concern), 0.5 – 1.5 (little concern), 1.5 – 2.5 (medium concern), 2.5 – 3.5 (concern), and 3.5 – 4 (great concern). There are twelve indicators divided into three categories: social, environmental and financial pressures, see Table 2.1 and the Trends and Pressures Index (TPI) is the arithmetic mean of the all TPF indicators (Koop and Van Leeuwen 2015b).

The CAF is a complement to the CBF and the TPF. The main goal of the City Amberprint is a baseline assessment of the sustainability of Energy, Transport and ICT in cities. The city Amberprint consists of twenty two indicators: seven indicators to assess the Energy aspect, seven to assess the Transport aspect and eight to assess the ICT aspect in a city, see Table 2.6. Similarly, to the City Blueprint, the indicator results are presented in a spider diagram, see Figure 2.6. To comply with City Blueprint, the indicators that have a value between 0 (there is a concern) to 10 (no concern) are proposed. The overall sustainability of the three aspects is expressed as Amber City Index (ACI). The ACI is the geometric mean of the twenty two indicators.

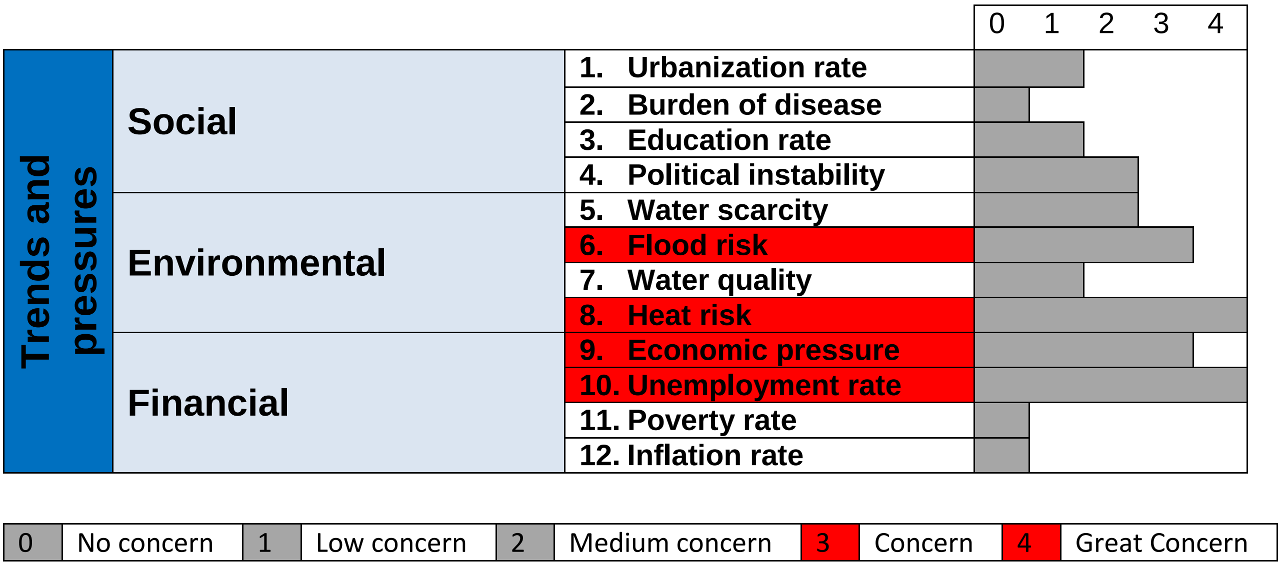
2 Performance

The Trends and Pressures Framework, The City Blueprint and The City Amberprint for the four case study cities are summarized. Full description of each city can be found in the relevant Annex.

2.1 The Trend and Pressures

The Trends and Pressure indicators for the four case study cities are listed in Tables 2.1 – 2.4. Helsinki (Annex C) has the lowest TPI equal to 0.8 with unemployment rate being the biggest concern in the city (being a medium concern). The TPI for Istanbul (Annex D) is the higher amongst the four case study cities being 2.4. Flood risk, heat risk and inflation rate are a great concern to the city and political instability, economic pressures and unemployment rate are a concern (Table 2.4). The TPI for Athens (Annex A) and Genoa (Annex B) are 1.7 and 1.4 respectively. For Athens heat risk and unemployment rate are a great concern while in Genoa these two aspects are a concern. Flood risk and economic pressure are a concern in Athens.

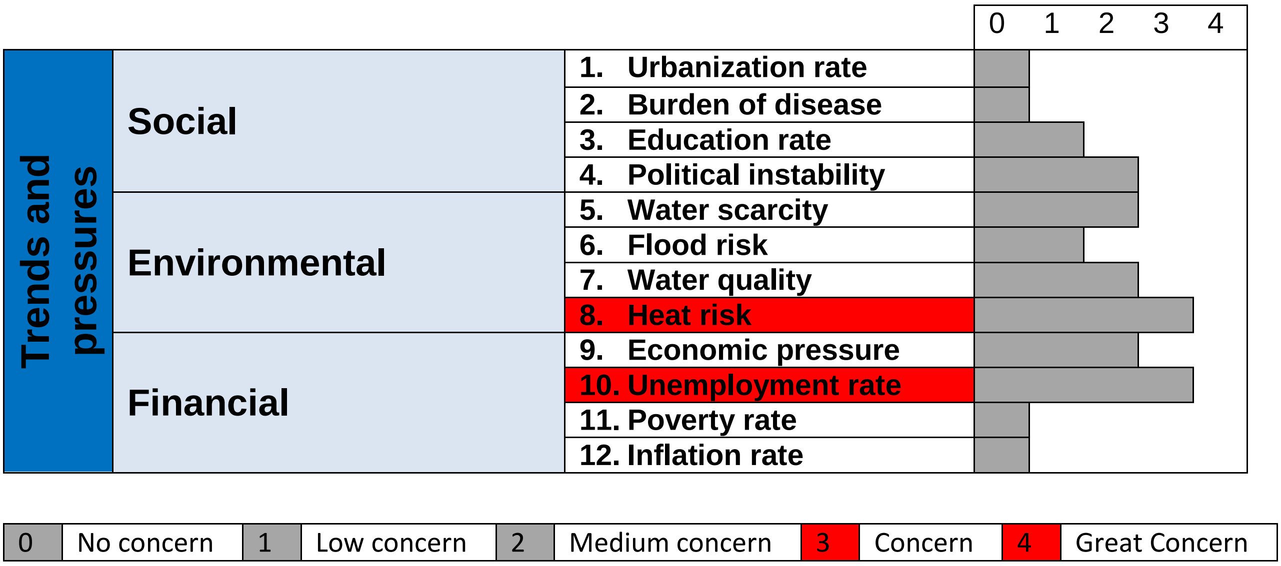
Table 2.1: ***Trends and pressures*** **in Athens. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**



			0	1	2	3	4
Trends and pressures	**Social**	**1. Urbanization rate**	▨	▨			
		2. Burden of disease	▨				
		3. Education rate	▨	▨			
		4. Political instability	▨	▨	▨		
	Environmental	**5. Water scarcity**	▨	▨	▨		
		6. Flood risk	▨	▨	▨	▨	
		7. Water quality	▨	▨			
		8. Heat risk	▨	▨	▨	▨	▨
	Financial	**9. Economic pressure**	▨	▨	▨	▨	
		10. Unemployment rate	▨	▨	▨	▨	▨
		11. Poverty rate	▨				
		12. Inflation rate	▨				

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Table 2.2: ***Trends and pressures*** **in Genoa. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**



			0	1	2	3	4
Trends and pressures	**Social**	**1. Urbanization rate**	▨				
		2. Burden of disease	▨				
		3. Education rate	▨	▨			
		4. Political instability	▨	▨	▨		
	Environmental	**5. Water scarcity**	▨	▨	▨		
		6. Flood risk	▨	▨			
		7. Water quality	▨	▨	▨		
		8. Heat risk	▨	▨	▨	▨	
	Financial	**9. Economic pressure**	▨	▨	▨		
		10. Unemployment rate	▨	▨	▨	▨	
		11. Poverty rate	▨				
		12. Inflation rate	▨				

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Table 2.3: ***Trends and pressures*** **in Helsinki. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**

			0	1	2	3	4
Trends and pressures	**Social**	**1. Urbanization rate**	▨	▨			
		2. Burden of disease	▨				
		3. Education rate	▨	▨			
		4. Political instability	▨	▨			
	Environmental	**5. Water scarcity**	▨				
		6. Flood risk	▨	▨			
		7. Water quality	▨	▨			
		8. Heat risk	▨				
	Financial	**9. Economic pressure**	▨	▨			
		10. Unemployment rate	▨	▨	▨		
		11. Poverty rate	▨				
		12. Inflation rate	▨	▨			

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Table 2.4: ***Trends and pressures*** **in Istanbul. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**

			0	1	2	3	4
Trends and pressures	**Social**	**1. Urbanization rate**	▨	▨	▨		
		2. Burden of disease	▨	▨			
		3. Education rate	▨	▨			
		4. Political instability	▨	▨	▨	▨	
	Environmental	**5. Water scarcity**	▨	▨	▨		
		6. Flood risk	▨	▨	▨	▨	▨
		7. Water quality	▨	▨	▨		
		8. Heat risk	▨	▨	▨	▨	▨
	Financial	**9. Economic pressure**	▨	▨	▨	▨	
		10. Unemployment rate	▨	▨	▨	▨	
		11. Poverty rate	▨	▨			
		12. Inflation rate	▨	▨	▨	▨	▨

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

2.2 The City Blueprint

The City Blueprint indicators and their scores for four case studies are listed in Table 2.5

Table 2.5: List of City Blueprint indicators for Athens, Genoa, Helsinki and Istanbul

Category	No.	Indicator	Athens	Genoa	Helsinki	Istanbul
I	1	Secondary WWT	9.2	9.4	8.3	3.5
	2	Tertiary WWT	8.6	8.4	8.3	3.4
	3	Groundwater quality	5.0	6.5	9.8	4.0
II	4	Solid waste collected	5.4	2.7	3.4	4.9
	5	Solid waste recycled	1.9	4.1	4.7	0.1
	6	Solid waste energy recovered	0.0	2.6	3.8	0.0
III	7	Access to drinking water	10	10	10	10
	8	Access to sanitation	9.5	8.9	9.9	10
	9	Drinking water quality	10	9.8	10	10
IV	10	Nutrient recovery	0.0	8.7	8.3	1.2
	11	Energy recovery	9.2	4.7	8.3	0.2
	12	Sewage sludge recycling	9.2	8.8	8.3	3.5
	13	WWT Energy efficiency	6.0	4.0	10	5.0
V	14	Average age sewer	8.0	2.0	6.0	8.0
	15	Operation cost recovery	3.6	4.3	3.3	3.6
	16	Water system leakages	5.6	4.8	1.8	5.0
	17	Stormwater separation	9.7	8.7	8.0	2.4
VI	18	Green space	0.0	3.8	9.3	1.3
	19	Climate adaptation	5.0	4.0	7.0	4.0
	20	Drinking water consumption	7.3	8.0	9.4	9.7
	21	Climate robust buildings	5.0	3.0	7.0	2.0
VII	22	Management and action plans	5.0	3.0	8.0	4.0
	23	Public participation	3.5	4.2	9.0	2.0
	24	Water efficiency measures	6.0	3.0	3.0	4.0
	25	Attractiveness	9.0	1.0	8.0	7.0

Categories: I – Water quality, II – Solid waste treatment, III – Basic water services, IV – Wastewater treatment, V – Infrastructure, VI – Climate robustness, VII – Governance

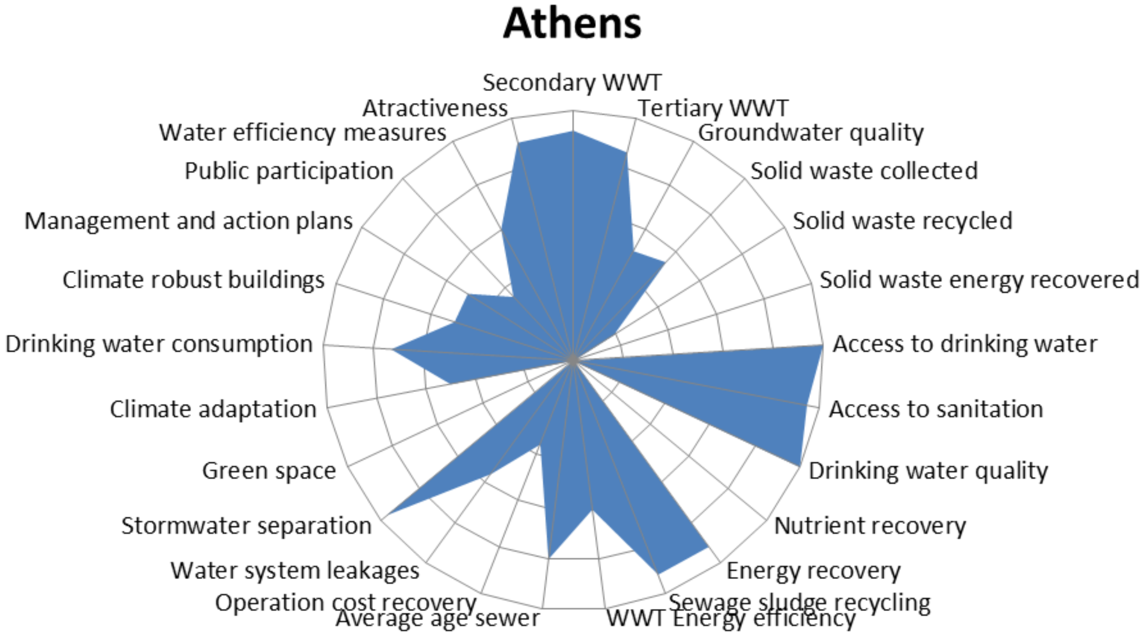


Figure 2.1: City Blueprint of Athens. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 4.9.

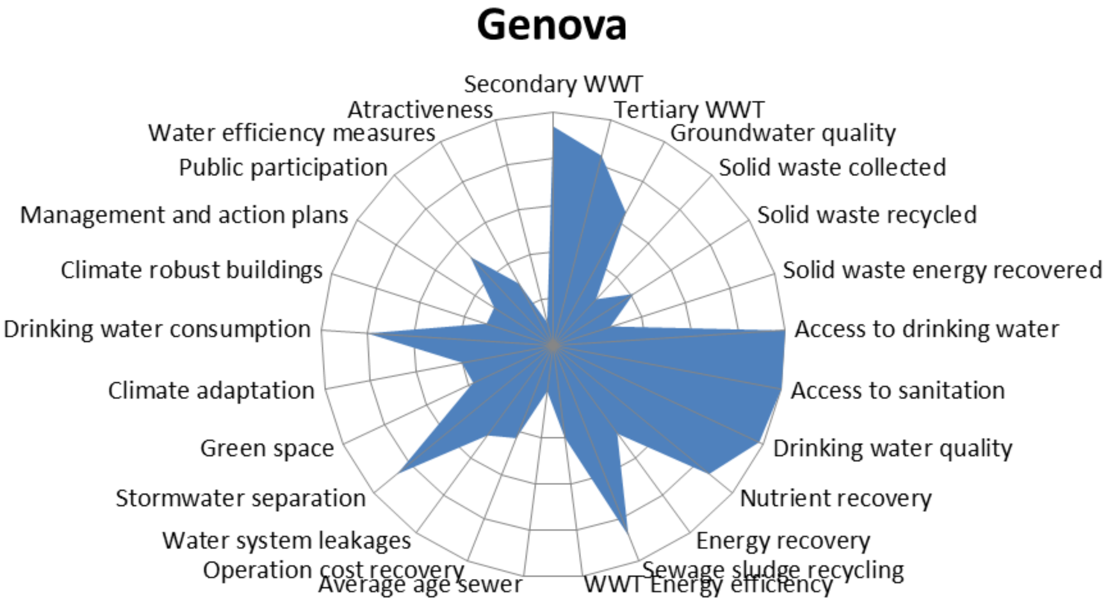


Figure 2.2: City Blueprint of Genoa. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 5.0.

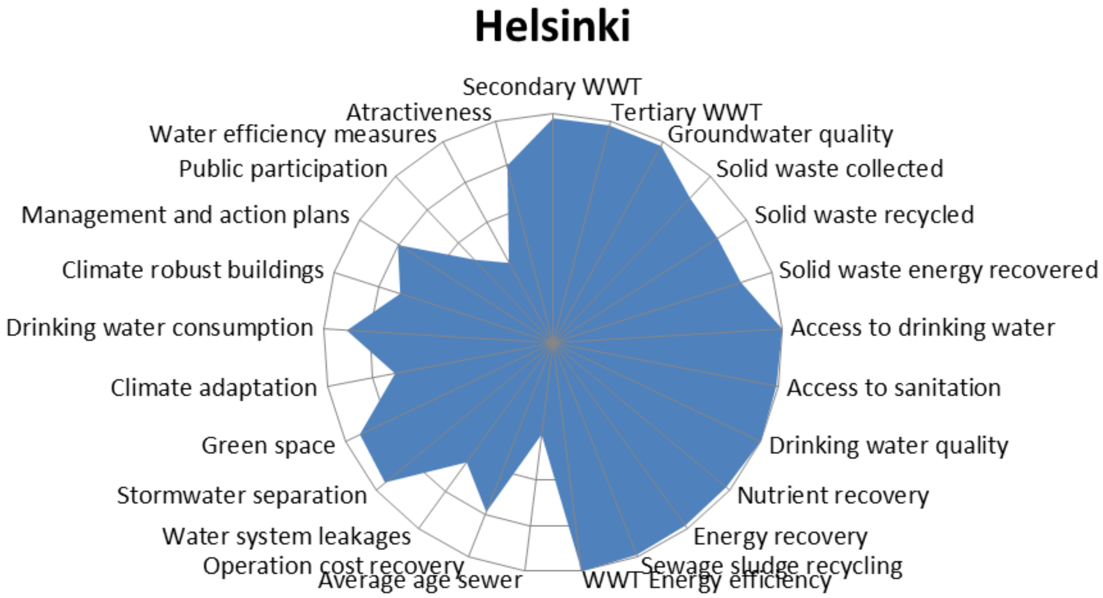


Figure 2.3: City Blueprint of Helsinki. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 8.2

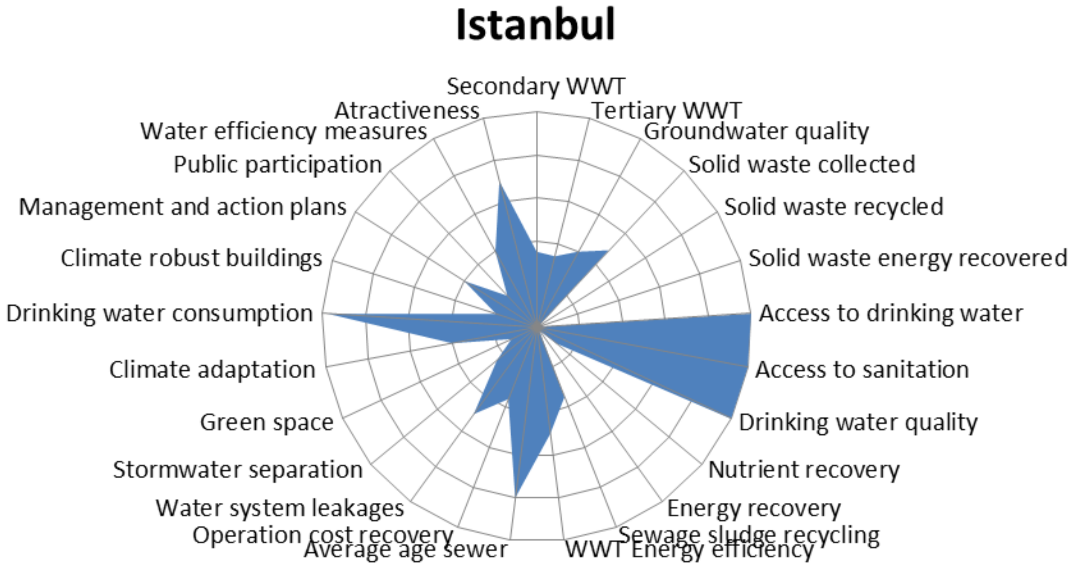


Figure 2.4: City Blueprint of Istanbul. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 3.4.

2.3 The City Amberprint

The City Amberprint indicators and their scores for the four case study cities are listed in Table 2.6.

Table 2.6: List of City Amberprint indicators for Athens, Genoa, Helsinki and Istanbul

Category	No.	Indicator	Athens	Genoa	Helsinki	Istanbul
ENERGY	1	Carbon footprint	9.8	6.6	6.75	6.4
	2	Fuel poverty	7.9	9.6	9.1	8.8
	3	Energy consumption	7.1	9.6	7.6	2.5
	4	Energy self-sufficiency	3.2	10	3.5	0.2
	5	Renewable energy ratio	1.3	0.4	0.8	3.6
	6	Energy efficiency plans	8.0	6.0	8.0	5.0
	7	Energy infrastructure investment	1.8	4.1	1.2	5.7
TRANSPORT	8	Commuting time	6.9	0.3	4.3	3.5
	9	Use of public transport	2.0	1.5	2.7	0.0
	10	Bicycle network	0.3	1.0	9.4	0.3
	11	Transportation fatalities	9.5	9.7	10.0	10.0
	12	Clean energy transport	4.0	6.0	7.0	6.0
	13	Transport-related pollutions	8.5	8.5	9.7	10.0
	14	Transport infrastructure investment	5.4	0.3	2.6	0.0
ICT	15	ICT access	5.3	4.8	7.4	5.0
	16	ICT use households	9.0	7.6	9.1	5.4
	17	ICT use water utilities	7.3	8.0	8.5	8.3
	18	ICT use energy utilities	7.5	8.5	9.0	7.5
	19	ICT use transport	3.3	7.5	8.0	7.8
	20	ICT use waste management	2.0	7.3	8.8	6.3
	21	Digital public service	5.8	2.3	8.1	7.0
	22	ICT infrastructure investment	4.1	3.5	10	7.2

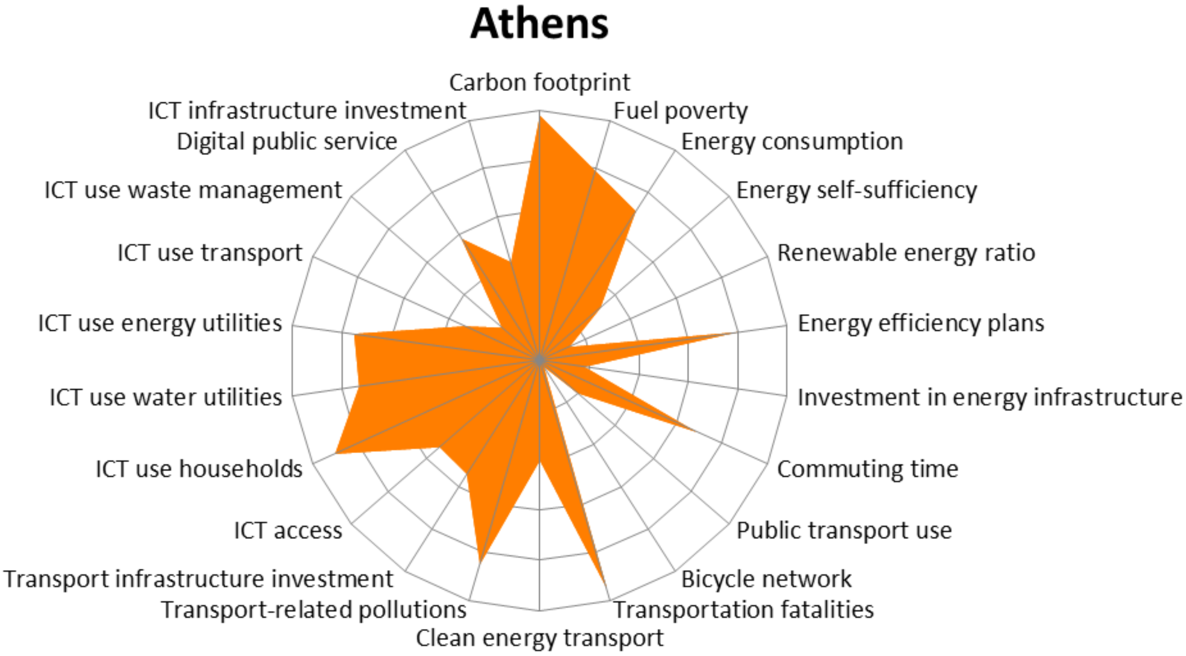


Figure 2.5: City Amberprint of Athens. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Amber City Index has a score of 4.7.

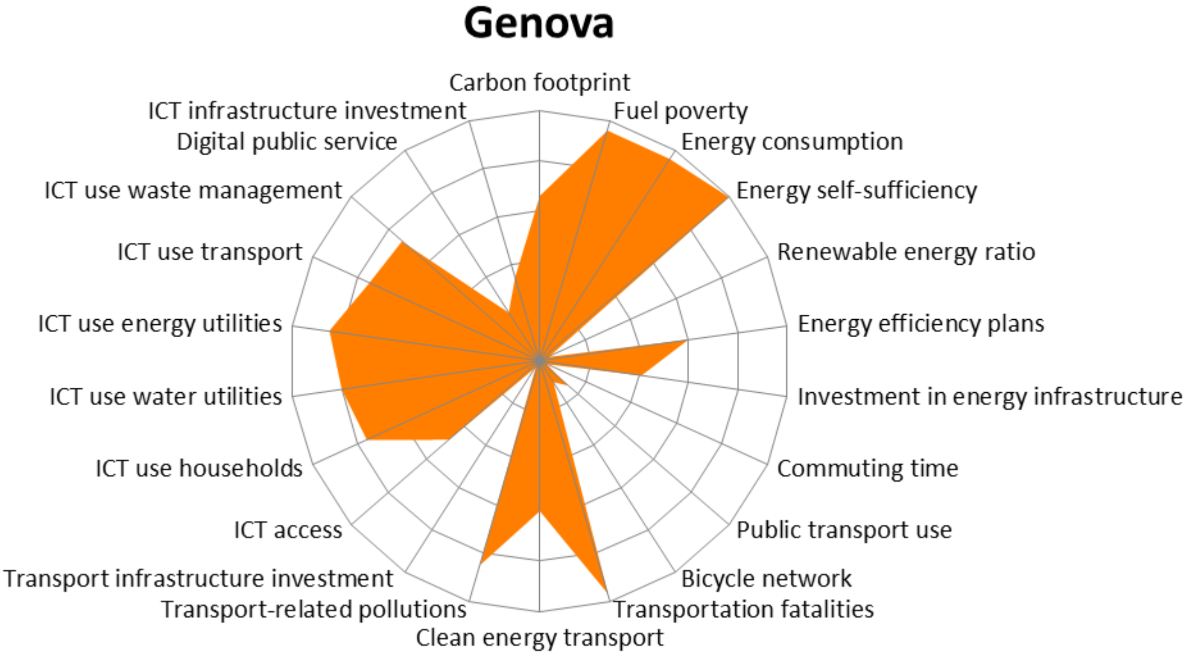


Figure 2.6: City Amberprint of Genoa. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Amber City Index has a score of 4.4.

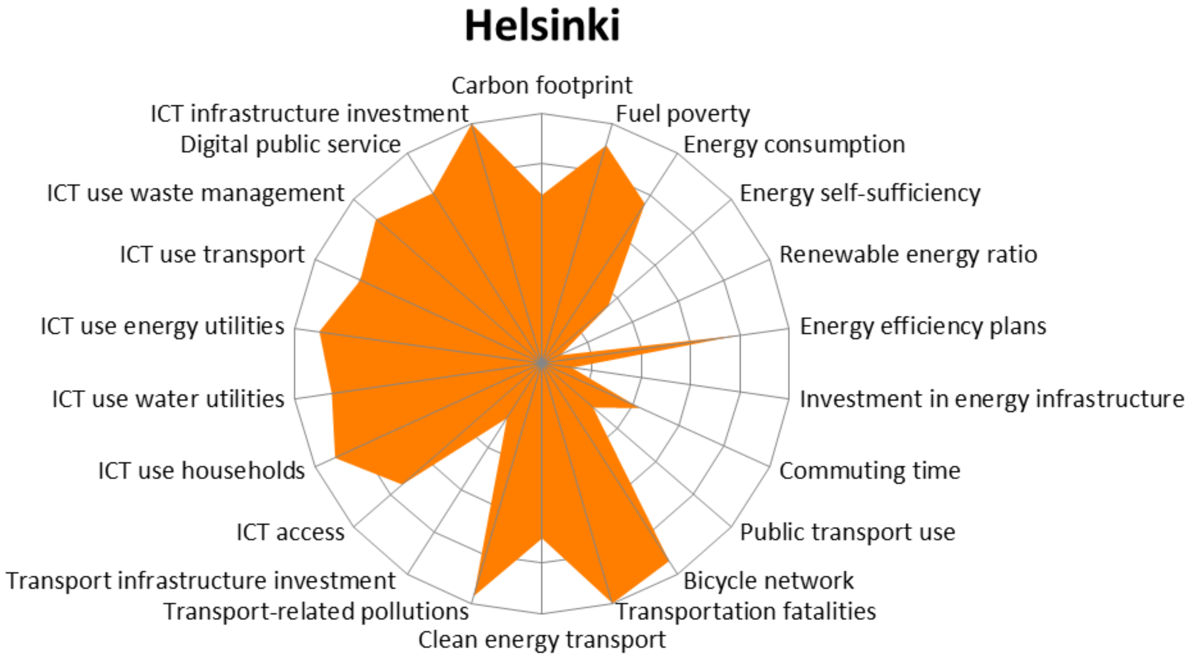


Figure 2.7: City Amberprint of Helsinki. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Amber City Index has a score of 6.1.

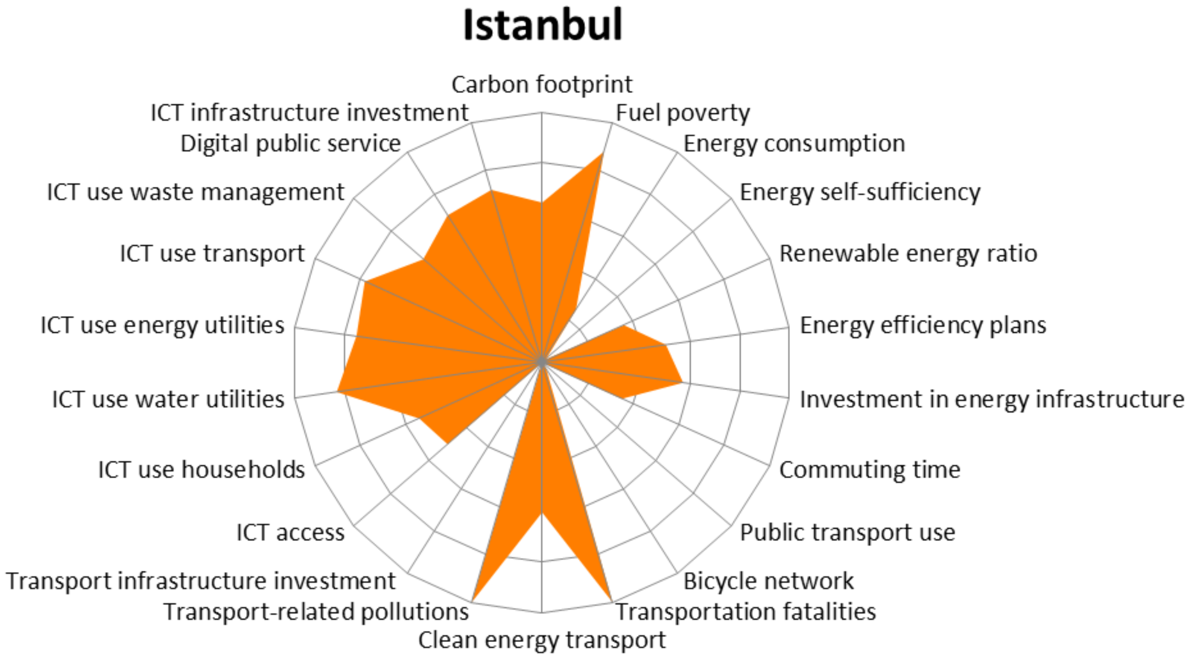


Figure 2.8: City Amberprint of Istanbul. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Amber City Index has a score of 4.1.

3 The City Blueprint Direct Links

In this chapter direct links between each City Blueprint indicator and water, waste, energy, transport and ICT are described. These direct links were extracted from each case study city and summarized here. In some cases one or more aspects are greyed out to avoid self-reference.

I – Water Quality

3.1.1 Indicator 1 – Secondary WWT

Table 3.1: Indicator 1 – Secondary WWT – Direct links

Water	▨
Waste	Sewage sludge can be incinerated
Energy	The resulted sludge and biogas are used in energy generation. Energy is required for secondary waste water treatment plant.
Transport	Transport is used to empty the septic tanks. Biogas to fuel.
ICT	ICT used in treatment technology will increase the efficiency of plants by controlling them.

3.1.2 Indicator 2 – Tertiary WWT

Table 3.2: Indicator 2 – Tertiary WWT – Direct links

Water	▨
Waste	no direct links identified
Energy	Energy is required for tertiary waste water treatment plant.
Transport	no direct links identified
ICT	ICT used in treatment technology will increase the efficiency of plants by controlling them.

3.1.3 Indicator 3 – Groundwater quality

Table 3.3: Indicator 3 – Groundwater quality – Direct links

Water	▨
Waste	Landfills may pollute groundwater especially, for example, in many cities historical industrial waste or mining has led to pollution of the groundwater.
Energy	Energy is required to improve soil and groundwater quality.
Transport	The vehicles cause build-up of pollution on the roads which may reach ground water resources during wash off by surface runoff. As a result, the ground water quality decreases.
ICT	ICT can be used in monitoring groundwater quality.

II – Solid waste treatment

3.1.4 Indicator 4 – Solid waste collected

Table 3.4: Indicator 4 – Solid waste collected – Direct links

Water	Poor waste collection results in contamination of drinking watersheds, e.g. if solid waste is not collected, water quality in cities, rivers, canals and ultimately the ocean is affected
Waste	
Energy	Mixed waste is incinerated, municipal sludge digested for biogas. Maximized energy recovery producing both power and heat.
Transport	Transport is used to move solid waste.
ICT	ICT management can be used in effective solid waste collection.

3.1.5 Indicator 5 – Solid waste recycled

Table 3.5: Indicator 5 – Solid waste recycled – Direct links

Water	Reduces surface water pollution by untreated solid waste, e.g. plastic bags.
Waste	
Energy	Energy is required to recycle waste, on the other hand waste can be incinerated to generate heat or electricity
Transport	Recycled waste collection is made via transportation.
ICT	ICT management can be used in effective solid waste recycling.

3.1.6 Indicator 6 – Solid waste energy recovery

Table 3.6: Indicator 6 – Solid waste energy recovery – Direct links

Water	All solid waste that is collected and incinerated with energy recovery reduces the impact of solid waste on surface water pollution
Waste	
Energy	
Transport	Transport is required to collect solid waste.
ICT	ICT management can be used in effective solid waste energy recovery.

III – Basic water services

3.1.7 Indicator 7 – Access to drinking water

Table 3.7: Indicator 7 – Access to drinking water – Direct links

Water	
Waste	Access to clean drinking water reduces the use of bottled water. Bottled water often generates a lot of collected or uncollected plastic that may pollute the aquatic environment.
Energy	Supply of drinking water requires energy.
Transport	Access to piped drinking water reduces water trucks or transportation of bottled water
ICT	ICT tools are used for efficient water distribution system management, e.g. leakage reduction, energy optimization, maintenance and planning.

3.1.8 Indicator 8 – Access to sanitation

Table 3.8: Indicator 8 – Access to sanitation – Direct links

Water	
Waste	If access to sanitation is lacking, sewage cannot be collected and the sludge may seriously affect the aquatic environment
Energy	Energy is required to move wastewater. Energy is required to move waste water if access to sanitation infrastructure is lacking
Transport	Decreases the need to transport wastewater. Access to piped sanitation system decreases the need to transport waste water
ICT	ICT based automation and control for optimised operations of drainage and the WWT plants enables energy efficient operations and minimises bypasses of the treatment processes.

3.1.9 Indicator 9 – Drinking water quality

Table 3.9: Indicator 9 – Drinking water quality – Direct links

Water	
Waste	Leachate from waste can contaminate drinking water resources, especially when surface water is used to produce drinking water
Energy	Energy is required to treat potable water at treatment works. Different technologies require different input of energy.
Transport	Decreases the need to transport bottled water.
ICT	ICT enables to run treatment process in an optimal matter and monitor water quality along the distribution system.

IV – Solid waste treatment

3.1.10 Indicator 10 – Nutrient recovery

Table 3.10: Indicator 10 – Nutrient recovery – Direct links

Water	
Waste	Reduces waste (no need for sludge incineration).
Energy	Energy is required to make nutrient recovery in waste water treatment plants; digestion of sludge and biogas utilisation. Nutrient recovery from waste water has the potential to strongly decrease energy use for phosphate mining and production
Transport	Nutrient recovery from waste water has the potential to strongly reduce global transportation of phosphate from mines in Chili and Morocco
ICT	ICT management can be used to control nutrient recovery in waste water treatment plant.

3.1.11 Indicator 11 – Energy recovery WWT

Table 3.11: Indicator 11 – Energy recovery – Direct links

Water	
Waste	Sludge can be treated as waste and incinerated
Energy	
Transport	Biogas to fuel.
ICT	ICT management can be used to control energy recovery in waste water treatment plant.

3.1.12 Indicator 12 – Sewage sludge recycling

Table 3.12: Indicator 12 – Sewage sludge recycling – Direct links

Water	
Waste	Reduces waste (no need for sludge incineration)
Energy	Sludge used as fertilizer has the potential to strongly decrease energy use for fertilizer production
Transport	Sludge utilisation sometimes requires transportation.
ICT	ICT management can be used to control sewage sludge recycling in waste water treatment plant.

3.1.13 Indicator 13 – Energy efficiency

Table 3.13: Indicator 13 – Energy efficiency – Direct links

Water	
Waste	Reduces waste (no need for sludge incineration)
Energy	
Transport	Biogas to fuel.
ICT	ICT management can be used in efficient energy management.

V – Infrastructure

3.1.14 Indicator 14 – Average sewer age

Table 3.14: Indicator 14 – Average sewer age – Direct links

Water	
Waste	No direct links identified
Energy	Old infrastructure requires more energy for maintenance and transport of wastewater, e.g. old infrastructures are often combined sewers which require more energy to treat the waste water that is 'diluted' with rainwater. Moreover, less sewage sludge is abstracted leading to reduced energy recovery yield
Transport	Maintenance and repair work disrupt traffic.
ICT	ICT management can be used in sewer system design, operation and maintenance.

3.1.15 Indicator 15 – Operating costs recovery (ratio)

Table 3.15: Indicator 15 – Operating costs recovery (ratio) – Direct links

Water	
Waste	No direct links identified
Energy	Energy cost impacts this indicator.
Transport	No direct links identified
ICT	ICT facilitates financial management and accurate information.

3.1.16 Indicator 16 – Water system leakages

Table 3.16: Indicator 16 – Water system leakages– Direct links

Water	
Waste	No direct links identified
Energy	Requires more energy to compensate for the water losses caused by leakages in the water distribution system.
Transport	Heavy transport may cause pipe breakages. Leaks from pipes can cause road surface damage and traffic interruption.
ICT	ICT helps to identify, predict and fix leaks.

3.1.17 Indicator 17 – Stormwater separation

Table 3.17: Indicator 17 – Stormwater separation – Direct links

Water	
Waste	May impact mass of sludge to be incinerated
Energy	Separated infrastructures lead to more concentrated waste flows to the waste water treatment facility. The higher concentration makes the treatment process much more energy efficient.
Transport	No direct links identified
ICT	ICT tools can be used for planning and design of the separation systems.

VI – Climate robustness

3.1.18 Indicator 18 – Green space

Table 3.18: Indicator 18 – Green space – Direct links

Water	
Waste	Green and blue spaces are contaminated by uncollected waste. At the same time, green spaces reduce groundwater pollution by solid waste as biological soil processes enhance breakdown of pollutants and filter the water
Energy	Green space reduces urban heat island effect which in turn reduces energy use of cooling devices.
Transport	Competition between space for transport network and green and blue spaces.
ICT	ICT tools can be used for planning and design of green and blue spaces.

3.1.19 Indicator 19 – Climate adaptation

Table 3.19: Indicator 19 – Climate adaptation – Direct links

Water	Reduces water consumption.
Waste	Reduces waste generation.
Energy	Reduces energy consumption.
Transport	Reduces need for transport and vulnerability to flooding.
ICT	ICT tools can be used to plan and design climate adaptation measures.

3.1.20 Indicator 20 – Drinking water consumption

Table 3.20: Indicator 20 – Drinking water consumption – Direct links

Water	
Waste	No direct links identified
Energy	Energy is consumed by water pumping stations distributing water around the network.
Transport	Consumption of bottled water strongly increases need for transport
ICT	ICT facilitates advanced participatory demand management.

3.1.21 Indicator 21 – Climate robust buildings

Table 3.21: Indicator 21 – Climate robust buildings – Direct links

Water	Reduces water consumption.
Waste	Reduces waste generation.
Energy	Energy is produced and then returned back to the energy distribution network. Moreover, energy is saved by better insulation, heat storage (in the ground), green roofs, etc.
Transport	No direct links identified
ICT	ICT tools are used for planning, design and management of buildings.

VII – Governance

3.1.22 Indicator 22 – Management and action plans

Table 3.22: Indicator 22 – Management and action plans – Direct links

Water	
Waste	Action plans to properly manage solid waste may prevent water pollution by uncollected solid waste or improper landfill management.
Energy	Efficient water management saves energy (water-energy nexus).
Transport	Efficient water resources management prevents flooding. Waterways should be included into transport policy.
ICT	ICT is a fundamental tool in implementing efficient management and action plans.

3.1.23 Indicator 23 – Public participation

Table 3.23: Indicator 23 – Public participation – Direct links

Water	People have more tools to get informed about water topics. It increases awareness.
Waste	People have more tools to get informed about waste topics. It increases awareness.
Energy	People have more tools to get informed about energy topics. It increases awareness.
Transport	People have more tools to get informed about transport topics. It increases awareness.
ICT	People have more tools to get informed about ICT topics. It increases awareness.

3.1.24 Indicator 24 – Water efficiency measures

Table 3.24: Indicator 24 – Water efficiency measures – Direct links

Water	
Waste	Reduces waste (no need for sludge incineration)
Energy	Water efficiency measures reduce energy consumption.
Transport	No direct links identified
ICT	ICT is a fundamental tool in introducing water efficiency measures.

3.1.25 Indicator 25 – Attractiveness

Table 3.25: Indicator 25 – Attractiveness – Direct links

Water	
Waste	Uncollected waste reduces attractiveness of water infrastructure. Furthermore, waste can be collected and transported by ships.
Energy	No direct links identified
Transport	Waterways can be utilized for industrial and recreational purposes.
ICT	ICT tools can be used for planning and design to improve attractiveness of the city.

4 The City Amberprint Direct Links

In this chapter direct links between each City Amberprint indicator and water, waste, energy, transport and ICT are described. These direct links were extracted from Deliverable D3.1. and each case study city and summarized here. In some cases one or more aspects are greyed out to avoid self-reference.

Energy indicators

4.1.1 Indicator 1 – Carbon footprint

Table 4.1: Indicator 1 – Carbon footprint – Direct links

Water	Energy is used to pump clean water and wastewater; energy can be generated from wastewater or from clean water (turbines)
Waste	Waste disposal contributes to CO_2 emissions (e.g. landfill sites), reuse and recycling can reduce CO_2 emissions
Energy	
Transport	Transport generates CO_2 (e.g. from combustion engines)
ICT	ICT can improve efficiency of many processes/plants which generate CO_2 (e.g. by more energy efficient operation)

4.1.2 Indicator 2 – Fuel poverty

Table 4.2: Indicator 2 – Fuel poverty – Direct links

Water	Using hydropower more may decrease the cost of energy for households and therefore decrease the percentage of fuel poor households.
Waste	Waste can be considered as fuel, for example using landfill gas to produce energy may decrease the cost of energy for households and therefore decrease the percentage of fuel poor households.
Energy	
Transport	Cost of transport can affect fuel poverty.
ICT	Can alleviate the fuel poverty by efficient use of energy

4.1.3 Indicator 3 – Energy consumption

Table 4.3: Indicator 3 – Energy consumption – Direct links

Water	Water usage contributes to energy consumption, for example energy is used to supply drinking water to the households and to collect waste water. Furthermore, energy is used in drinking and waste water treatment plants and water supply systems.
Waste	Lower energy consumption reduces combustion waste. The quantity of waste produced affects the energy consumption of the waste treatment and disposal processes.
Energy	
Transport	Transport contributes to energy consumption. Green transport reduces energy demand for transportation.
ICT	ICT can improve efficiency of many processes/plants (e.g. smart building technologies built on ICT systems can make building design, construction and operation more energy efficient)

4.1.4 Indicator 4 – Energy self-sufficiency

Table 4.4: Indicator 4 – Energy self-sufficiency – Direct links

Water	Energy is used to pump clean water and wastewater; energy can be generated from wastewater or from clean water (turbines)
Waste	Some of the energy demand could be obtained from waste incineration. Organic waste and bio-masses can be seen as a renewable source of bio-gas (for instance, when added to sludge in the process of codigestion)
Energy	
Transport	Hybrid vehicles are capable of producing part of the energy they use for motion
ICT	No direct links identified

4.1.5 Indicator 5 – Renewable energy ratio

Table 4.5: Indicator 5 – Renewable energy ratio – Direct links

Water	Hydro electrical power dams produce electricity. Bio gas in waste water treatment plant generates energy.
Waste	Some of the energy demand could be obtained from waste (e.g. sludge can be used to produce energy). Various forms of waste to energy applied. Municipal solid mixed waste is incinerated with energy recovery. Biogas is produced from sludge at the WWTPs. The waste water plant also receives sludge from grease separation tanks from restaurants and kitchens which is codigested with the municipal sludge boosting biogas production. HSY landfill gas is utilised for power production. This power plant is one of the largest utilization plants of landfill gas in Europe.
Energy	
Transport	Electric vehicles and trains (electricity from hydropower). Biogas buses.
ICT	ICT management systems can be used effectively in renewable energy generation

4.1.6 Indicator 6 – Energy efficiency plans

Table 4.6: Indicator 6 – Energy efficiency plans – Direct links

Water	Water efficient appliances can contribute to efficient energy use. There are engineering solutions which reduce energy consumption, for example the tunnel through which Helsinki drinking water is drawn slopes slightly downhill so that water flows naturally. Water from the southern portion of Lake Päijänne is of rather good quality at the water tunnel intake and is usually drinkable without processing.
Waste	Some of the energy demand could be obtained from waste (e.g. waste incineration) Energy is produced using landfill gas in the main landfill of Athens metropolitan area (Liosion). Encouragement and placement of emphasis for reuse and recycle processes will result in decrease in energy usage for waste disposal.
Energy	
Transport	Energy efficient means of public and private transportation (bio-gas powered bus and coaches, high efficient car engines, hybrid vehicles, etc.)
ICT	ICT can improve efficiency of many processes/plants (e.g. through running heating or cooling according to each occupant's needs)

4.1.7 Indicator 7 – Energy infrastructure investment

Table 4.7: Indicator 7 – Energy infrastructure investment – Direct links

Water	Investment in the energy infrastructure can prompt water utilities to carry out the necessary work (e.g. replacing old pipes, or installing new ones). Water can be used for central heating and cooling, biogas equipment at waste water plants.
Waste	Example of investment which in waste sources for producing energy: incineration of waste, landfill gas projects, biogas to vehicle fuel
Energy	
Transport	Road works associated with investment in the energy infrastructure may disturb transport
ICT	Investment in the energy infrastructure can prompt ICT companies to carry out the necessary work

Transport indicators

4.1.8 Indicator 8 – Commuting time

Table 4.8: Indicator 8 – Commuting time – Direct links

Water	Transportation by means of waterways in Istanbul shortens commuting time significantly in rush hours.
Waste	Uncollected solid waste may slow down traffic
Energy	Availability of energy can affect the commuting time, for example metro, metro bus lines, trams and the operation of traffic lights are operated by using energy.
Transport	
ICT	ICT can improve efficiency of managing transport in the city reducing commuting time

4.1.9 Indicator 9 – Public transport use

Table 4.9: Indicator 9 – Public transport use – Direct links

Water	Can be used as infrastructure for transportation
Waste	Can be used as a fuel for public transport
Energy	Energy is required for transportation
Transport	
ICT	ICT can improve efficiency of managing transport in the city

4.1.10 Indicator 10 – Bicycle network

Table 4.10: Indicator 10 – Bicycle network – Direct links

Water	good bicycle paths are often along canals
Waste	No directs links identified
Energy	Bicycle transport results in decrease vehicle transport, and hence energy usage
Transport	
ICT	ICT tools can be used to plan optimal bicycle network

4.1.11 Indicator 11 – Transportation fatalities

Table 4.11: Indicator 11 – Transportation fatalities – Direct links

Water	No direct links identified
Waste	No direct links identified
Energy	No direct links identified
Transport	
ICT	ICT can improve efficiency of managing transport in the city (e.g. high speed prevention, cruise control)

4.1.12 Indicator 12 – Clean energy transport

Table 4.12: Indicator 12 – Clean energy transport – Direct links

Water	Clean transportation reduces water pollution and purification costs
Waste	No direct links identified
Energy	Clean energy means of transport reduce the exploitation of other energy sources
Transport	
ICT	ICT can help to plan to achieve higher level of efficiency of transport

4.1.13 Indicator 13 – Transport-related pollutions

Table 4.13: Indicator 13 – Transport-related pollutions – Direct links

Water	Pollutants from road surfaces contaminate drainage water
Waste	Trucks used for collection and transportation of waste cause pollution.
Energy	No direct links identified
Transport	
ICT	ICT can improve efficiency of managing transport in the city

4.1.14 Indicator 14 – Transport infrastructure investment

Table 4.14: Indicator 14 – Transport infrastructure investment – Direct links

Water	Investment in transport infrastructure, e.g. by refurbishing roads, may prompt water utilities to carry out necessary works. Water is required in transport infrastructure implementation.
Waste	No direct links identified
Energy	Investment in transport infrastructure may prompt energy utilities to carry out necessary works. Energy is required in transport infrastructure implementation.
Transport	
ICT	Investment in transport infrastructure may prompt ICT companies to carry out necessary works

ICT indicators

4.1.15 Indicator 15 – ICT access

Table 4.15: Indicator 15 – ICT access – Direct links

Water	People have more tools to get informed about water topics. It increases awareness
Waste	People have more tools to get informed about waste topics. It increases awareness
Energy	People have more tools to get informed about energy topics. It increases awareness
Transport	People have more tools to get informed about transport topics, for example access to information about public transport, traffic, or available routes. ICT may reduce the need for transportation, for example using videoconferencing
ICT	

4.1.16 Indicator 16 – ICT use households

Table 4.16: Indicator 16 – ICT use households – Direct links

Water	People have more tools to get informed about water topics. It increases awareness
Waste	People have more tools to get informed about waste topics. It increases awareness
Energy	People have more tools to get informed about energy topics. It increases awareness
Transport	People have more tools to get informed about transport topics, for example access to information about public transport, traffic, or available routes. ICT may reduce the need for transportation, for example using videoconferencing
ICT	

4.1.17 Indicator 17 – ICT use water utilities

Table 4.17: Indicator 17 – ICT use water utilities – Direct links

Water	
Waste	ICT can reduce waste production from water and wastewater treatment plants
Energy	The ICT use by water utilities can help them in achieving an optimized management with potential saving in energy consumption
Transport	No direct links identified
ICT	

4.1.18 Indicator 18 – ICT use energy utilities

Table 4.18: Indicator 18 – ICT use energy utilities – Direct links

Water	ICT can be used to optimise water usage in energy production
Waste	ICT can be used to optimise generation energy from waste
Energy	
Transport	No direct links identified
ICT	

4.1.19 Indicator 19 – ICT use transport

Table 4.19: Indicator 19 – ICT use transport – Direct links

Water	No direct links identified
Waste	No direct links identified
Energy	The use of ICT in transport management can help reducing travel times and energy consumption
Transport	
ICT	

4.1.20 Indicator 20 – ICT use waste management

Table 4.20: Indicator 20 – ICT use waste management – Direct links

Water	ICT used in landfill systems controls the leachate better which results in less contamination of water resources.
Waste	
Energy	ICT used in waste management is helpful to reduce waste collection and transportation time and also energy.
Transport	ICT used in waste management decreases the number of waste collection vehicles in the traffic.
ICT	

4.1.21 Indicator 21 – Digital public service

Table 4.21: Indicator 21 – Digital public service – Direct links

Water	Fast communication with water related public offices via digital public services
Waste	Fast communication with waste related public offices via digital public services
Energy	Fast communication with energy related public offices via digital public services
Transport	Digital public services imply a reduced number of visits of customers and citizens to public offices, with benefits in terms of traffic congestion
ICT	

4.1.22 Indicator 22 – ICT infrastructure investment

Table 4.22: Indicator 22 – ICT infrastructure investment – Direct links

Water	Investment in ICT infrastructure, e.g. by refurbishing roads, may prompt water utilities to carry out necessary works. Investment in ICT infrastructure increases ICT used in drinking and waste water management. Therefore, people have more tools to get informed about water topics. It increases awareness.
Waste	Investment in ICT infrastructure increases ICT used in waste management. Therefore, people have more tools to get informed about waste topics. It increases awareness.
Energy	Investment in ICT infrastructure, e.g. by refurbishing roads, may prompt energy utilities to carry out necessary works. Investment in ICT infrastructure increases ICT used in energy. Therefore, people have more tools to get informed about energy topics. It increases awareness.
Transport	Road works associated with investment in the ICT infrastructure may disturb transport. Investment in ICT infrastructure increases ICT used in transportation. Therefore, people have more tools to get informed about traffic and public transport. It improves commuting time.
ICT	

5 Conclusion

The results of the City Amberprint, City Blueprint and Trends and pressures of Helsinki, Genova, Athens and Istanbul show interesting similarities (Fig. 5.1). The Amber City Index and the Blue City Index are both performance indicators and their approximately equal overall scores are promising results that could indicate that the patterns of development for energy, transport , ICT, water, solid waste and climate adaptation have many similarities emphasizing their interconnectivity and mutual dependencies. It also indicates that higher social, environmental and financial pressures generally result in low performances in most sectors. More city assessments employing both methods and complementary in-depth case studies are needed to confirm the hypothesis that smart cities are also water-wise cities. Both the City Amberprint and City Blueprint provide valuable, integrated, communicative and much needed empirical information that can help cities plan and continuously evaluate their current policies. Both methods have the potential to strongly contribute to the European urban agenda by providing city-to-city comparisons, quick identification of pitfalls and opportunities, and providing useful heuristic tools to support integrated policy and decision making in cities. The City Amberprint and City Blueprint also show the large learning potential of exchanging best practices, experiences and knowledge between cities. The City Amberprint and City Blueprint tools provide an important first step in seizing these opportunities by connecting cities (winning by twinning) in Europe and beyond. This report also shows the linkages between elements of each sector. It therefore provides an integrated perspective, highly needed to combine sectoral policy and seize opportunities for smartly combining different goals in order to gain efficiency, effectiveness win-win solutions for energy, transport, ICT, water, solid waste and climate adaptation in cities.

In the next sections a concise summary of the highlight of the City Amberprint, City Blueprint and Trends and Pressure assessments of Helsinki Genova, Athens and Istanbul will be provided.

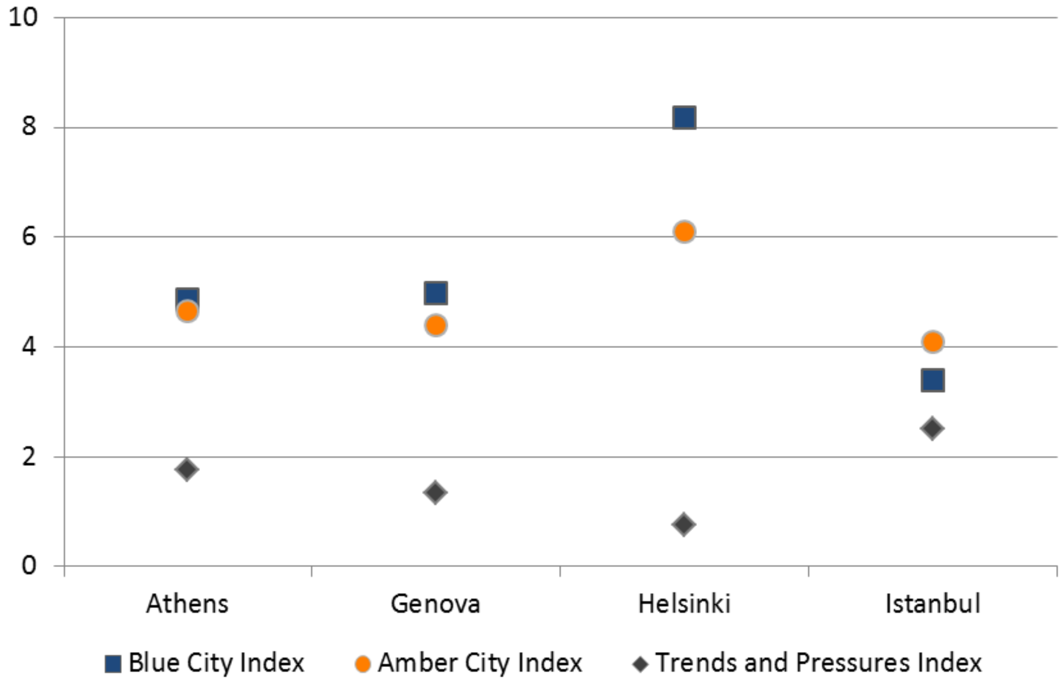


Figure 5.1: Comparison of the Blue City Index, the Amber City Index and the Trends and Pressures Index for the four case study cites. Please note that the Trends and Pressure scores range from 0 (no concern) to 4 points (great concern)

Trends and Pressures Concerns

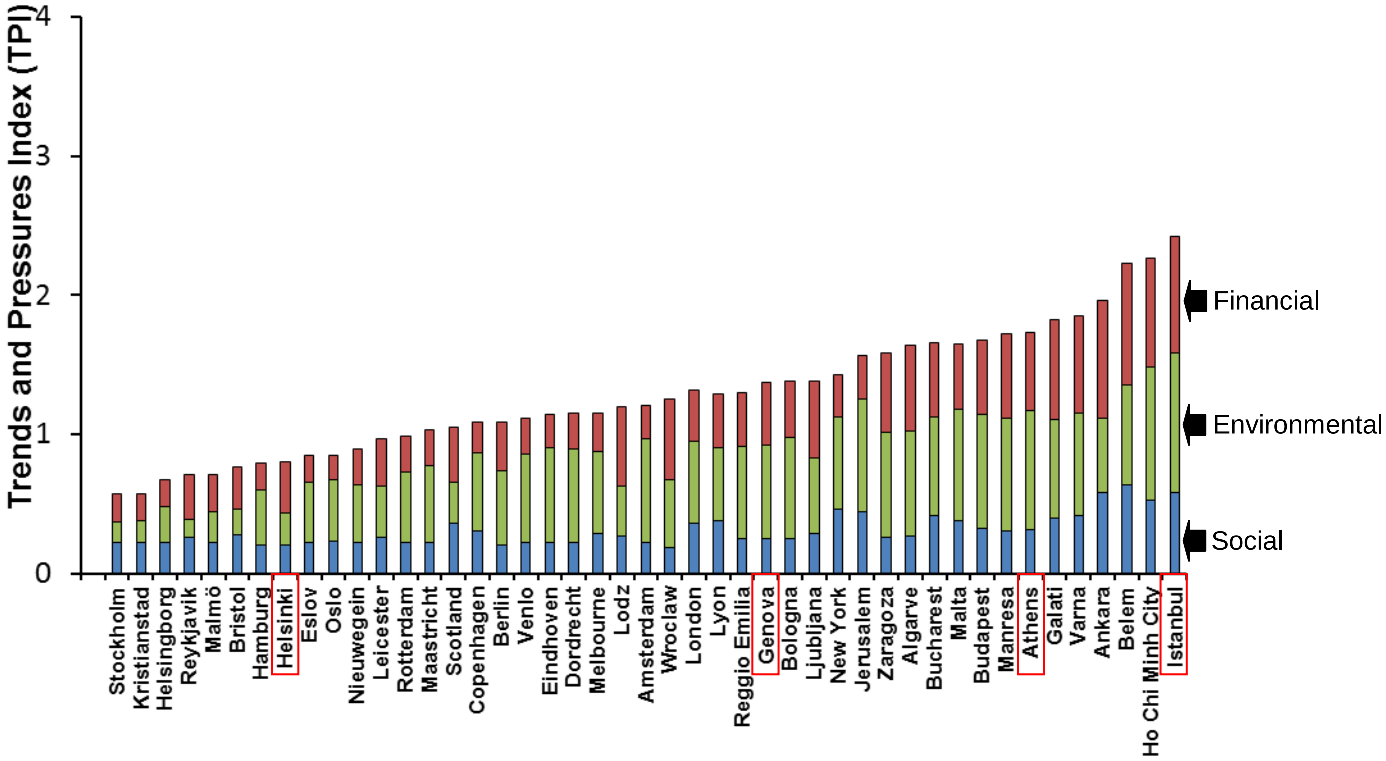


Figure 5.2: Trends and Pressures Index (Koop, S.H.A. and Van Leeuwen, C.J. 2015)

The Trends and Pressure assessment (Fig. 5.2) shows that the city of Istanbul is subject to many financial, environmental and social pressures. Flood vulnerability is of great concern of Istanbul. Moreover, the capacity of flood protection works is insufficient to ensure long term flood safety (Duman et al. 2005). The sea level rise together with the reports of land subsidence pose imminent threats (Karaca and Nicholls 2008). Furthermore, the percentage of the soil that is sealed with impermeable concrete and asphalt is high making the city vulnerable to urban drainage flooding. Finally the inflation rate of Turkey is high (World Bank 2014), which may impede long-term investments in water infrastructure, flood protection measures and heat adaptation measures.

Genova experiences moderate pressure, especially Urban Heat Islands and the unemployment rate which are concerns that may affect the city

Athens experiences moderate to great pressure. In particular, flood risk, urban heat islands, economic pressure and unemployment are of concern or even of great concern.

Helsinki has only minor pressures that may affect the city. It is one of the lowest of the 45 municipalities and regions assessed.

Blueprint performance

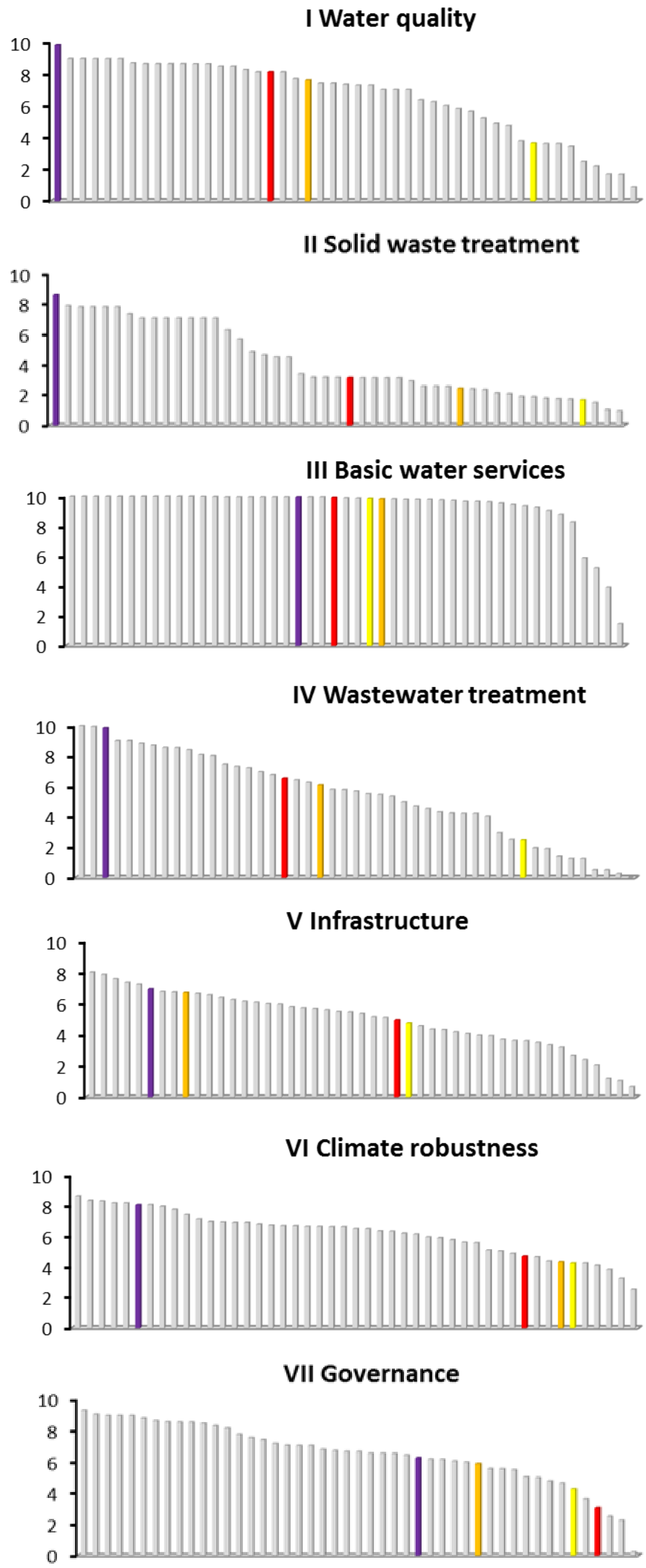


Figure 5.3: Category ranking of the City Blueprints of Athens (orange), Genova (red), Helsinki (purple) and Istanbul (yellow). The arithmetic average of the indicator scores for each of the seven categories are ranked from high to low for each of the 4 cities and compared with other cities. (Koop, S.H.A. and Van Leeuwen, C.J. 2015))

In Figure 5.3 the four case study cities were compared to other cities assessed during Task 2.2. The average for each category in the City Blueprint was calculated. On average, Helsinki is performing well or very well in each of the seven categories (leading in Water quality, Solid waste treatment and wastewater treatment). Athens scored well in the Infrastructure category, otherwise receiving average scores. Istanbul is facing significant challenges as can be seen in the Trends and Pressures Framework (Figure 5.2). Genova average scores are in between Helsinki, Athens and Istanbul. It faces some challenges, such as Governance, similar to Istanbul, but on the other hand has some similarities, such as Basic Water Services, as is the case with Helsinki.

Amberprint Performance

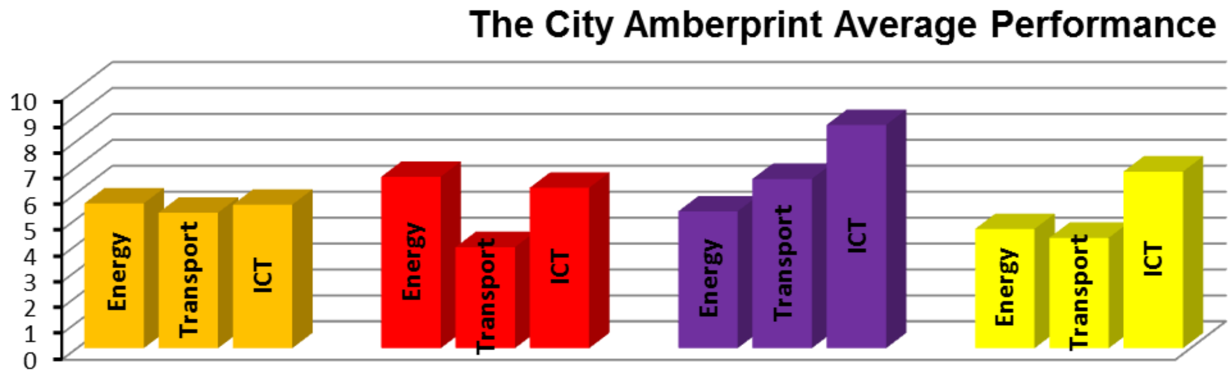


Figure 5.4: Category performance of the City Amberprints of Athens (orange), Genoa (red), Helsinki (purple) and Istanbul (yellow). The arithmetic average of the indicator scores for each of the three categories (BlueSCities, 2016)

In Figure 5.4 the City Amberprint average performance for energy, transport and ICT is presented. It is clearly visible, that Athens has similar results in all three aspects. In Genova the transport aspect falls behind the other two. Helsinki and Istanbul are, on average, performing better in the ICT category.

Simple statistical analysis of the case study results

This is the first attempt to qualitatively assess relationships between different measures and cities. The analysis is not statistically significant because only four cities are analysed. However, it gives some insight into the relationships.

Table 5.1: Correlation between cities with respect to City Blueprint

	Athens	Genova	Helsinki	Istanbul
Athens	1			
Genova	0.44	1		
Helsinki	0.19	0.60	1	
Istanbul	0.61	0.33	0.04	1

Table 5.1 shows that Athens and Istanbul have a strong correlation (0.61) with respect to the City Blueprint performance. The weakest correlation is between Helsinki and Istanbul (0.04). Genova is the most interesting city as it has a comparatively strong correlation with Helsinki (0.6), but at the same time moderate correlations with Athens (0.44) and Istanbul (0.33).

Table 5.2: Correlation between cities with respect to City Amberprint

	Athens	Genova	Helsinki	Istanbul
Athens	1			
Genova	0.50	1		
Helsinki	0.47	0.52	1	
Istanbul	0.52	0.52	0.61	1

Correlations between cities with respect to the City Amberprint are quite similar (Table 5.2). This is very interesting as there were significant differences with respect to the City Blueprint indicators.

Table 5.3: Correlation between Blue City Index (BCI), Amber City Index (ACI) and Trends and Pressures Index (TPI)

	BCI	ACI	TPI
BCI	1		
ACI	0.98	1	
TPI	-0.93	-0.84	1

A strong correlation between the City Blueprint performance and the City Amberprint performance can be observed (Table 5.3). However, it is striking that there is very strong negative correlation between BCI and TPI. Considering this and previous conclusions from Tables 5.1 and 5.2 it is easier to overcome Trends and Pressure circumstances in order to improve the City Amberprint performance than the City Blueprint performance.

The water related infrastructure has the highest value compared to the energy, transport and ICT sectors in terms of the existing assets as well as future investment needs (Table 5.4). In the World as a whole the required future investment up to 2030 was forecasted in the UNEP report (UNEP, 2013) and is summarised in the table below with water systems as requiring a $22.6 trillion investment, more that energy and transport put together.

Table 5.4: Required future investment up to 2030

Infrastructure	Costs (in trillion US$)
Water systems	22.6
Energy	9
Road and rail infrastructure	7.8
Air- and sea-ports	1.6

This clearly highlights the urgent need to include water and waste within the smart city concept.

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Annex A – Athens Report

Deliverable Title	**D3.2a Report on the Athens case study**
Deliverable Lead:	National Technical University of Athens
Related Work Package:	WP3: City Case Studies
Related Task:	T3.2: Case-studies
Author(s):	Ifigeneia Koutiva, Christos Makropoulos, Kees van Leeuwen, Stef Koop and Anna Strzelecka
Dissemination Level:	Public/Confidential
Due Submission Date:	31.01.2016
Actual Submission:	14.04.2016
Project Number	642354
Instrument:	Coordination and Support Action
Start Date of Project:	01.02.2015
Duration:	24 months
Abstract	The key objective was to assess the city of Athens, Greece using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Athens has a Blue City Index score of 6.4 with basic water services receiving the highest scores and solid waste treatment the lowest. Additionally, Athens has an Amber City Index of 4.7 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 5.5. The financial and debt crisis in Greece has affected greatly the sustainable development of all development sectors in the capital of Athens.

Project funded by the European Commission as part of the EU Framework Programme for Research and Innovation

Table of Contents

Versioning and Contribution History

D3.2 V0.1 – Anna Strzelecka template for the report 22/01/2016

D3.2 V0.2 – Ifigeneia Koutiva and Christos Makropoulos, NTUA, incorporation of Trends and Pressures and Blueprint report (provided by Kees van Leeuwen and Stef Koop) and the Amberprint report (provided by Ifigeneia Koutiva and Christos Makropoulos) into one report 12/02/2016

D3.2 V0.3 – Integration of revision comments from Stef Koop (Ifigeneia Koutiva, NTUA) 04/04/2016

Executive Summary

The key objective was to assess the city of Athens, Greece using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Athens has a Blue City Index score of 6.4 with basic water services receiving the highest scores and solid waste treatment the lowest. Additionally, Athens has an Amber City Index of 4.7 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 5.5. The financial and debt crisis in Greece has affected greatly the sustainable development of all development sectors in the capital of Athens.

1 Introduction

Athens is the capital and the largest city of Greece with approximately 5,000,000 inhabitants. Athens is in a water scarce area: Western Greece is the wet part of the country while Eastern Greece (where Athens is situated) is much drier with most of the demand for water and almost all of the population. Athens' climate is characterised by mild wet winters and dry summers, with an overall low annual rainfall (long term annual average of the past 100 years = 400 mm) (Mamasis and Koutsoyiannis, 2007).

One of the greatest issues of the metropolitan area of Athens is the waste management with 35 uncontrolled waste disposal sites (EEA, 2015). Additionally, the air pollution and the lack of air circulation in Athens, due to its geographic characteristics, enhance the urban heat island effect, which increases during summer (EEA, 2015). The European Green Cities Index (Siemens, 2009) ranked Athens 22nd out of 30 countries with a score of 53.09 out of 100 with the lowest scores for air quality, performance on waste and land use, and the green credentials of its buildings (Siemens, 2009). However, the score was reinforced by its environmental policies on water and transport (Siemens, 2009).

The country's economic crisis and prolonged recession, since 2008, is one of the main socioeconomic pressures affecting the city of Athens (Koutrolikou, 2016). All key development indicators, in Athens, have been affected. The sharp decline in per capita GDP in the 1st year of the crisis (in 2008) amounted to 122% of EU-27 GDP, the unemployment rate (from 7.30% in 2008 to 28.20% in 2012) and the concomitant reduction in the employment rate (63.4% in 2008, 51.7% in 2012) are some of the major impacts that affected Athens (PEP ATTIKIS, 2014).

On the other hand, the debt crisis had as a result the further penetration of natural gas usage and the implementation of measures and incentives for the environmental efficiency of buildings (EEA, 2015). Additionally, the National Strategic Reference Framework (NSRF) 2014-2020 has secured about 1.13 billion euros for investments in the area. The vision of the framework is to support "the social, economic and environmental reconstruction of the Attica region, with main growth drivers the cultural identity, the local productive forces and the technology and innovation poles" (PEP ATTIKIS, 2014). This objective is in line with the strategic plan of Athens for 2021 that has identified as its main objectives the urban regeneration by promoting urban rail systems, the environmental protection by reducing pressures, and the reinforcement of the business sector by promoting entrepreneurship, tourism, innovation and culture (Organismos Athinas, 2011).

Amid the worst economic crisis of Greece in modern times, Athens has to deal as well with the increasing number of refugees (The Guardian, 2016). To give an example of the ongoing crisis, between 1st of January 2016 and 29th of February 2016, 122,637 people have entered Greece, mainly from the Turkish coast to the Aegean islands and from there to the port of Piraeus and Athens, continuing their trip towards the Balkan borders (UNHCR, 2016). Even though refugees and immigrants want to leave Athens and Greece, there are fears that immigrants may be stranded in Athens for years to come adding another pressure to the already vulnerable economic environment and social structure of the Greek capital (The Guardian, 2016).

2 Trends and Pressures Framework

The trends and pressure indicators are standardized to a scale of 0-4 and divided in ordinal classes expressed as a 'degree of concern'.

Table 2.1: ***Trends and pressures*** **in Athens. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**

			0 1 2 3 4
Trends and pressures	**Social**	**1. Urbanization rate**	1
		2. Burden of disease	0
		3. Education rate	2
		4. Political instability	2
	Environmental	**5. Water scarcity**	1
		6. Flood risk	3
		7. Water quality	1
		8. Heat risk	4
	Financial	**9. Economic pressure**	3
		10. Unemployment rate	4
		11. Poverty rate	1
		12. Inflation rate	0

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Explanation of the concerns of Athens

The economic and unemployment rate are the main financial concerns in Athens. The Athens metropolitan area concentrates 39.8% of the country's unemployed, of whom 350,000 are long-term unemployed and 155,000 are young people (PEP ATTIKIS, 2014). Even though poverty rate was not assessed to be of great concern, the percentage of people at risk of poverty has increased by 42% from 2004 to 2014 (from 24% to 34%) (EUROSTAT, 2016).

Additionally, the air pollution and the lack of air circulation in Athens, enhance the urban heat island effect, which increases during summer (EEA, 2015). The flooding risk in Athens is high, with 179 casualties during the last 100 years, mainly because of anthropogenic alterations with streams converted into streets, buildings constructed over old stream beds, no priority to flood protection works and storm drainage network (which is still primitive) (Center for Climate Adaptation, 2016).

Social Pressures

2.1 Urbanization rate

Percentage of population growth either by birth or migration. The percentages are annually averages per country. Urbanization increases the pressure on integrated water resources management (IWRM) in cities.

Calculation:

The indicator is calculated as follows:

Score urbanization rate = $-0.114X^2 + 1.3275X + 0.1611$

Where X is the urbanization rate (%).For urbanization rates lower than 0% the score is also zero and the above formula is not applied.

In Athens urbanization rate is 0.6%, CIA (2014). Therefore:

Score urbanization rate = $-0.114 \cdot 0.6^2 + 1.3275 \cdot 0.6 + 0.1611 = 0.91$

Which means that urbanization is of low concern for Athens.

2.2 Burden of disease

The gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability of population growth either by birth or migration. The indicator measures the age-standardized disability-adjusted life years (DALY) per 100,000 people. DALY is the quantification of premature death, burdens of disease and disability in life years. It is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health, e.g. disease, injuries and risk factors (WHO, 2004).

Calculation:

WHO calculation of DALY

Years of premature death: Sum of the number of deaths at each age * [global standard life expectancy for each age – the actual age].

Years lost due to disability: Number of incident cases in that period * average duration of the disease * weight factor.

Years of premature death + Years lost due to disability = DALY

The average DALY per 100,000 people is a strong tool to indicate the burden of disease.

The WHO subdivided these DALY’s per 100,000 people into 5 classes. These classes are used to standardize this indicator to a score of 0 to 4 in the CBF analysis as shown below.

DALY per 100,000 people	Score
0 – 20,000	0
20,000 – 40,000	1
40,000 – 60,000	2
60,000 – 80,000	3
80,000 <	4

In Athens DALY per 100,000 people is 19627 (WHO, 2014). Which means that the burden of disease not (a considerable) concern for Athens.

2.3 Education rate

Education rate expressed as percentage of children completing their primary education

Calculation:

The indicator is calculated as follows:

Score education rate = $-10^{-5}X^{3} + 0.0012X^{2} – 0.0426X + 4.3057$

Where X is the education rate (%)

In Athens the education rate is 98%. Therefore:

Score education rate = $-10^{-5}\cdot 98^{3} + 0.0012\cdot 98^{2} – 0.0426\cdot 98 + 4.3057 = 2.24$

Which means that education rate is of medium concern for Athens. (note that definition of education rate is sometimes differently reported; World Bank 2014C))

2.4 Political instability (and absence of violence)

The estimated likelihood that the government will be destabilized or overthrown by violent means such as terrorism and politically-motivated violence of population growth either by birth or migration.

Calculation:

The indicator is calculated as follows:

4 – [(Estimated political stability score – 2.5)/(2.5 – -2.5)×4] = Score

In Athens estimated political stability score is -0.23 (World Bank 2014A). Therefore:

4 – [(-0.23 – 2.5)/(2.5 – -2.5)×4] = 1.82

Which means that the political instability (and absence of violence) is of medium concern for Athens.

Environmental Pressures

2.5 Water scarcity

Indicator 5 consists of three sub-indicators: Fresh water scarcity, Groundwater scarcity, Salinization & seawater intrusion

2.5.1 Fresh water scarcity

The abstracted fresh water as percentage of total renewable resource. This includes surface water and groundwater sources.

The scoring method is in accordance with the European Environmental Agency’s classification (OECD, 2004; WRI, 2013).

% of renewable resource abstracted	Score
0. –.2	0
2 – 10	1
10 – 20	2
20 – 40	3
>40	4

13.25% of the total renewable resource is abstracted in Greece. There Athens scores 2 points which means that fresh water scarcity is of medium concern for the city.

2.5.2 Groundwater scarcity

The abstracted groundwater as a percentage of the annual groundwater recharge. This is a measure of the pressure on groundwater resources.

Calculation:

The indicator scoring is in accordance with the classification used by UNESCO.

% abstracted of annual recharge	Score
0.- 2	0
2 - 20	1
20- 50	2
50 - 100	3
>100	4

30.95% (Aquastat 2015)

Therefore, the city of Athens scores 2 points which means that groundwater scarcity is of medium concern.

2.5.3 Salinization & seawater intrusion

Measure of the vulnerability of seawater intrusion and salinization of the soil.

Calculation method:

This indicator score is based on a quick literature check in which seawater and groundwater intrusion are scored as suggested below.

Seawater intrusion

Description	Score
No seawater intrusion reported and city not prone to (future) intrusion	0
No seawater intrusion reported and city can experience intrusion in coming century	1
No seawater intrusion reported but city is prone to intrusion in the near future	2
Seawater intrusion reported	3
Seawater intrusion reported and city is particularly prone to intrusion	4

Seawater intrusion is reported in de vicinity of Athens leading to a scores 3 points (Gounari et al. 2014).

Groundwater salinization

Based on literature studies, here the following scheme is applied to determine a score:

Description	Score
No concern	0
Low concern	1
Medium concern	2
Concern	3
Great concern	4

Groundwater salinization is a concern (3 points) for Greece as for example, it is estimated that the total surface area of aquifers impacted by seawater intrusion is about 1,500 km^2 (EASAC 2010).

The highest score of both indicators is used as the final score for salinization and seawater intrusion.

Both seawater intrusion and groundwater salinization score 3 points leading to a score of 3 points for salinization and seawater intrusion. This is a concern for the city of Athens.

Scale: National.

2.6 Flood risk

The indicator flood risk consists of 4 sub-indicators: Urban drainage flood, Sea level rise, River peak discharges, Land subsidence.

2.6.1 Urban drainage flood

Risk of flooding due to intensive rainfall expressed as the share of urban soil that is sealed.

Calculation method:

Sealed soil cover in the city standardized according to the min-max method. The minimum and maximum values are determined by taking the bottom and the top 10% of the 572 European cities assessed. Green and blue areas refer to 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 (EEA, 2012A).

Soil sealing for Athens is 72.2%. Lower 10% of all European cities assessed is 31.7%, top 10% has a share impermeable area of 69.6% (EEA 2012). Min-max transformation leads to:
Athens is within the top 10% most sealed cities of Europe and therefore receives a maximum score of 4 points. Urban drainage flooding is a serious concern for the city of Athens.

2.6.2 Sea level rise

Measure of the vulnerability of flooding due to sea level rise. Percentage of the city that would flood with 1 meter sea level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams *etcetera* are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter sea level increase without flood protection on a scale from 0 to 4.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
41-100	4

0% of the city centre of Athens will be flooded by 1 meter increase in sea level (EEA 2012).

Hence, Athens a no concern for sea level rise.

2.6.3 River peak discharges

Measure for the vulnerability of flooding due to river level rise. Also flash floods from outside the city are included in this indicator. Percentage of the city that would flood with 1 meter river level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams etcetera are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter river level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
40-100	4

More than 44.8% of Athens will flood if the river level would increase with 1 meter (EEA 2012). The city therefore receives a score of 4.

2.6.4 Land subsidence

Land subsidence increases the risks of river and coastal floods and salt water intrusion. The cause of land subsidence is irrelevant for its impact on flooding.

Calculation method

This score is based on a qualitative assessment according to the following classification:

Score	Description
0	No infrastructure damage, no flood risk
1	Low/medium infrastructure damage expected, no major increase in flood risk expected
2	Experienced infrastructure damage and medium infrastructure damage expected or <0.50m subsidence by 2100 in a substantial area of the city.
3	Serious experienced infrastructural damage or < 1m subsidence by 2100 in a substantial area of the city
4	Serious experienced infrastructure damage, Imminent flooding/ < 2m subsidence by 2100 in a substantial area of the city

Land subsidence is has resulted in some infrastructure damage and medium infrastructure damage expected, also in flood prone areas leading to a score of 2 (Parcharidis et al. 2006). Land subsidence is of medium concern for the city of Athens.

2.7 Water quality

Water quality consists of two sub-indicators: Surface water quality, Biodiversity.

2.7.1 Surface water quality

Measure of relative surface water quality. A lower Indicator score is given for better quality.

Calculation method:

A national surface water quality index (WQI) is available as a measure out of 100. Then, the indicator is calculated as follows:

(100 – WQI)/25 = score

Water quality index for Greece is 71.1 (EPI 2010).

(100 – 71.1)/25 = 1.16

Incoming water quality is of relatively low concern for the city of Athens.

2.7.2 Biodiversity

Measure of the biodiversity of aquatic ecosystems in the city. A low indicator score is given where biodiversity is good.

Calculation method

The calculation is based on national or regional data when city-level data are not available. There are many ways of assessing biodiversity, so there is no globally uniform approach.

For EU countries, it is recommended to use data from the European Environment Agency (EEA) on ‘percent of classified waters in less than good ecological status’ as shown in this map – for which a high resolution version is available via the link.

Then apply the following criteria to determine an Indicator score

% of waters with less than good ecological status or potential	**Indicator value (for EU countries)**
<10%	0
10 to 30%	1
30 to 50%	2
50 to 70%	3
≥ 70%	4

For non-EU countries, it is recommended to use data from software called the Environmental Performance Index (EPI), led by Yale University (epi.yale.edu).

The latest 2012 update does not include the relevant parameter called ‘Water – impact on ecosystem’. This is available from the 2010 version (see also Indicator 4).

The value is obtained from the Country Profiles.

For Athens ecological status is within 30 to 50% of water with less than good ecological status or potential (EEA 2012). Aquatic biodiversity is therefore of medium concern for the city of Athens.

2.8 Heat risk

Prediction of heat island effects severity on human health

Calculation method

1. Number of combined tropical nights (>20°C) and hot days (>35°C) in the period 2071-2100, where the maximum is set on 50 days. The number is standardized using the following formula:

[Number of combined tropical nights and hot days/50]×4 = score

2. Percentage of green and blue urban area. Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

4 – [(% green and blue area – 16)/(48 – 16)×4] = score

3. The overall score is the arithmetic average of both standardized scores.

Athens has a green coverage of 14.1% and the number of combined nights higher than 20 °C and days above 35 °C is higher than 50 days. Athens has the lowest green coverage resulting in a maximum score of 4.Combined tropical nights and hot days: for Athens this is the maximum of, i.e. 4 point score which means: (4+4)/2= 4

Financial Pressures

2.9 Economic pressure

Gross Domestic Product (GDP) per head of the population is a measure of the economic power of a country. A low GDP per capita implies a large economic pressure.

Calculation method

The country average GDP the world (World Bank 2013) is taken. From all country GDP values the average of the lowest 10% is taken as minimum (514.7 US$/cap/yr) and the average of the highest 10% is taken as maximum (59231.2 US$/cap/yr). The country GDP is standardized according to the min-max method.

Score = 4 – [((X – 514.7)/(59231.2 – 514.7))×4]

For Greece the GDP is 21645.5 US$/cap/yr. Therefore:

4 – [((21645.5 – 514.7)/(59231.2 – 514.7))×4] = 2.6

Which means that economic pressure is a concern for Athens.

2.10 Unemployment rate

Percentage of population of the total labor force without a job.

Calculation method

Score unemployment rate = $0.0002X^3 – 0.0173X^2 + 0.5077X – 0.8356$

Where X is unemployment rate (%)

In Athens unemployment rate is 24.2% (World Bank 2015)
$0.0002 \cdot 24.2^3 – 0.0173 \cdot 24.2^2 + 0.5077 \cdot 24.2 – 0.8356 = 4.15$
Which means that the unemployment is a serious concern for Athens.

2.11 Poverty rate

Percentage of people that is below the poverty line of 2 US$ a day.

Calculation method
Score poverty rate = $–0.0001X^2 + 0.0404X + 1.1686$
Where X is poverty rate (% less than 2US$ a day)

1.7% of the people in Greece have less than 2 US$ a day to spend (World Bank 2014D)
This is below 2% implying that poverty is (relatively) of no concern for Athens.

2.12 Inflation

Percentage inflation per year. High inflation rates may hamper investments.

Calculation method
Score inflation rate = $0.0025X^3 – 0.0744X^2 + 0.8662X + 0.0389$
Where X is the inflation rate (%).

-0,3% inflation in Greece (World Bank 2015)
$0.0025(-0.3)^3 – 0.0744(-0.3)^2 + 0.8662(-0.3) + 0.0389 = -0.01$
Which means that inflation rate is not a concern for Athens. Although deflation is also a serious financial concern

3 City Blueprint

Table 3.1: List of City Blueprint indicators for Athens

Category	No.	Indicator	Score
I	1	Secondary WWT	9.2
	2	Tertiary WWT	8.6
	3	Groundwater quality	5.0
II	4	Solid waste collected	5.4
	5	Solid waste recycled	1.9
	6	Solid waste energy recovered	0.0
III	7	Access to drinking water	10.0
	8	Access to sanitation	9.5
	9	Drinking water quality	10.0
IV	10	Nutrient recovery	0.0
	11	Energy recovery	9.2
	12	Sewage sludge recycling	9.2
	13	WWT Energy efficiency	6.0
V	14	Average age sewer	8.0
	15	Operation cost recovery	3.6
	16	Water system leakages	5.6
	17	Stormwater separation	9.7
VI	18	Green space	0.0
	19	Climate adaptation	5.0
	20	Drinking water consumption	7.3
	21	Climate robust buildings	5.0
VII	22	Management and action plans	5.0
	23	Public participation	3.5
	24	Water efficiency measures	6.0
	25	Attractiveness	9.0

Categories: I – Water quality, II – Solid waste treatment, III – Basic water services, IV – Wastewater treatment, V – Infrastructure, VI Climate robustness, VII - Governance

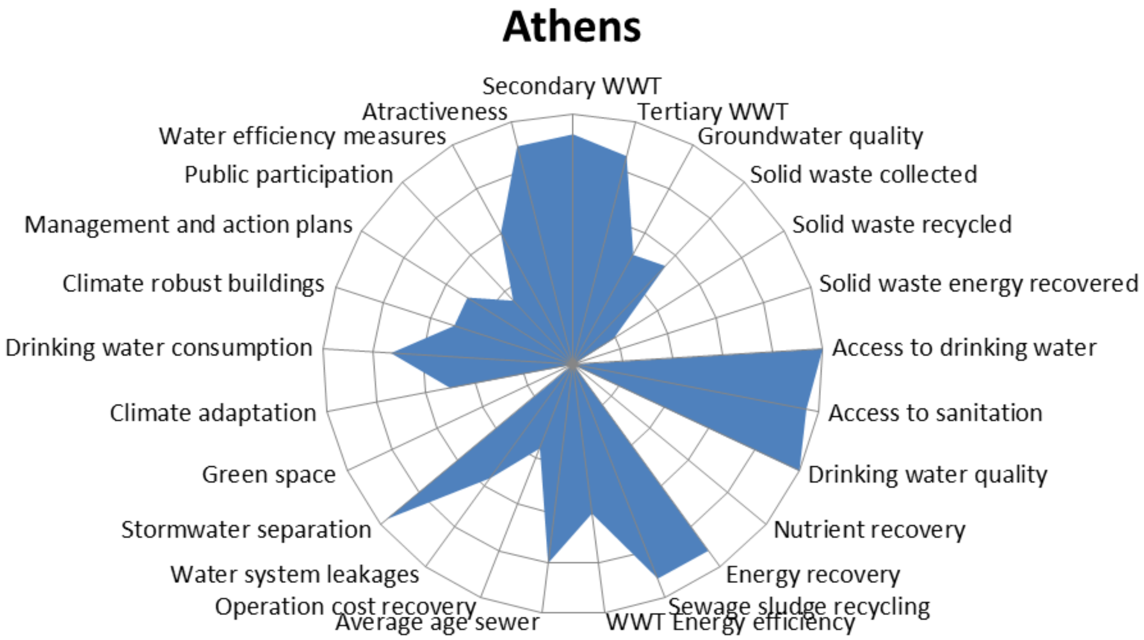

Figure 1.1. City Blueprint of Athens. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 4.9

I – Water quality

3.1 Secondary WWT

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 (biochemical oxygen demand) and nutrient removal.

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).

3.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = X/10,

Where X is the percentage of population connected to secondary sewage treatment. Assumed that there is only tertiary treatment after secondary treatment has been done.

In Athens 92.4% of waste water connected to secondary WWT (OECD 2013)

Indicator 1 = **92.4**/10

Indicator 1 = 9.2

Please note that this is national average data as local data has been difficult to access.

3.1.2 Current practices

The Athens Water Supply and Sewerage Company (EYDAP S.A.) has constructed and operates three waste water treatment plants that serve the Athens Metropolitan Area (EYDAP, 2016):

- The WWT of Metamorfosi operating since 1986 and receiving waste water collected from septic tanks in areas that lack central sewer network. The facility has a processing capacity of around 500000 citizens. The plant receives daily around 550 vehicles that transfer 11000 cubic meters of waste and around 10000 cubic meters of seweage. The plant has a 97% efficiency and is able to decrease the pollution load by 90% -95% and return it to the sea of the Saronic Gulf.
- The WWT in Psyttalia operates since 1994 and includes pretreatment, primary treatment and advanced secondary biological treatment with nitrogen removal, sludge treatment and electricity and heat production. It is one of the largest WWT plants in Europe and worldwide, with a capacity of 5.6 million inhabitants. The average flow of incoming waste water is of the order of 730,000 cubic meters daily. The treated effluent returns in the Saronic Gulf through deep diffusion treatments, with a reduced organic content of about 93% and a reduced nitrogen load of about 80%.
- The WWT in Thriasio operates since 2010 and serves a population equivalent of 117,000. The WWT in Thriassio is believed to be underactive since the works of connecting citizens have been delayed (Kathimerini, 2015).

3.2 Tertiary WWT

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 inters the surface water.

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

3.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = X/10,

Where X is the percentage of population connected to tertiary sewage treatment.

In Athens 86.2% of population is connected to tertiary sewage treatment (OECD 2013).

Indicator 2 = 86.2/10

Indicator 2 = 8.6

Please note that this is national average data as local data has been difficult to access.

3.2.2 Current practices

Tertiary treatment is included in the WWT in Psitallia (EYDAP, 2016) that has a capacity of serving 5.4 million people.

3.3 Groundwater quality

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

3.3.1 Calculation

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’

Best estimated score of 5 points (Van Leeuwen and Marques, 2013)

Indicator 3 = X/(X + Y)×10 = 5

3.3.2 Current practices

The main pressures of groundwater quality in the Athens metropolitan area are the heavy groundwater abstractions that have caused salinization of aquifers and groundwater pollution due to heavy industrial activity. The creation of the WWT plant in Thriasio and the licensing of boreholes and groundwater abstractions are some of the responses that the Ministry of Environment, EYDAP S.A. and the Prefecture of Athens have been implementing to reduce the impacts on groundwater quality.

II – Solid waste treatment

3.4 Solid waste collected

Represents waste collected from households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that threat or dispose of waste at the same used for municipally collected waste (OECD, 2013).

3.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = [1 – (X – 136.4)/(689.2 – 136.4)]×10,

Where X is the kg/cap/year of collected solid waste.

Athens’ average municipal waste production is 388 kg/cap/year (Waste Atlas, 2016). Applying the formula results in:

Indicator 4 = [1 – (388 – 136.4)/(689.2 – 136.4)]×10

Indicator 4 = 5.4

3.4.2 Current practices

One of the biggest problems of the metropolitan area of Athens is the waste management with 35 uncontrolled waste disposal sites (EEA, 2015). The National Waste Management Plan (NWMP) and the National Waste Prevention Programme are currently under preparation including specific measures for promoting waste recovery and recycling (EEA, 2015).

3.5 Solid waste recycled

Percentage of solid waste that is recycled or composted.

3.5.1 Calculation

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.

Indicator 5 = (% recycled or composted)/(100 – % used for incineration with energy recovery)×10,

In Athens 19% of solid waste is recycled; 0% is incinerated with energy recovery (Waste Atlas, 2016). Applying the formula results in:

Indicator 5 = [**19**/(100 – **0**)]×10

Indicator 5 = **1.9**

3.5.2 Current practices

In the Athens metropolitan area a total of 35 recycling centres are operating with: 4 for packaging and packaging waste; 17 for end life cycle vehicles; 2 for tires; 3 for waste of electrical and electronic equipment; 1 for lubricating oil wastes; 1 for waste batteries and accumulators; and 6 for excavation, construction and demolition wastes. The recycling goal in 2011, for the whole of Greece, was set to 60% of all glass, 60% of all paper and cardboard, 50% of all metals, 22.5% of all plastic and 15% of all wood (Hellenic Recycling Agency, 2014).

3.6 Solid waste energy recovery

Percentage of solid waste that is incinerated with energy recovery.

3.6.1 Calculation

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.

Indicator 6= (% incineration with energy recovery)/(100 – % recycled or composted)×10,

In Athens 19% of solid waste is recycled; 0% is incinerated with energy recovery (http://www.atlas.d-waste.com/). Applying the formula results in:

Indicator 6= **0**/(100 – **19**)×10 = **0**

3.6.2 Current practices

The National Plan for Solid Waste Management focuses mainly on recycling and energy recovery is considered an additional measure when all other options have been exhausted before sending solid wastes to landfills (NPSWM, 2015).

III – Basic water services

3.7 Access to drinking water

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

3.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = X/10,

Where X is the percentage of total urban population with access to potable drinking water.

100% access to drinking water (Van Leeuwen and Marques 2013)

Indicator 7 = **100**/10

Indicator 7 = **10**

3.7.2 Current practices

EYDAP S.A. has managed to effectively provide the population of Athens with access to affordable safe drinking water. This is either provided directly through the EYDAP S.A. drinking water network or from other drinking water networks built and maintained by local authorities that are supplied with water from the EYDAP S.A. treatment facilities (EYDAP, 1999).

3.8 Access to sanitation

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.

3.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = X/10,

Where X is the percentage of total urban population with access to proper sanitation facilities.

In Athens, 95% with access to sanitation (Van Leeuwen and Marques 2013)

Indicator 8 = **95**/10

Indicator 8 = **9.5**

3.8.2 Current practices

Three WWT are in place for treating the wastewater produced in Athens. Out of these three, the WWT in Thriasio operates since 2010 and is believed to be underactive mainly because of the low number of buildings that are connected to the sewerage network (Kathimerini, 2015).

3.9 Drinking water quality

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

3.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = X/10,

Where X is the percentage of total urban population with access to potable drinking water.

In Athens 100% of the population has access to potable drinking water

Indicator 9 = 100/10

Indicator 9 = 10

3.9.2 Current practices

EYDAP S.A. performs several tests of drinking water quality which certify that the quality of drinking water provided by EYDAP fully meet the legislative requirements of the national legislation for "Quality of water intended for human consumption" (as amended and currently in force by JMD Y2/2600/2001).

IV – Solid waste treatment

3.10 Nutrient recovery

Measure of the level of nutrient recovery from the wastewater system.

3.10.1 Calculation

A. Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Mm^3/year)

B. Total amount of wastewater passing the wastewater treatment plants (Mm^3/year)

Indicator 10 = [A/B]×[% secondary WWT coverage/100]×10

In Athens, wastewater treated with recovering techniques 0 Mm^3/year and total amount of wastewater passing through the WWT plants 268123525 Mm^3/year (Van Leeuwen and Marques 2013). Additionally, in Athens there is a 92.4% secondary WWT coverage.

Indicator 10 = [**0** / **268123525**] × [**92.4** / 100] × 10

Indicator 10 = **0**

3.11 Energy recovery WWT

Measure of energy recovery from the wastewater system.

3.11.1 Calculation

A) Total volume of wastewater treated with techniques to recover energy (Mm^3/year).

B) Total volume of water produced by the city (Mm^3/year).

[A / B]×10 = 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^3/year).

D) Total volume of wastewater treated in wastewater treatment plants (Mm^3/year).

Indicator 11 = [C/D]×[% secondary WWT coverage/100]×10

In Athens, the total volume of wastewater treated with techniques to recover energy is 268123525 Mm^3/year and the overall total volume of waste water treated is WWT plants is 268123525 Mm^3/year and the secondary WWT coverage is 92.4% (Van Leeuwen and Marques 2013).

Indicator 11 = [**268123525** / **268123525**] * (**92.4** / 100)×10

Indicator 11 = **9.2**

3.11.2 Current practices

In the Psyttalia WWT plant the produced biogas during treatment is utilised giving 11,4 MW of electrical power covering the wastewater treatment plant's energy needs (EYDAP, 2016).

3.12 Sewage sludge recycling

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.

3.12.1 Calculation

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)

Indicator 12 = [(C+D)/A]×[% secondary WWT coverage/100]×10

In Athens, A = 40410, B = 0, C = 40410, D. = 0, E. = 0 (Van Leeuwen and Marques 2013) and secondary WWT coverage = 92.4% (OECD 2013).

Indicator 12 = [(**40410** + **0**) / (**4041092.4** / 100)] × 10

Indicator 12 = **9.2**

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.

3.12.2 Current practices

As reported in the National Plan for Solid Waste Management (NPSWM, 2015), part of the sludge produced in the WWT plants is sold either in Greece or is exported, mainly as fuel to industries.

3.13 Energy efficiency

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

3.13.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 13.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens, the score is **6** (Van Leeuwen and Marques 2013).

3.13.2 Current practices

The Psyttalia WWT plant is energy efficient and EYDAP S.A. is able to sell back to the power administrator part of the co-produced energy from the WWT plant (EYDAP, 2016).

V – Infrastructure

3.14 Average age sewer

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

3.14.1 Calculation

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.

Indicator 14 = (60 – X)/(60 – 10)×10

In Athens, the average age of sewers is 20 years (Van Leeuwen and Marques 2013)

Indicator 14 = (60 - **20**) / (60 - 10) x 10

Indicator 14 = **8.0**

Where X is the average age sewer

3.14.2 Current practices

The waste water collection and distribution system operated by the Athens Water Supply and sewerage Company (EYDAP S.A.) is approximately 6.000 km and is still growing with new in the East and West areas of the Attiki region connecting with the network (EYDAP, 2016).

3.15 Operating costs recovery (ratio)

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.

3.15.1 Calculation

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

Operating cost recovery (ratio) = (Total annual operational revenues)/(Total annual operating costs)

Total annual operating costs: Total annual operational expenditures for drinking water

Total annual operational revenues: Total annual income from tariffs and charges for drinking water and sanitation services (US$/year)

Indicator 15 = (X – 0.33)/(2.34 – 0.33)×10

Where X is operating cost recovery (ratio).

In Athens, the operating cost recovery ratio is 1.06 (Koundouri et al., 2014). Therefore the indicator is calculated as follows:

Indicator 15 = (1**.06** – 0.33) / (2.34 – 0.33) × 10

Indicator 15 = **3.6**

3.15.2 Current practices

The annual financial cost of untreated water in Athens is estimated at 0.15 € / m3, with a steady annual domestic water demand of 415 hm3 and a 99% reliability of the water supply (Makropoulos et al., 2011). This cost takes into account the fixed operation and maintenance costs of all the water infrastructure from the reservoirs and groundwater boreholes to the aqueducts and the pumping stations, that are used to bring water in Athens and includes as well the depreciation of the fixed assets.

3.16 Water system leakages

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

3.16.1 Calculation

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.

Indicator 16 = (50 – X)/(50 – 0)×10

Where X is water system leakages (%).

In Athens, water system leakages are approximately 22% (Van Leeuwen and Marques 2013).

Indicator 16 = (50 – **22**)/(50 – 0) x 10

Indicator 16 = **5.6**

3.16.2 Current practices

In mid 1990s the leakages from the Athens water distribution network were at aout 35% (EYDAP, 2009). This amount has decreased considerably to about 22% in 2009 and continues to decrease mainly because of the maintenance of the distribution network and the optimisation of the operational scheduling (EYDAP, 2009).

3.17 Stormwater separation

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.

3.17.1 Calculation

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)

Indicator 17 = [(B + C)/(A + B + C)] × 10

In Athens, total length of combined sewers managed by the utility is 250 km (Van Leeuwen and Marques 2013), total length of stormwater sewers managed by the utility is 1200 km (Van Leeuwen and Marques 2013) and total length of sanitary sewers managed by the utility is 7550 km (Van Leeuwen and Marques 2013).

Indicator 17 = [(**1200** + **7550**) / (**250** + **1200** + **7550**)] × 10

Indicator 17 = **9.7**

3.17.2 Current practices

New sewers are built in their majority separating stormwater and wastewater (EYDAP, 2016).

VI – Climate robustness

3.18 Green space

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).

Definition of green area (EEA, 2012A): 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.

3.18.1 Calculation

City specific: Numbers are provided in %

Country average: Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

Indicator 18 = (X – 16)/(48 – 16)×10

Where X is the share of blue and green area (%).

In Athens, the share of blue and green area is around 14.1% (EEA, 2012A)

Indicator 18 = (**14.1** – 16)/(48 – 16)×10

Indicator 18 = -0.6

However every value below the minimum of 16% receives a score of 0

3.18.2 Current practices

One of the objectives of the strategic plan for Athens 2021 (Organismos Athinas, 2011) is the creation of new green areas in the Athens metropolitan area.

3.19 Climate adaptation

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

3.19.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 19.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

The score for Athens is 5 (Van Leeuwen and Marques 2013)

3.19.2 Current practices

Protecting citizens against flooding is one of the objectives of the strategic plan for Athens 2021 (Organismos Athinas, 2011) and in previous years several flood protection works were implemented to protect the city and prevent extreme events like those of 1994 that resulted in the loss of 11 lives.

The Athens Water Supply and Sewearage Company (EYDAP S.A.) implements measures for addressing water scarcity and securing that Athens will have secure drinking water supply.

3.20 Drinking water consumption

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 authorised 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 authorised 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.

3.20.1 Calculation

The volume is then normalized against maximum and minimum volumes for European cities.

Indicator 20 = [1 – (X – 45.2) / (266 – 45.2)] × 10

Where X is m^3/person/year drinking water consumption.

In Athens drinking water consumption is 105.8 m^3 /cap/yr (Van Leeuwen and Marques 2013)

Indicator 20 = [1 – (**105.8** – 45.2) / (266 – 45.2)] × 10

Indicator 20 = **7.3**

3.20.2 Current practices

The main water demand management measures implemented by the Athens Water Supply and Sewerage Company in Athens are water price changes and awareness raising campaigns. In periods of high water shortages, such as the persistent drought of 1988-1994 restrictions of outdoor water use were also used (Kanakoudis, 2008). A social research in 2013, showed that basic and sufficient water saving behaviours of Athenians are attributed to the lasting effects of the awareness campaigns and alarming experiences during the Athens' drought period of 1988-1994 (Koutiva et al., 2016).

3.21 Climate robust buildings

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.

3.21.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 21.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens the score is 5 (Van Leeuwen and Marques 2013)

3.21.2 Current practices

The Ministry of Environment and Energy implements a project giving incentives for refurbishing old apartments, houses and buildings in order to reduce their energy footprint (YPEKA, 2016).

VII – Governance

3.22 Management and action plans

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. 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).

3.22.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 22.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

The score for Athens is 5 (Van Leeuwen and Marques 2013).

3.22.2 Current practices

The Athens Water Supply and Sewerage Company (EYDAP S.A.) and the Ministry of Environment and Energy, through the Central Water Agency implement the WFD and other National and EU policies and strategies in the Athens metropolitan area.

3.23 Public participation

A measure of share of people involved or doing unpaid work

3.23.1 Calculation

The indicator is calculated as follows (for EU countries):

Indicator 23 = (X – 5)/(53 – 5)×10

X = Involvement in voluntary work

In Athens the involvement in voluntary work is about 22% (EFILWC 3006)

Indicator 23 = (**22** – 5)/(53 – 5)×10

Indicator 23 = **3.5**

3.23.2 Current practices

Public participation, especially in areas with evolving social phenomena such as the increase of refugees and the economic crisis, has increased in the recent years.

Regarding water, educational programs in schools as well as awareness raising campaigns are implemented by several NGOs in Athens.

3.24 Water efficiency measures

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.

3.24.1 Calculation

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.

The following guidance is proposed to make self-assessment score for Indicator 24.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens, the score regarding water efficiency measures is 6 (Van Leeuwen and Marques 2013).

3.24.2 Current practices

Several water efficiency measures are implemented such as the increase of the number of serviced areas by the central wastewater treatment, the efforts to decrease leakages from the drinking water network, or the implementation of awareness raising campaigns.

3.25 Attractiveness

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 harbours 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.

3.25.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 25.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens, the score of attractiveness is 9 (Van Leeuwen and Marques 2013).

4 City Amberprint

The City Amberprint is a complement to the City Blueprint and the Trends and Pressures Framework. The main goal of the City Amberprint is a baseline assessment of the sustainability of Energy, Transport and ICT in cities. To comply with City Blueprint, indicators that have a score between 0 (there is a concern) to 10 (no concern) are proposed. The quantitative indicators were "normalised" on a scale of 0 to 10, where 10 points were assigned to cities that met or exceeded certain criteria on environmental performance. The overall sustainability of the three aspects is expressed as Amber City Index (ACI). The ACI is the geometric mean of the 22 indicators.

Table 4.1: List of City Amberprint indicators for Athens

Category	No.	Indicator	Score
ENERGY	1	Carbon footprint	9.8
	2	Fuel poverty	7.9
	3	Energy consumption	7.1
	4	Energy self-sufficiency	3.2
	5	Renewable energy ratio	1.3
	6	Energy efficiency plans	8.0
	7	Energy infrastructure investment	1.8
TRANSPORT	8	Commuting time	6.9
	9	Use of public transport	2.0
	10	Bicycle network	0.3
	11	Transportation fatalities	9.5
	12	Clean energy transport	4.0
	13	Transport-related pollutions	8.5
	14	Transport infrastructure investment	5.4
ICT	15	ICT access	5.3
	16	ICT use households	9.0
	17	ICT use water utilities	7.3
	18	ICT use energy utilities	7.5
	19	ICT use transport	3.3
	20	ICT use waste management	2.0
	21	Digital public service	5.8
	22	ICT infrastructure investment	4.1

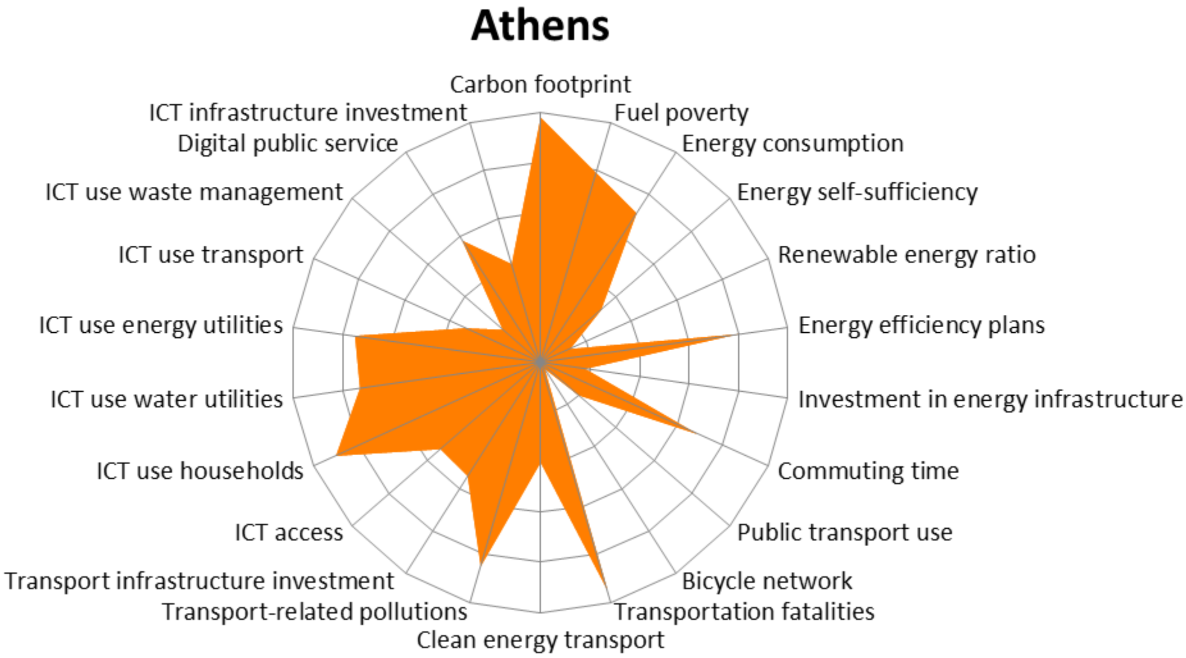

Figure 1.1: City Amberprint of Athens The centre of the circle corresponds to 0 and its periphery to 10. The Amber City Index (ACI) for Athens is 4.7

Energy indicators

4.1 Carbon footprint

How city's carbon footprint (CF) per person per year does compare with the international range? A lower indicator score is given for a larger carbon footprint.

Definition of Carbon Footprint: the total sets of greenhouse gas emissions caused by an organization, event, product or person.

4.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = 10×(16.464 - X)/(16.464 - 0.237),

Where X is the CF/capita/year in the city.

In Greece the CF value is 9.779 tonnes/cap/year (EUROSTAT, 2013a):

Indicator 1 = 10×(16.464 - **9.779**)/(16.464 - 0.237) = **4.1**

Note: No data at a city level.

4.1.2 Current practices

In Greece several policies and projects are in place to reduce the carbon footprint that impact the city of Athens as well. Some examples include:

- The Ministry of Environment Energy and Cimate Change implements an energy efficiency at buildings project, that includes a set of financial incentives, with co-financing from the European Union, for the implementation of energy efficiency upgrading interventions in residential buildings (YPEKA, 2016)

- The landfill gas (methane - CH4) of the main landfill of Athens, in Ano Liosia, is used for generating power of around 175 GWh per year which is then sold in the Greek power market operator (LAGIE S.A.) thus reducing the overall carbon footprint (Helector, 2016).

4.2 Fuel poverty

What is the proportion of households in the city that are considered to be fuel poor? The lower indicator score is given when the proportion is higher.

Under the Low Income High Costs definition, a household is considered to be fuel poor if:

- they have required fuel costs that are above average (the national median level)
- were they to spend that amount, they would be left with a residual income below the official poverty line.

4.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = (100-X)/10,

Where X is the percentage of households in the city considered to be fuel poor.

For Athens the percentage of households which is considered to be fuel poor is 12.1% (in 2006) (Bank of Greece, 2011). Therefore:

Indicator 2 = (100 **– 21.1**)/10 = **7.9**

4.2.2 Current practices

The Public Power Corporation has implemented a Social Residential Tariff (PPC, 2016) that decreases the energy prices for specific beneficiaries that fulfil certain conditions. The Social Residential Tariff is a 42% reduction for:

- family income of less than €12,000 (plus €3,000 for each child – max of 2 children) and with energy consumption of the permanent residence from 200 kWh to 1,500 kWh in 4-months
- families with 3 children and a family income of less than €23,500 and with energy consumption of the permanent residence from 200 kWh to 1,700 kWh in 4-months
- families with unemployed for a continuous unemployment period of 6 months with family income of less than €12,000 (plus €6,000 for each child – max of 2 children) and with energy consumption of the permanent residence from 200 kWh to 1,500 kWh in 4-months
- families with disabled people of more than 67% handicap and a family income of less than €23,500 and with energy consumption of the permanent residence from 200 kWh to 1,700 kWh in 4-months
- families with people on life support with and annual family income of less than €30,000 and with energy consumption of the permanent residence from 200 kWh to 2,000 kWh in 4-months

4.3 Energy consumption

This indicator presents how does total energy consumption (domestic, industrial and commercial, and transport) per capita in the city compares with the international range (kgoe/cap/yr). A lower indicator score is given where the consumption is greater.

4.3.1 Calculation

The indicator is calculated as follows:

Indicator 3 = 10×(5419 – X)/(5419 – 893.15),

where X is the total energy consumption for the city in kgoe/cap/yr.

In Greece total energy consumption is 2213.7 kgoe/cap/yr (EUROSTAT, 2013b): Therefore:

Indicator 3 = 10×(5419 – **2213.7**)/(5419 – 893.15) = **7.1**

Note: No data at a city level.

4.4 Energy self-sufficiency

Measure of the proportion of a city's demand that could be met through indigenous production including renewable resources, waste, and traditional but generated locally in the city. A lower indicator score is given where self-sufficiency is lower.

4.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = 10×X/Y,

where X is the the amount of energy generated locally, and Y is the total energy consumption in the city.

In Greece 10% of energy is generated locally in 2006, (CRES, 2009). Therefore:

Indicator 4 = 10×10/31.5 = **3.2**

Note: No data at city level.

4.5 Renewable energy ratio

A measure of proportion of total energy derived from renewable sources in the city, as a share of the city's total energy consumption compared to the international range. A lower indicator is given where the percentage is lower.

4.5.1 Calculation

The indicator is calculated as follows:

Indicator 5 = 10×(X – 1.15)/(98.8 – 1.15),

Where X is the percentage of energy derived from renewable sources.

In Greece 13.9% of energy was derived from renewable sources in 2012 (RAE, 2012). Therefore:

Indicator 5 = 10×(**13.9** – 1.15)/(98.8 – 1.15) = **1.3**

Note: No data at city level.

4.5.2 Current practices

Based on a report of the Regulatory Authority for Energy (RAE, 2012), in 2012, in the Attika Region there were:

- Wind farms: 1 with operational licence, 8 with construction licence, 18 with energy production licence, 1 with environmental terms and 17 under assessment.
- Biomass: 3 with operational licence and 4 with energy production licence
- PV: 5 with operational licence, 7 with construction licence, 42 with energy production licence and 5 with environmental terms.

4.6 Energy efficiency plans

Measure of the application of energy efficiency measures by the range of energy users across the city. A lower indicator score is given where efficiency measures are more limited. 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. energy companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the efficiency of energy usage:

- at household level, e.g. efficient household appliances,

- at community level by energy efficient buildings or energy recycling, e.g. heat can be collected in summer, and stored to use it in winter,
- by encouraging people to change their behaviour.

4.6.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 6.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens, one of the main goals of the strategic plan of Athens for 2021 is the promotion of integrated energy saving programmes and improvement of the actual building's energy efficiency (Organismos Athinas, 2011). Energy efficiency projects are co-financed under the National Strategic Reference Framework (Anaptyxi, 2016). Additionally, the Ministry of environment, energy and climate change has implemented a project for Energy Efficiency for buildings providing subsidies to households for increasing their energy efficiency applicable among other areas in the Athens metropolitan area (YPEKA, 2016).

Therefore, Athens is given a score of **8.**

4.7 Energy infrastructure investment

A measure of the investment in the infrastructure for energy distribution compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the energy infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = $10\times(100 \times X/Y – 0.06)/(2.29 - 0.06)$

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Athens total energy infrastructure investment per capita is 74.75 Euros/capita and GDP per capita in Greece is 16200 in 2016 (Anaptyxi, 2016). Therefore:

Indicator 7 = 10×(100 × **74.75/16200 –** 0.06)/(2.29 − 0.06) **= 1.8**

4.7.2 Current practices

The National Strategic Reference Framework (NSRF) 2007-2013 has funded energy projects of around 285 million euros. The projects of Development Sector 'Energy' included projects relevant with electricity, natural gas, petroleum products, renewable energy sources (wind, solar, biomass, hydroelectric, geothermal and other) and energy efficiency, co-generation and energy management. The NSRF 2014-2020 has planned energy projects of around 590 million euros for renewable energy and energy efficiency projects as well as management of energy distribution and related operations (Anaptyxi, 2016).

Transport indicators

4.8 Commuting time

A measure of the proportion of time spent on commuting (minutes per day). Includes average time spent in: public transport (bus, coach, train, underground, tram, light railway), car (as driver or passenger), motorcycle, moped, scooter, bicycle, taxi on the way to and from work. A lower indicator score is given where the time spent on commuting is greater.

4.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = 10×(74.2 – X)/(74.2 – 10.8),

Where X is the average time spent on commuting in the city (or region). In Athens average time spend on commuting per day is 30.5 minutes in 2013 (OECD, 2015). Therefore:

Indicator 8 = 10×(74.2 **– 30.5**)/(74.2 – 10.8) = **6.9**

4.9 Public transport use

Kilometres travelled by public transport and bicycles compared to overall kilometres travel by all means of transport. A lower indicator score is given where the use of public transport and bicycles is higher.

4.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = 10×X/Y,

Where X is the kilometres travelled by public transport and cycling (or %) and Y is the overall kilometres travelled by all means of transport (or %). In Greece there was 19.6 km travelled by public transport compared to 100.1 km travelled by all means of transport in 2011 (YPYMEDI, 2014). Therefore:

Indicator 9 = 10×**19.6/100.1** = **2.0**

Note: No data at city level.

4.9.2 Current practices

One of the main goals of the strategic plan of Athens for 2021 is the reinforcement of sustainable mobility by promoting means of public transportation, walking and bicycling (Organismos Athinas, 2011).

4.10 Bicycle network

Length of bicycle network per inhabitant compared to the international range. The lower indicator score is given where the length of bicycle network per inhabitant is lower.

4.10.1 Calculation

The indicator is calculated as follows:

Indicator 10 = 10×(X/2.03),

Where X is the length of bicycle network per capita. In Athens there are 54800 metres of designated cycle routes and 3663763 inhabitants in 2014 (Athanasopoulos, 2015). Therefore total length of bicycle network in meters per inhabitant is 0.014 m/cap:

Indicator 10 = 10×(**0.014**/2.03) = **0.1**

4.10.2 Current practices

The 2014 review of the Athens metropolitan area master plan promotes bicycling by proposing the creation of cycling roads that will link the coastal area of Faliro with the centre of Athens and other urban green spaces of the Athens metropolitan area (Organismos Athinas, 2011).

4.11 Transportation fatalities

A measure of transportation fatalities per 100 000 population in the city per year. A lower indicator score is given where the number is greater.

4.11.1 Calculation

The indicator is calculated as follows:

Indicator 11 = 10×(33.4 – X/Y)/(33.4 – 3.6)

Where X is the number of fatalities related to transportation of any kind within the city borders and Y is the 100,000 of the city's total population. In Athens there were 199 transportation fatalities and the population is 3863763 in 2014 (Athens Traffic Police, 2016). Therefore:

Indicator 11 = 10×(33.4 – 100000×**199/3863763**)/(33.4 – 3.6) = **9.5**

4.11.2 Current practices

There is a decrease in the mortality from road accidents in Athens, since 2000, which can be mainly attributed in: (a) the implementation of stricter road safety measures by the traffic police such as the use of seat belts and helmets and the application of sanctions against drunk drivers, (b) the improvement of the road network infrastructure such as Attiki Odos, (c) the increase of public transportation use with the construction of lines 2 and 3 of the Metro, the tram, the suburban railway and the regeneration of the urban railway in Attica, and (d) the implementation of frequent and targeted educational and information campaigns regarding road safety (KEELPNO, 2013).

4.12 Clean energy transport

Clean energy transport and clean energy sharing transport. A lower indicator score is given where efficiency measures are more limited. 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. transport companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the transport efficiency by e.g.

- efficient public transport (electric train, subway/metro, tram, cable railway)
- efficient private transport (electric taxis or cars, electric scooter, bicycling)
- and encouragements to use public transport.

4.12.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 12.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Athens, efficient public transport and bicycling is promoted and addressed in the 2014 review of the Athens metropolitan area master plan (Organismos Athinas, 2011).

Therefore Athens is given a score of **4**.

4.12.2 Current practices

The Transport for Athens organisation implements awareness campaigns for using public transportation and supports the transport of bicycles using the metro lines (OASA, 2016). Additionally, the city of Athens implements a green ring where cars with low emissions are allowed at all times.

4.13 Transport-related pollutions

Air pollutant emissions (Sulphur oxides (SO_x), Nitrogen oxides (NO_x), Ammonia (NH_3), Non-methane volatile organic compounds, Particulates (PM_{10}) - airborne particulate matter with aerodynamic diameter less than 10 micrometres) from transport measured in kg per capita per year. A lower indicator score is given where the pollutant emissions are greater.

4.13.1 Calculation

The sub-indicators are calculated as follows:

- Sulphur oxides (SO_x):
  $SO_x = 10\times(2.753 - A)/(2.753 - 0.114)$
  where A is the emissions from the city (kg/cap/yr).
- Nitrogen oxides (NO_x):

$NO_x = 10×(0.337 – B)/(0.337 – 0.021)$
where *B* is the emissions from the city (kg/cap/yr).

- Ammonia (NH_3):
  $NH_3 = 10×(9,153.3 – C)/(9,153.3 – 11.3)$
  where *C* is the emissions from the city (kg/cap/yr).
- Non-methane volatile organic compounds (Non-mth):
  Non-mth = 10×(5.643 – D)/(5.643 – 0.432)
  where *D* is the emissions from the city (kg/cap/yr).
- Particulates (PM_{10}):
  $PM_{10} = 10×(2.197 – E)/(2.197 – 0.169)$
  where E is the emissions from the city (kg/cap/yr).

Therefore the indicator is calculated as follows

Indicator 13 = (SO_x + NO_x + NH_3 + Non-mth + PM_{10})/5

In Greece the emissions are as follows: Sulphur oxides – 0.01 kg/cap/yr, Nitrogen oxides – 0.02 kg/cap/yr, Ammonia – 0.01 kg/cap/yr, Non-methane volatile organic compounds – 0.01 kg/cap/yr Particulates PM_{10} – No information in kg/cap/yr in 2013 (EUROSTAT, 2013c). Therefore:

Indicator 13 = (**10** + **10** + **10** + **10** + **0**)/5 = **8.5**

Note: No data at city level.

4.13.2 Current practices

Data about the concentration of the emissions at city level are reported daily and annually by the Ministry of Environment, and Energy. Total emissions in tonnes are reported only on a country level.

4.14 Transport infrastructure investment

A measure of the investment in the transport infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.14.1 Calculation

The indicator is calculated as follows:

Indicator 14 = 10×(100 × X/Y – 0.02)/(3.89 − 0.02)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Athens total transport infrastructure investment per capita is 339.2 Euros/capita and GDP per capita in Greece is 16200 in 2015 (Anaptyxi, 2016). Therefore:

Indicator 14 = 10×(100 × **339.2/16200** – 0.02)/(3.89 − 0.02)= **5.4**

4.14.2 Current practices

The NSRF has invested around 1.3 billion euros in transport infrastructure. This includes investments for a) projects under the Development Sector 'Transports' such as railways, motorways, cycle tracks, urbas transport, intelligent transport systems and others and b) projects under the Development Sector of “Clean urban transportation” promoting the use of clean urban transport in the Athens metropolitan area (Anaptyxi, 2016).

ICT indicators

4.15 ICT access

The ICT access is a measure of access to information and communication technology (ICT) in the city. A lower indicator score is given where the ICT access is lower.

4.15.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Mobile-cellular telephone subscriptions per 100 inhabitants, where X is the number of mobile- cellular telephone subscriptions per 100 inhabitants in the city: A = 10 × X/120
- International Internet bandwidth (bit/s) per Internet user, where Y is the International Internet bandwidth (bit/s) per Internet user in the city: B = 10 × Y/787, 260
- Proportion of households with a computer, where Z is the percentage of households with a computer in the city: C = Z/10
- Proportion of households with Internet access, where Q is the percentage of households with Internet access in the city: D = Q/10

The indicator is calculated as follows:

Indicator 15 = (A+B+C+D)/4.

In Greece the values are as follows (WEF, 2014):

- X = 120, so A = 10 × **120**/120 = **10**
- Y = 64.2, so B = 10 × **64.2**/787, 260 = **0**
- Z = 57.4, so C = **57.4**/10 = **5.7**
- Q = 54, so D = **54**/10 = **5.4**

Therefore:

Indicator 15 = (**10**+**0**+**5.7**+**5.4**)/4 = **5.3**

Note: No data at a city level.

4.16 ICT use households

The ICT use in households is a measure of use of information and communication technology (ICT) in the city. A lower indicator score is given where the ICT use is lower.

4.16.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Proportion of individuals using the Internet, where X is the percentage of population in the city using the Internet: A = X/10
- Fixed (wired)-broadband subscriptions per 100 inhabitants, where Y is the number of fixed (wired)-broadband subscriptions per 100 inhabitants in the city: B = 10×Y/60

- Wireless-broadband subscriptions per 100 inhabitants, where Z is the number of wireless-broadband subscriptions per 100 inhabitants in the city: C = Z/10

Therefore, the indicator is calculated as follows:

Indicator 15 = (A + B + C)/3

In Greece the values for 2014 are as follows (EUROSTAT, 2015):

- X = 0.71, so A = **71**/10 = **7.1**
- Y = 74, so B = 10×**74**/60 = **10**
- Z = 75, so C = **75**/10 = **7.5**

Therefore:

Indicator 15 = (**7.1**+**10**+**7.5**)/3 = **8.9**

Note: No data at a city level.

4.17 ICT use water utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.17.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Athens the following scores were given (2016):

Description	Score (0-10) evaluated locally	Comments
Operation	**8**	SCADA system, telemetry,
Maintenance	**8**	Asset management data base and GIS
Planning and design	**8**	Optimisation, GIS interface
Customer service	**5**	Water Meters, BCC, e-bill, 24hour 1022 call centre

Therefore the indicator is calculated as follows:

Indicator 17 = (**8**+**8**+**8**+**5**)/4 = **7.3**

4.17.2 Current practices

Currently the Athens Water Supply and Sewerage Company is involved in many R&D projects funded by both Greek (NSRF) and European (Horizon2020 and FP7) that investigate, develop and apply new ICT tools in the field of urban water system management (EYDAP, 2016).

4.18 ICT use energy utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.18.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Athens the following scores were given (2016):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**8**	SCADA system, energy management, ICT use in energy production from coal
Maintenance	**8**	Asset management data base and GIS
Planning and design	**8**	Optimisation, GIS interface
Customer service	**6**	Smart metering

Therefore the indicator is calculated as follows:

Indicator 18 = (**8**+**8**+**8**+**6**)/4 = **7.5**

4.18.2 Current practices

The Ministry of Environment, Climate Change and Energy has developed a National Information System on Energy with the main scope of both providing information to the public regarding energy and supporting decision makers (YPEKA, 2016).

The Hellenic Electricity Distribution Network Operator S.A.(DEDDHE) operates a telemetering system for medium voltage users. Additionally, it supports the public regarding questions about the metered and billed energy (DEDDHE, 2016).

Greece has mandated a large-scale roll-out of smart meters to 80% of consumers by 2020. Additionally, the replacement of 160,000 old electricity meters with smart metering systems was expected to be completed by 2015 (EU, 2014).

The Public Power Corporation of Greece has a scada system and energy management for the energy production from coal. Additionally, the Regulatory Authority for Energy (RAE) developed a Geoinformation Map (RAE GeoPortal http://www.rae.gr/geo/) as a web application, including information about all renewable energy projects in Greece that are either implemented, or under development. This application is in line with modern requirements and the existing legal framework (Law 3882/2010 - INSPIRE Directive) and is one of the first attempts of openly distributing geospatial data (RAE, 2016).

4.19 ICT use transport

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.19.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance		e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design		e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service		e.g. mobile bus tickets, online feedback forms

Final indicator is an average of the four values.

In Athens the following scores were given (2016):

Description	Score (0-10) evaluated locally	Comments
Operation	**5**	Under development coverage of installation of road sensing terminals and traffic control in the city
Maintenance	**0**	No available information
Planning and design	**0**	No available information
Customer service	**8**	Mobile bus tickets under development, online feedback forms and online route planning

Therefore the indicator is calculated as follows:

Indicator 19 = (**5**+**0**+**0**+**8**)/4 = **3.25**

4.19.2 Current practices

The Athens Transport Organisation (OASA) has a newly developed trip planner for mobile devices also available in google maps and here.com (OASA, 2016). A mobile ticket service is available since 2014, however it is not widely known and used (OASA, 2016).

4.20 ICT use waste management

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.20.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. ICT system for logistics of waste collection
Maintenance		e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design		e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service		e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Final indicator is an average of the four values.

In Athens the following scores were given (2016):

Description	Score (0-10) evaluated locally	Comments
Operation	**5**	The entrance of the waste collection vehicles is supported by automatic recording systems and vehicle transit control such as entrance electronic card, automatic vehicle identification through automatic number plate 'reader'.
Maintenance	**1**	no information
Planning and design	**1**	no information
Customer service	**1**	no information

Therefore the indicator is calculated as follows:

Indicator 20 = (**5**+**1**+**1**+**1**)/4 = **2**

4.21 Digital public service

A measure of ICT implementation within public administration (percentage of Internet users that have engaged with the public administration and exchanged filled forms online) and health system. A lower indicator score is given where there are less ICT tools implemented.

4.21.1 Calculation

Following sub-indicators need to be calculated:

- Proportion of eGovernment Users, A. Percentage of individuals sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet X divided by 10: A = X/10
- Medical Data Exchange, B. Percentage of general practitioners using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists, Y, divided by 10: B = Y/10

Therefore, the indicator is calculated as follows:

Indicator 21 = (A + B)/2

In Athens 45% of individuals is sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet (EUROSTAT, 2014). Therefore:

A = **45**/10 = **4.5.**

71% of general practitioners is using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists (ELTRUN, 2013). Therefore:

B = **71**/10 = **7.1**.

The final indicator is:

Indicator 21 = (**4.5** + **7.1**)/2 = **5.8**.

4.21.2 Current practices

In Greece, citizens are able to use online services such as income tax returns, wealth declaration, public insurance status and to apply online or through the telephone for several supporting documents, such as family status, birth certificate and others.

Doctors in Greece have been very active online since 8 out of 10 doctors say that they participate in forums / blogs through which they communicate information with colleagues. Nevertheless, only 7% of medical professionals use the internet for communicating with patients and/or the public in general (ELTRUN, 2013).

4.22 ICT infrastructure investment

A measure of the investment in the ICT infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.22.1 Calculation

The indicator is calculated as follows:

Indicator 22 = 10×(100 × X/Y – 0.09)/(1.5 − 0.09)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Athens total ICT infrastructure investment per capita is 108.6 Euros/capita (Anaptyxi, 2016) and GDP per capita in Greece is 16200 2015. Therefore:

Indicator 22 = 10×(100 × **108.6**/**16200** – 0.09)/(1.5 − 0.09)= **4.1**

4.22.2 Current practices

The National Strategic Reference Framework (NSRF) has invested around 420 million euros in ICT infrastructure in the Athens Metropolitan area (Attika region) during the 2007-2013 development program (Anaptyxi, 2016). This program has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds. In particular, the ICT infrastructure projects fall under the Development Sector of 'Digital Convergence' and are comprised by the following thematic priorities:

- 10: Telephone infrastructures (including broadband networks)
- 11: Information and communication technologies (access, security, interoperability, risk-prevention, research, innovation, e-content, etc.)
- 12: Information and communication technologies (TEN-ICT)
- 13: Services and applications for the citizen (e-health, e-government, e-learning, e-inclusion, etc.)
- 14: Services and applications for SMEs (e-commerce, education and training, networking, etc.)
- 15: Other measures for improving access to and efficient use of ICT by SMEs

5 Conclusion

The main scope of this report is to explore the sustainability of multiple services of the Athens metropolitan area based on two assessments. Firstly, the city's sustainability of urban Integrated Water Resources Management is assessed based on the City Blueprint and Trends and Pressures Framework. Additionally, the city's sustainability of the energy, transport and ICT services is assessed following the City Amberprint.

The assessment of the Trends and Pressures Index ranks Athens 37 out of a total of 45 cities from all around the world (Figure 5.1) (Koop, S. and Van Leeuwen, K., 2015). Athens performs worse on the environmental assessment with flood and heat risk being the main concerns and on the financial assessment with the economic pressure and the unemployment rate being the main concerns. Athens performs better on the social assessment.

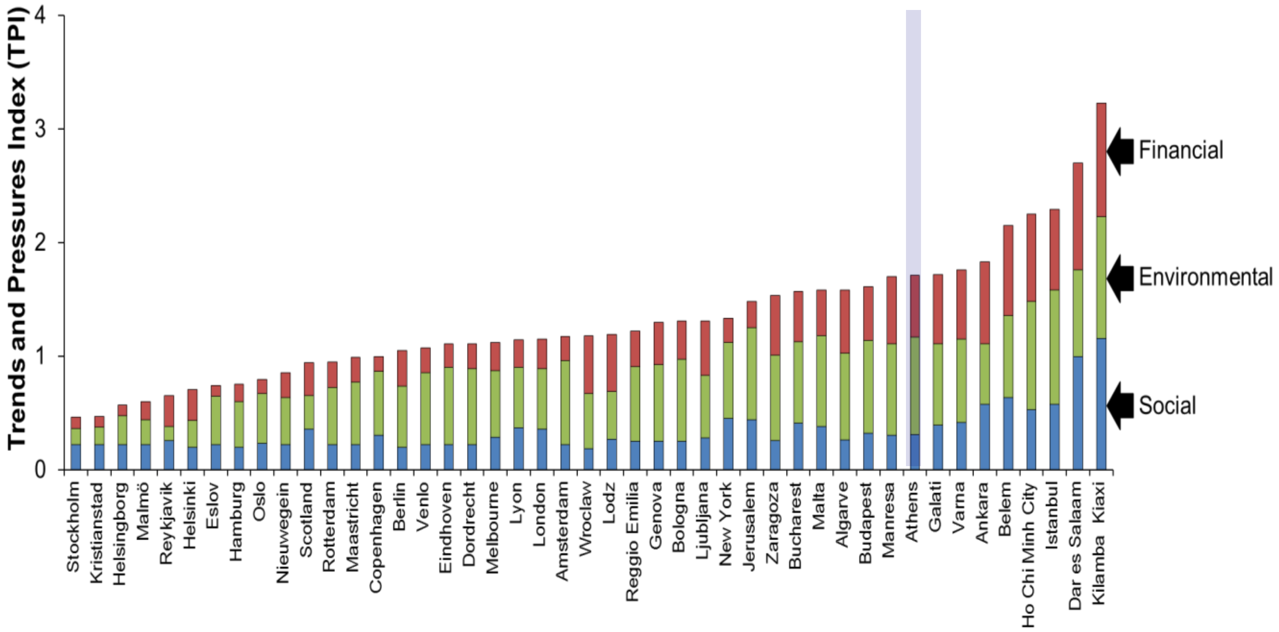

Figure 5.1. Trends and Pressures Index for 45 countries (Koop, S. and Van Leeuwen, K., 2015)

The city of Athens ranks 32nd out of 45 cities from all around the world, with a score of 6.4 in the Blue City Index (Figure 5.2) (Koop, S. and Van Leeuwen, K., 2015). The city performs best in basic water services and water quality and above average on their wastewater infrastructure and treatment. On the othe hand, compared to the other European cities assessed the city performs worst in the solid waste treatment of the wastewater treatment plants as well as climate adaptation (Figure 5.3).

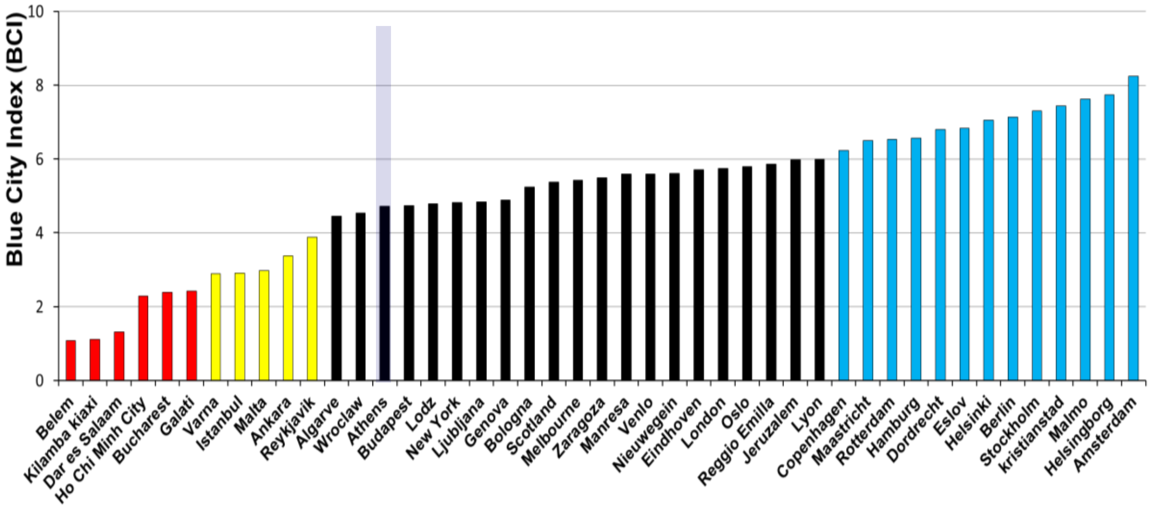

Figure 5.2. Blue City Index for 45 countries (Koop, S. and Van Leeuwen, K., 2015)

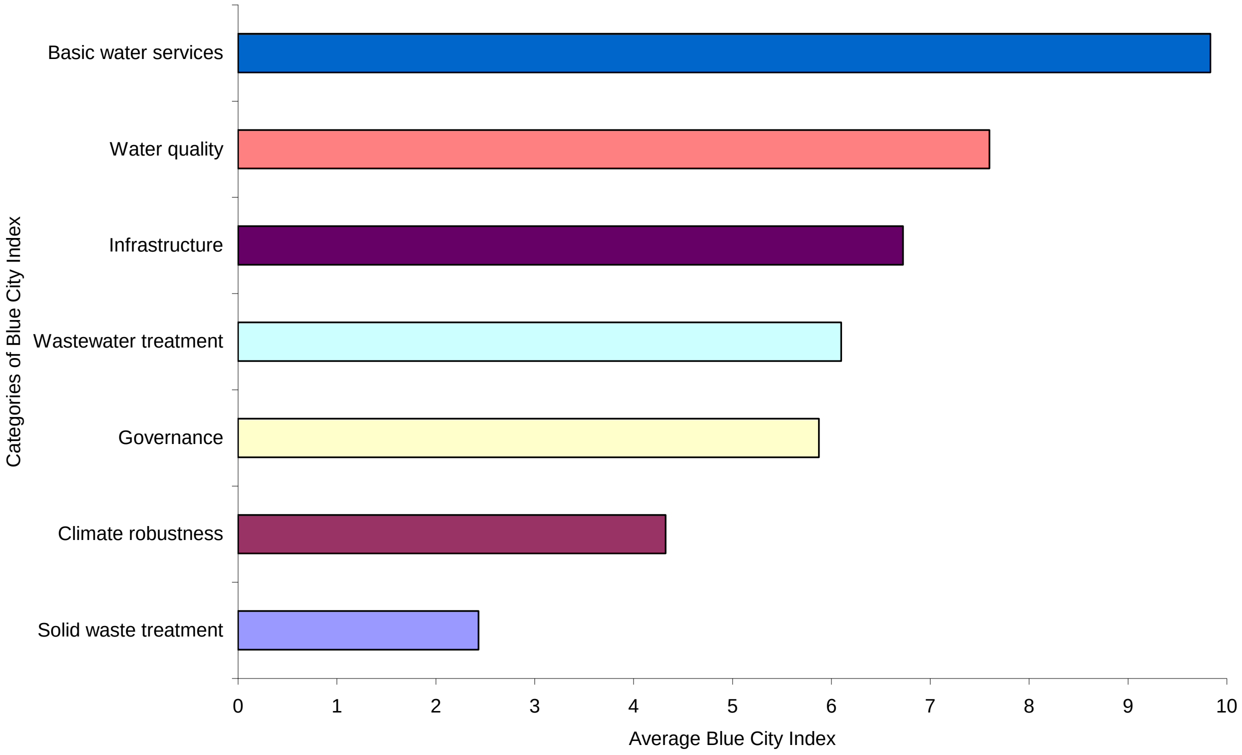

Figure 5.3. Performance of Athens in the different assessment categories of the Blue City Index.

Finally, the Amber City Index the city performs almost equally and mediocre to all three assessed services, energy, transport and ICT with a score of around 5.5.

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Annex B – Genova Report

Deliverable Title	**D3.2b Report on the Genova case study**
Deliverable Lead:	Iren SpA
Related Work Package:	WP3: City Case Studies
Related Task:	T3.2: Case-studies
Author(s):	C.Arena; N.Bazzurro; G.Capannelli; P-Castiglieri; A.Fortunato; S.Gianazzi; A.Marchese
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Start Date of Project:	01.02.2015
Duration:	24 months
Abstract	The key objective was to assess the city of Genova, Italy, using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Genova has a Blue City Index score of 4.9 and an Amber City Index of 4.44 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 2.75.

Project funded by the European Commission as part of the EU Framework Programme for Research and Innovation

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Executive Summary

The key objective was to assess the city of Genova, Italy, using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Genova has a Blue City Index score of 4.9 and an Amber City Index of 4.44 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 2.75.

Further contents deal with suitable technological nucleus and available integrated ICT proposed to be used as best practices to make the supplied water and solid waste services more efficient at industrial and Municipality level.

1 Introduction

Genova is the capital of Liguria and the sixth largest city in Italy. The urban area called Genova Metropolitan City has an official population of 862,885. Over 1.5 million people live in the Genova Metropolitan Area. Genova is one of Europe's largest cities on the Mediterranean Sea and the largest seaport in Italy.

Genova has been nicknamed la Superba ("the Proud one") due to its glorious past and impressive landmarks. Part of the old town of Genova was inscribed on the World Heritage List (UNESCO) in 2006.

Genova, which forms the southern corner of the Milan-Turin-Genova industrial triangle of north-west Italy, is one of the country’s major economic centres. The city has hosted massive shipyards and steelworks since the 19th century, and its solid financial sector dates back to the Middle Ages.

The city of Genova covers an area of 243 square kilometres between the Ligurian Sea and the Apennine Mountains. The city stretches along the coast for about 30 kilometres from the neighbourhood of Voltri to Nervi, and for 10 kilometres from the coast to the north along the valleys Polcevera and Bisagno. The territory of Genova can then be popularly divided into 5 main zones: the centre, the west, the east, the Polcevera and the Bisagno Valley.

With 598,700 inhabitants (as of 30th Nov. 2013) Genova ranks sixth in Italy by population and ranks fifth (2010 data) by average per-capita income among the fifteen largest Italian cities.

The most striking feature of Genova as a city is its dramatic depopulation over the last 35 years, a process that does not show to revert (Figure 1.1).

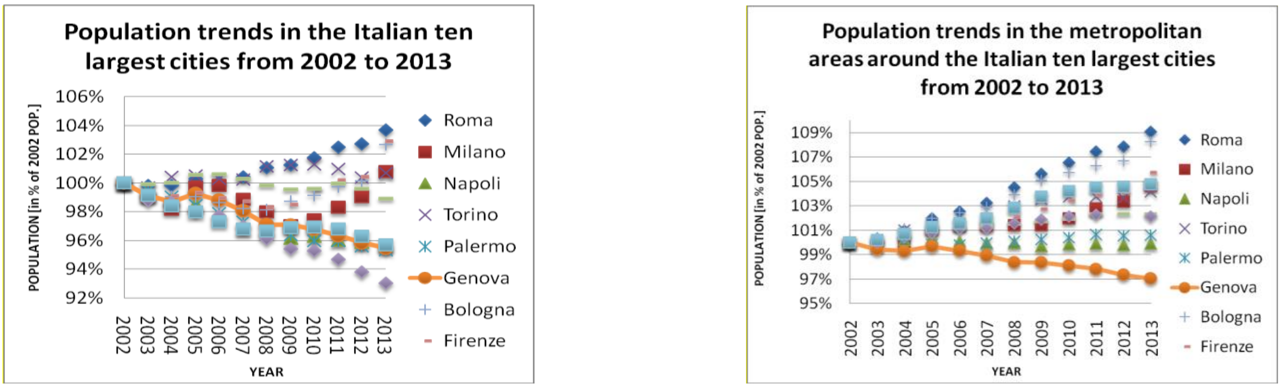

Figure 1.1: (a) Population trends in the Italian ten largest cities from 2002 to 2003. (b) Population trends in the metropolitan areas around the Italian ten largest cities from 2002 to 2003.

Speaking about **water cycle and its management**, the average per-capita domestic water consumption in 2012 was 175 litres/day. The average yearly consumption per household in 2012 was around 120 m^3 (1.9 components per household, according to ISTAT data);

The average rate for the integrated water service (water supply and distribution, sewer and wastewater treatment) in the Genova is presently around 1.7 €/m^3 (Figure 1.3).

The rate structure presently includes a fixed quota (≈ 7 €/trimester) and a variable quota, according to an increasing block structure based on multiples of a water module, corresponding for a single household to around 15 m^3/month (if the customer is a resident, they have the first 8 m^3 at a cut rate).

The integrated water service (supply, sewerage and sanitation) is now operated by Mediterranea delle Acque, a single company established in 2006 from the merging of three different companies managing the service in three different parts of the Genova city.

For this reason, it is difficult to obtain “dependable” consumption data before year 2006.

In 2013, total water consumption in Genova was of 59.58 Mm^3, 38.26 Mm^3 (64%) of which for domestic consumption, 19.32 Mm^3 (32%) for industrial/commercial use, and 2.0 Mm^3 for other uses.

In 2013, the number of connections to the water distribution network was 91,580 – 69,742 of these are domestic connections, and 15,499 are commercial/industrial ones.

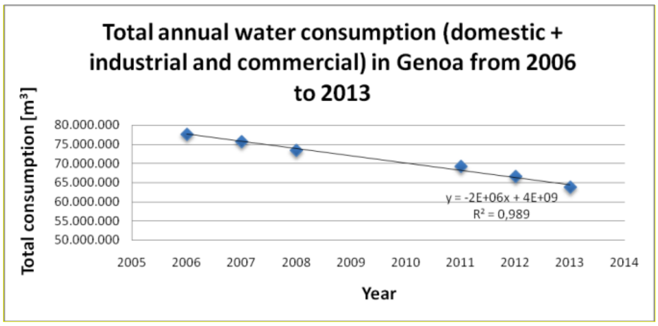

Figure 1.2: Total annual water consumption in Genova from 2006 to 2013

In 2011-2013, when data sorted by category are available, decrease in domestic consumption (Figure 1.2) was of around 1.4 Mm3/year (3.2%/year) and decrease in industrial/commercial consumption rated 1.1 Mm3/year (4.9%/year).

Due to population decrease, contraction of per capita consumptions is smaller (around 2.8%/year).

Average 2006-2013 consumption decrease ≅ 1.98 Mm^3/year (≈ 2.5%/year).

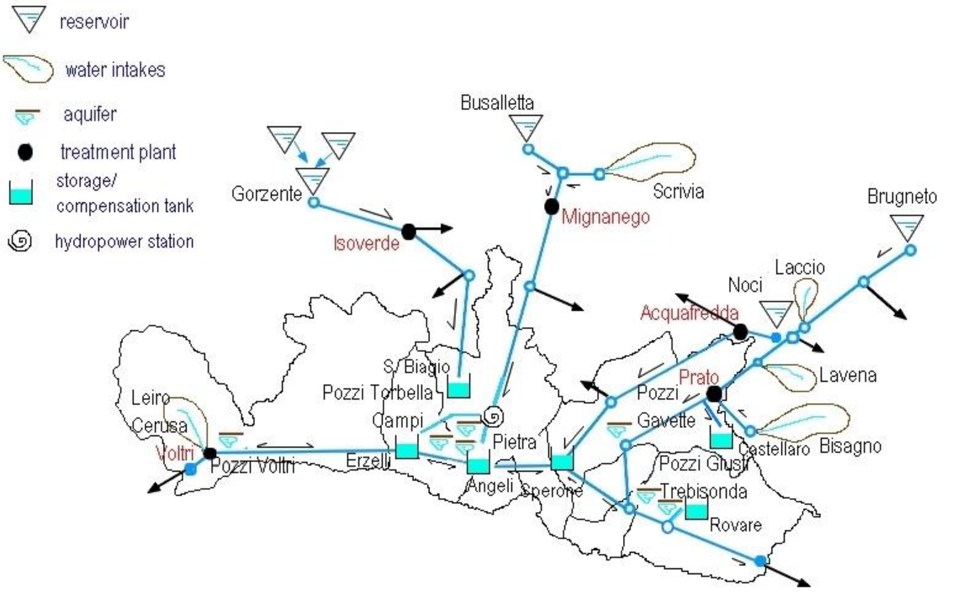

Figure 1.3: Genova water resources system

Waste Management in Liguria - the region including the town of Genova - reflects a specific situation characterized, to date, by gaps in availability of waste treatment plants. Due to this, waste generally has been displaced to other Italian Regions or directly to local garbage dumps. On top of this, proper recycling (separate collection) reached only a mere 32% on total. The picture related to the town of Genova must be linked to this overall condition, being the contribution of the municipality to the total regional urban solid waste production near to 75%. Indeed, the new Regional Waste Plan - "*Piano di gestione dei rifiuti e delle bonifiche della Regione Liguria*" - approved with proper official document on march 24th, 2015 by the Regional Council, moved from an unfavorable framework in comparison to other regions but with interesting opportunities given by a virtual lack of industrial or plants-related boundaries. Such is its overall setting characterized by integration and lining-up to waste-related EC Directives and legislative proposals (Waste Framework Directive, or Directive 2008/98/EC, Circular Economy Package, Proposed Directive on Waste, Proposed Directive on Packaging Waste, Proposed Directive on Landfill, Proposed Directive on electrical and electronic waste, on end-of-life vehicles, and batteries and accumulators and waste batteries and accumulators). On top of this, the goal defined in the regional Plan is the reaching out, by 2020, of a 65% recycling (separate collection) target, ensuring minimum production of unsorted waste by means of its full reuse and targeting differentiation and valorization of the organic component; all of this, in order to minimize waste transport costs and of its organic part transport cost in particular.

The regional Plan, which is implemented in a relevant component for the Genova Municipality, foresees valorization of the organic part of waste also, mainly by exploiting better management of retrieval in areas with low population density, - and this is an interesting field of application for Smart City related technologies - reuse of organic mixes including food waste and sewage sludge. Last, it is to be underlined that definition and planning of industrial processes underlying the Regional Waste Plan adopted an innovative approach based on the quantity of waste production in relation to population density, which for the Municipality of Genova is relevantly higher than European average (e.g. Genova has the wider historic town center in Europe). Higher density means higher kilograms of waste per square kilometer.

Amiu spa (Azienda Multiservizi e d'Igiene Urbana) is the utility company in charge for the Municipality of Genova Waste Management. It takes care of cleaning services, waste collection and urban sanitation in the territory of the city of Genova and other neighboring municipalities, serving over 700 thousand inhabitants with an average 582 kg per capita. In line with the indications of the Covenant of Mayors and the Regional Waste Plan, no closing of the waste cycle by means of incinerators is actually foreseen by the Municipality of Genova and Amiu. The policy adopted, as discussed above, is based on a better Governance of the Waste Management Cycle, targeting a minor production (-12%), a better concentration for collection and increase of recycling.

2 Trends and Pressures Framework

The trends and pressure indicators are standardized to a scale of 0-4 and divided in ordinal classes expressed as a 'degree of concern'.

Table 2.1: ***Trends and pressures*** **in Genova. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.**

			0	1	2	3	4
Trends and pressures	**Social**	**13. Urbanization rate**	▨	▨			
		14. Burden of disease	▨				
		15. Education rate	▨				
		16. Political instability	▨	▨	▨		
	Environmental	**17. Water scarcity**	▨	▨	▨		
		18. Flood risk	▨	▨	▨		
		19. Water quality	▨	▨			
		20. Heat risk	🟥	🟥	🟥	🟥	
	Financial	**21. Economic pressure**	▨	▨	▨		
		22. Unemployment rate	🟥	🟥	🟥	🟥	
		23. Poverty rate	▨	▨			
		24. Inflation rate	▨				

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Explanation of the concerns of Genova

Heat risk

One of the areas in the world more subjected to the effects of the global warming is the Mediterranean Sea (cnr, geophysical research letters). In the last 50 years Mediterranean Sea increased its temperature of around 1°C in the average summer temperature. Ongoing researches are demonstrating a strong connection between high temperature of the waters in the Liguria sea and the occurrence of heavy precipitations and v-shaped storms on the coast, especially in autumn when the gradient of temperatures between cold air from the north and sea temperature is higher. In such a perspective, the risk for Genova is to have more frequently heavy rainfalls that at local level can generate floods and increase the hydro-geological risk of the city.

Unemployment rate

Unemployment rate in Genova is increasing along the years. This is due in particular to the current crisis, that brought to close several small medium enterprises and forced the big/medium companies to close different sectors or move them in other big cities in the north to rationalize the production and optimize the costs. To overcome this big problem, the local and regional administrations are pushing other sectors, such as the tourism, and are giving incentives for SMEs (Small and Medium Enterprises) and enterprises incubators, as well as for the agriculture, handicraft and the re-launch of local production.

Social Pressures

2.1 Urbanization rate

Percentage of population growth either by birth or migration. The percentages are annually averages per country. Urbanization increases the pressure on integrated water resources management (IWRM) in cities.

Calculation:

The indicator is calculated as follows:

Score urbanization rate = $-0.114X^2 + 1.3275X + 0.1611$

Where X is the urbanization rate (%). For urbanization rates lower than 0% the score is also zero and the above formula is not applied.

In Genova

Urbanization rate is 0.49%, CIA (2014). Therefore:

Score urbanization rate = $-0.114 \cdot 0.49^2 + 1.3275 \cdot 0.49 + 0.1611 =$ **0.78**

Which means that urbanization is of little concern for Genova.

2.2 Burden of disease

The gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability of population growth either by birth or migration. The indicator measures the age-standardized disability-adjusted life years (DALY) per 100,000 people. DALY is the quantification of premature death, burdens of disease and disability in life years. It is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health, e.g. disease, injuries and risk factors (WHO, 2004).

Calculation:

WHO calculation of DALY

Years of premature death: Sum of the number of deaths at each age * [global standard life expectancy for each age – the actual age].

Years lost due to disability: Number of incident cases in that period * average duration of the disease * weight factor.

Years of premature death + Years lost due to disability = DALY

The average DALY per 100,000 people is a strong tool to indicate the burden of disease.

The WHO subdivided these DALY's per 100,000 people into 5 classes. These classes are used to standardize this indicator to a score of 0 to 4 in the CBF analysis as shown below.

DALY per 100,000 people	Score
0 – 20,000	0
20,000 – 40,000	1
40,000 – 60,000	2
60,000 – 80,000	3
80,000 <	4

In Genova DALY per 100,000 people is 16957 (WHO, 2014). Score is **0** point. Which means that the burden of disease is of no concern for Genova.

2.3 Education rate

Education rate expressed as percentage of children completing their primary education

Calculation:

The indicator is calculated as follows:

Score education rate = $-10^{-5}X^3 + 0.0012X^2 – 0.0426X + 4.3057$

Where X is the education rate (%)

In Genova the education rate is 103,0%. Therefore, score education rate is higher than 100% and therefore a score of **0** points.

Which means that education rate is of no concern for Genova.

(note that definition of education rate is sometimes differently reported; World Bank 2014C)

2.4 Political instability (and absence of violence)

The estimated likelihood that the government will be destabilized or overthrown by violent means such as terrorism and politically-motivated violence of population growth either by birth or migration.

Calculation:

The indicator is calculated as follows:

4 – [(Estimated political stability score – 2.5) / (2.5 - -2.5) × 4] = Score

In Genova estimated political stability score is 0.50 (World Bank 2014A). Therefore:

4 – [(-0.50 – 2.5) / (2.5 - -2.5) × 4] = **1.60**

Which means that the political instability (and absence of violence) is of medium concern for Genova.

Environmental Pressures

2.5 Water scarcity

Indicator 5 consists of three sub-indicators: Fresh water scarcity, Groundwater scarcity, Salinization & seawater intrusion

2.5.1 Fresh water scarcity

The abstracted fresh water as percentage of total renewable resource. This includes surface water and groundwater sources.

The scoring method is in accordance with the European Environmental Agencies classification (OECD, 2004; WRI, 2013).

% of renewable resource abstracted	Score
0 – 2	0
2 – 10	1
10 – 20	2
20 – 40	3
>40	4

In Genova

The % of renewable resources abstracted is = 23.57 (Aquastat 2015)

Score for Genova is of **3** points.

Fresh water scarcity is a concern for Genova.

2.5.2 Groundwater scarcity

The abstracted groundwater as a percentage of the annual groundwater recharge. This is a measure of the pressure on groundwater resources.

Calculation:

The indicator scoring is in accordance with the classification used by UNESCO.

% abstracted of annual recharge	Score
0 - 2	0
2 - 20	1
20 - 50	2
50 - 100	3
>100	4

In Genova

The % of abstracted of annual recharge is 28.1 (Aquastat 2015).

Score for Genova is of 2 points.

Groundwater scarcity is of medium concern for Genova.

2.5.3 Salinization & seawater intrusion

Measure of the vulnerability of seawater intrusion and salinization of the soil.

Calculation method:

This indicator score is based on a quick literature check in which seawater and groundwater intrusion are scored as suggested below.

Seawater intrusion

Description	Score
No seawater intrusion reported and city not prone to (future) intrusion	0
No seawater intrusion reported and city can experience intrusion in coming century	1
No seawater intrusion reported but city is prone to intrusion in the near future	2
Seawater intrusion reported	3
Seawater intrusion reported and city is particularly prone to intrusion	4

Groundwater salinization

Based on literature studies, here the following scheme is applied to determine a score:

Description	**Score**
No concern	0
Low concern	1
Medium concern	2
Concern	3
Great concern	4

The highest score of both indicators is used as the final score for salinization and seawater intrusion.

Scale: National.

Genova has a score of **0** points for both seawater intrusion and salinization (Scheidleder et al., 2004).

2.6 Flood risk

The indicator flood risk consists of 4 sub-indicators: Urban drainage flood, Sea level rise, River peak discharges, Land subsidence.

2.6.1 Urban drainage flood

Risk of flooding due to intensive rainfall expressed as the share of urban soil that is sealed.

Calculation method:

Sealed soil cover in the city standardized according to the min-max method. The minimum and maximum values are determined by taking the bottom and the top 10% of the 572 European cities assessed. Green and blue areas refer to 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 (EEA, 2012A).

Score urban drainage flood = (X – 31.7) / (69.9 – 31.7) × 4

In Genova

The value for sealed soil cover of 53.9% (EEA 2015)

Score urban drainage flood = (**53.9** – 31.7) / (69.9 – 31.7) × 4 = **2.3**

Urban drainage flooding is a medium concern for Genova.

2.6.2 Sea level rise

Measure of the vulnerability of flooding due to sea level rise. Percentage of the city that would flood with 1 meter sea level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams *etcetera* are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter sea level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	**Score**
0-5	0
6-10	1
11-20	2
21-40	3
41-100	4

In Genova

The percentage of the city that would flood with 1 meter sea level rise is 0% (EEA, 2012).

Score for Genova is **0** points

Sea level rise is no concern for Genova.

2.6.3 River peak discharges

Measure for the vulnerability of flooding due to river level rise. Also flash floods from outside the city are included in this indicator. Percentage of the city that would flood with 1 meter river level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams etcetera are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter river level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	**Score**
0-5	0
6-10	1
11-20	2
21-40	3
40-100	4

In Genova

23.5% (EEA 2012) of Genova will flood if the river level would increase with 1 meter. The city therefore receives a score of **3**.

River peak discharge is a concern for Genova.

2.6.4 Land subsidence

Land subsidence increases the risks of river and coastal floods and salt water intrusion. The cause of land subsidence is irrelevant for its impact on flooding.

Calculation method

This score is based on a qualitative assessment according to the following classification:

Score	**Description**
0	No infrastructure damage, no flood risk
1	Low/medium infrastructure damage expected, no major increase in flood risk expected
2	Experienced infrastructure damage and medium infrastructure damage expected or <0.50m subsidence by 2100 in a substantial area of the city.
3	Serious experienced infrastructural damage or < 1m subsidence by 2100 in a substantial area of the city
4	Serious experienced infrastructure damage, Imminent flooding/ < 2m subsidence by 2100 in a substantial area of the city

In Genova

The score is 0 points since no indications of flood risk due to ground subsidence has been found in literature.

2.7 Water quality

Water quality consists of two sub-indicators: Surface water quality, Biodiversity.

2.7.1 Surface water quality

Measure of relative surface water quality. A lower Indicator score is given for better quality.

Calculation method:

A national surface water quality index (WQI) is available as a measure out of 100. Then, the indicator is calculated as follows:

(100 – WQI)/25 = score

In Genova

WQI is 82.2 (EPI 2010)

(**100** – 82.2)/25 = **0.71**

Surface water quality is of little concern for Genova.

2.7.2 Biodiversity

Measure of the biodiversity of aquatic ecosystems in the city. A low indicator score is given where biodiversity is good.

Calculation method

The calculation is based on national or regional data when city-level data are not available. There are many ways of assessing biodiversity, so there is no globally uniform approach.

For EU countries, it is recommended to use data from the European Environment Agency (EEA) on 'percent of classified waters in less than good ecological status' as shown in this map – for which a high resolution version is available via the link.

Then apply the following criteria to determine an Indicator score

% of waters with less than good ecological status or potential	**Indicator value (for EU countries)**
<10%	0
10 to 30%	1
30 to 50%	2
50 to 70%	3
≥ 70%	4

For non-EU countries, it is recommended to use data from software called the Environmental Performance Index (EPI), led by Yale University (epi.yale.edu).

The latest 2012 update does not include the relevant parameter called ‘Water – impact on ecosystem’. This is available from the 2010 version (see also Indicator 4).

The value is obtained from the Country Profiles.

In Genova

The % of waters with less than good ecological status or potential is between 50 and 70% (EEA 2012). Therefore, score is 3 points. Biodiversity in surface water is of concern for Genova.

2.8 Heat risk

Prediction of heat island effects severity on human health

Calculation method

1. Number of combined tropical nights (>20°C) and hot days (>35°C) in the period 2071-2100, where the maximum is set on 50 days. The number is standardized using the following formula:

[Number of combined tropical nights and hot days/50]×4 = score

2. Percentage of green and blue urban area. Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

4 – [(% green and blue area – 16)/(48 – 16)×4] = score

3. The overall score is the arithmetic average of both standardized scores.

In Genova

Green coverage of 28.2% (EEA 2015) and the number of combined nights higher than 20 °C and days above 35 °C is 38 days. The standardized number of combined tropical nights and hot days is 3.04. Genova has the lowest green coverage resulting in a maximum score of 2.5.

The overall score is the arithmetic average of both standardized scores: (3.04+2.5)/2= **2.7**

Hence, heat risk is a concern for Genova.

Financial Pressures

2.9 Economic pressure

Gross Domestic Product (GDP) per head of the population is a measure of the economic power of a country. A low GDP per capita implies a large economic pressure.

Calculation method

The country average GDP the world (World Bank 2013) is taken. From all country GDP values the average of the lowest 10% is taken as minimum (514.7 US$/cap/yr) and the average of the highest 10% is taken as maximum (59231.2 US$/cap/yr). The country GDP is standardized according to the min-max method.

Score = $4 – [((X – 514.7) / (59231.2 – 514.7)) \times 4]$

In Genova

For Italy the GDP is 24054 US$/cap/yr (IMF 2013)

Therefore: $4 – [((\mathbf{24054} – 514.7) / (59231.2 – 514.7)) \times 4] = \mathbf{2.4}$

Which means that economic pressure is a medium concern for Genova

2.10 Unemployment rate

Percentage of population of the total labor force without a job.

Calculation method

Score unemployment rate = $0.0002X^3 – 0.0173X^2 + 0.5077X – 0.8356$

Where X is unemployment rate (%)

In Genova

Unemployment rate is 10.7% (World Bank 2015)

$0.0002\cdot(10.7)^3 – 0.0173\cdot(10.7)^2 + 0.5077\cdot(10.7) – 0.8356 = \mathbf{2.86}$

Which means that the unemployment is a concern for Genova

2.11 Poverty rate

Percentage of people that is below the poverty line of 2 US$ a day.

Calculation method

Score poverty rate = $–0.0001X^2 + 0.0404X + 1.1686$

Where X is poverty rate (% less than 2US$ a day)

In Genova

1.7% of the people in Italy have less than 2 US$ a day to spend (World Bank 2014D)

$-0.0001\ \mathbf{(1.7)}^2 + 0.0404\ \mathbf{(1.7)} + 1.1686 = \mathbf{1.24}$

Score is below 2% implying that poverty is a little concern for Genova.

2.12 Inflation

Percentage inflation per year. High inflation rates may hamper investments.

Calculation method

Score inflation rate = $0.0025X^3 - 0.0744X^2 + 0.8662X + 0.0389$

Where X is the inflation rate (%).

In Genova

-0,1% inflation in Italy (World Bank 2015)

$0.0025(-0.1)^3 - 0.0744(-0.1)^2 + 0.8662(-0.1) + 0.0389 = \mathbf{-0.04}$

Which means that inflation rate is not a concern for Genova.

3 City Blueprint

Table 3.1: List of City Blueprint indicators for Genova

Category	No.	Indicator	Score
I	1	Secondary WWT	9.4
	2	Tertiary WWT	8.4
	3	Groundwater quality	6.5
II	4	Solid waste collected	2.7
	5	Solid waste recycled	4.1
	6	Solid waste energy recovered	2.6
III	7	Access to drinking water	10
	8	Access to sanitation	10
	9	Drinking water quality	9.8
IV	10	Nutrient recovery	8.7
	11	Energy recovery	4.7
	12	Sewage sludge recycling	8.8
	13	WWT Energy efficiency	4.0
V	14	Average age sewer	2.0
	15	Operation cost recovery	4.3
	16	Water system leakages	4.8
	17	Stormwater separation	8.7
VI	18	Green space	3.8
	19	Climate adaptation	4.0
	20	Drinking water consumption	8.0
	21	Climate robust buildings	3.0
VII	22	Management and action plans	3.0
	23	Public participation	5.2
	24	Water efficiency measures	3.0
	25	Attractiveness	1.0

Categories: I – Water quality, II – Solid waste treatment, III – Basic water services, IV – Wastewater treatment, V – Infrastructure, VI Climate robustness, VII - Governance

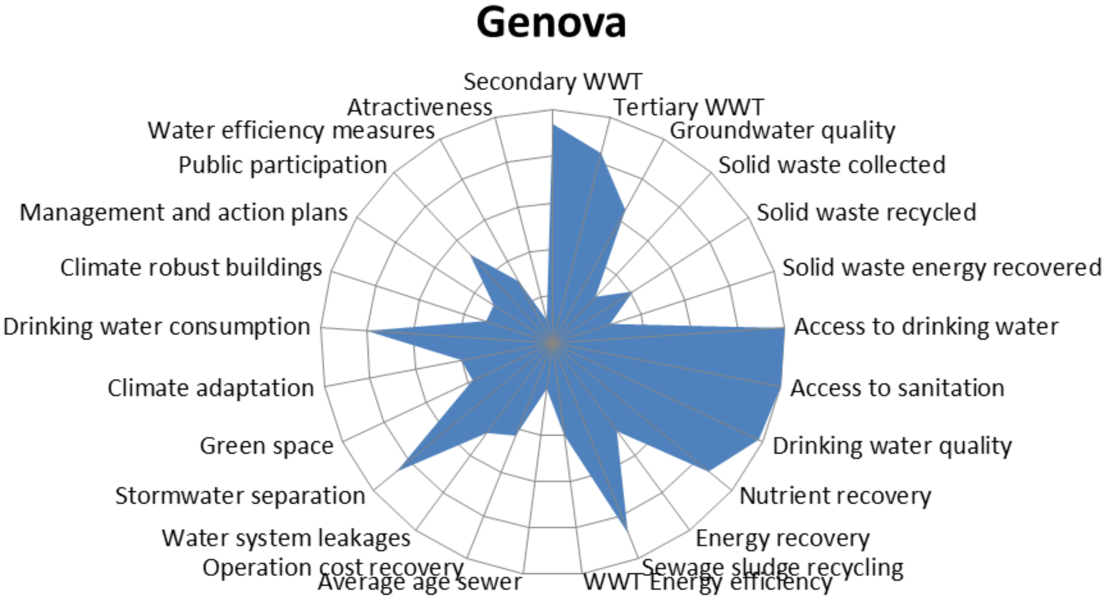

Figure 1.1. City Blueprint of Genova. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 4.9.

I – Water quality

3.1 Secondary WWT

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 (biochemical oxygen demand) and nutrient removal.

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).

3.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = X / 10,

Where X is the percentage of population connected to secondary sewage treatment. Assumed that there is only tertiary treatment after secondary treatment has been done.

In Genova

94% of waste water is connected to secondary WWT (EEA 2012)

Indicator 1 = **94** / 10 = **9.4**

3.1.2 Current practices

New Waste Water Treatment Plants needs to be designed through a proper survey about the expected incoming waste water during dry or rainfall conditions. This is normally done using mathematical simulation models for the drainage system and for the WWTP. It is important to pint out the need to use an **integrated approach** in the framework of which outputs from the drainage system model is the input of the WWTP model.

Monitoring of drainage systems **efficiency** and related waste water treatment plants through the application of novel methodologies for **detecting parasite waters in sewers**. The methodology is including the analysis of the **impact of sea outfalls** in a receiving water body for different wind and related sea water circulation.

3.2 Tertiary WWT

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 inters the surface water.

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

3.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = X / 10,

Where X is the percentage of population connected to tertiary sewage treatment.

In Genova

84% of population is connected to tertiary sewage treatment (EEA 2012).

Indicator 2 = **84** / 10 = **8.4**

3.2.2 Current practices

Tertiaty WWTPs aimed at implement waste water recovering needs to be always investigated with the purpose to reduce the volume of exploited freshwater recovering also phosphate as resource for fertilizing crops in agriculture.

3.3 Groundwater quality

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

3.3.1 Calculation

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’

Indicator 3 = X /(X + Y) × 10

Note: for non-EU countries, an alternative method should be applied, depending what data is available indicator is calculated as follows:

In Genova

Only a percentage has been provided

65% of samples has a ‘good chemical status’ (EEA 2012 – National Scale)

Indicator 3 = **65** / 10 = **6.5**

3.3.2 Current practices

In Genova, most of the water distributed for municipal use comes from surface water resources. Currently, groundwater is used to close the supply-demand balance, and its use has been decreasing along these last years, together with decreasing water consumption and improvements in water supply and distribution systems. This has implications for energy management, as decreased groundwater extraction implies energy savings.

II – Solid waste treatment

3.4 Solid waste collected

Represents waste collected from households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that threat or dispose of waste at the same used for municipally collected waste (OECD, 2013).

3.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = [1 – (X – 136.4) / (689.2 – 136.4)]×10,

Where X is the kg/cap/year of collected solid waste.

In Genova

Genova’s average municipal waste production is 540 kg/cap/year (OECD 2013).

Applying the formula results in:

Indicator 4 = [1 – (**540** – 136.4) / (689.2 – 136.4)] × 10 = **2.7**

3.4.2 Current practices

Best Practices related to Solid waste collection must take into account undifferentiated, semi-differentiated, and differentiated components of this activity and their potential gathering as close as possible to relevant production sites (in term of quantities). While Regional Waste Plan foresees a balance among them, a special focus for the coming years will be put on increasing education of citizens at large.

3.5 Solid waste recycled

Percentage of solid waste that is recycled or composted.

3.5.1 Calculation

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.

Indicator 5 = (% recycled or composted) / (100 – % used for incineration with energy recovery) × 10,

In Genova

34% of solid waste is recycled; 17% is incinerated with energy recovery (OECD 2013). Applying the formula results in:

Indicator 5 = **34** / (100 – 17) x 10 **= 4.10**

3.5.2 Current practices

Past experiences and coming development related to the implementation of the Regional Waste Management Plan foresees valorisation of the organic part of waste also, mainly by exploiting better management of retrieval in areas with low population density, an interesting field of application for Smart City related technologies. Reuse of organic mixes including food waste and sewage sludge may be pursued.

3.6 Solid waste energy recovery

Percentage of solid waste that is incinerated with energy recovery.

3.6.1 Calculation

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.

Indicator 6 = (% incineration with energy recovery)/(100 – % recycled or composted)×10,

In Genova

34% of solid waste is recycled; 17% is incinerated with energy recovery (OECD 2013).

Applying the formula results in:

Indicator 6 = $\frac{17}{100-34}$ x 10 = **2.58**

3.6.2 Current practices

Near future will see Bio-gas and bio-methane produced from the organic fraction of waste. This, in combination with anaerobic waste treatment. Key technologies applied involve alkaline Scrubbing. For all related technologies a strong technical and technological background (e.g. Regional Innovation Hubs) has been already tested in R&D Projects and is available for implementation.

III – Basic water services

3.7 Access to drinking water

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

3.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = X / 10,

Where X is the percentage of total urban population with access to potable drinking water.

In Genova

X = 100% (pers. Comm. Mediterranea delle Acque)

Indicator 7 = **100** / 10 = **10**

3.8 Access to sanitation

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.

3.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = X / 10,

Where X is the percentage of total urban population with access to proper sanitation facilities.

In Genova

100% of total urban population has access to proper sanitation facilities (World Bank 2015)

Indicator 8 = **100** / 10 = **10**

3.9 Drinking water quality

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

3.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = = (X / Y) * 10

X = Total number of samples meeting standards

Y = Total number of samples

In Genova
X = 88554
Y = 90196

Indicator 9 = (**88554** / **90196**) * 10 = **9.8** (Pers. Comm. Nicola Bazzurro)

3.9.2 Current practices

On line monitoring of water resources using distributed smart sensors: Conventional and innovative sensors (i.e. spectro-photometers) can be used at the same time comparing measurements and detecting pollutants concentrations. An effective on line monitoring includes monitoring of process parameters (i.e. flowrates, pressure and water levels in tanks), water quality parameters (pH, residual disinfectant, hardness, ammonia, chlorates) detecting natural or artificial pollution caused by terrorists attacks or by disinfection by-products decays.

Innovative sensors and treatment train for emerging pollutants: it includes sensors to detect Emerging Compounds based on a nanostructured sensing surface; automation and control systems for advanced treatment technologies; RT monitoring systems to detect ECs in drinking water; Development of innovative and cost-effective technologies aimed at improving drinking water quality.

IV – Solid waste treatment

3.10 Nutrient recovery

Measure of the level of nutrient recovery from the wastewater system.

3.10.1 Calculation

A. Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Mm3 year-1)

B. Total amount of wastewater passing the wastewater treatment plants (Mm3 year-1)

Indicator 10 = [A / B] × [% secondary WWT coverage / 100] × 10,

In Genova

92.5% of waste water is treated with nutrient recovering techniques including recovery out of sewage sludge via biological processes that is subsequently recycled amongst others for agricultural purposes (Pers. Comm. Nicola Bazzurro).

Indicator 10 = (**0.925**) * (**94** / 100) ×10 = **8.7**

3.11 Energy recovery WWT

Measure of energy recovery from the wastewater system.

3.11.1 Calculation

A) Total volume of wastewater treated with techniques to recover energy (Mm^3/year).

B) Total volume of water produced by the city (Mm^3/year).

[A / B]×10 = 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^3/year).

D) Total volume of wastewater treated in wastewater treatment plants (Mm^3/year).

Indicator 11 = [(C / D) × (% secondary WWT coverage / 100)] × 10,

In Genova94% of waste water is treated with secondary waste water treatment

50% of this waste water is treated with energy recovering techniques (Pers. Comm. Nicola Bazzurro)

Indicator 11 = [(**0.5**) * (**94** / 100)] × 10 = **4.7**

3.12 Sewage sludge recycling

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.

3.12.1 Calculation

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)

Indicator 12 = [(C+D) / A] × [% 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.

In Genova
A = 6103 tonnes/year (pers. Comm. Mediterranea della acque)
B = 240 tonnes/year (pers. Comm. Mediterranea della acque)
C = 0 tonnes/year (pers. Comm. Mediterranea della acque)
D = 5713 tonnes/year (pers. Comm. Mediterranea della acque)
E = 0 tonnes/year (pers. Comm. Mediterranea della acque)
% secondary WWT coverage = 94%

Indicator 12 = [(**0** + **5713**) / **6103**] × [**94** / 100] × 10 = **8.8**

3.13 Energy efficiency

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

3.13.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 13.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 13 = Score is 4 (Pers. Comm. Nicola Bazzurro)

V – Infrastructure

3.14 Average age sewer

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

3.14.1 Calculation

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.

Indicator 14 = $(60 - X) / (60 - 10) \times 10$

Where X is the average age sewer

In Genova

Tthe average age of sewer is 50 years (Pers. Comm. Nicola Bazzurro)

Indicator 14 = [(60 – **50**) / (60 – 10)] * 10 = **2.0**

3.15 Operating costs recovery (ratio)

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.

3.15.1 Calculation

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

Operating cost recovery (ratio) = (Total annual operational revenues)/(Total annual operating costs)

Total annual operating costs: Total annual operational expenditures for drinking water

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

Therefore the indicator is calculated as follows:

Indicator 15 = (X – 0.33) / (2.34 – 0.33) × 10

Where X is operating cost recovery (ratio).

In Genova

X = 1.19 (IBNET)
Indicator 15 = (**1.19** – 0.33) / (2.34 – 0.33) × 10 = **4.28**

3.16 Water system leakages

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

3.16.1 Calculation

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.

Indicator 16 = (50 – X) / (50 – 0) × 10

Where X is water system leakages (%).

In Genova

X = 25.98% (pers. Comm. Mediterranea delle Acque)
Indicator 16 = (50 – **25.98**) / (50 – 0) × 10 = **4.8**

3.16.2 Current practices

Monitoring of water consumptions using automatic meter readings applications. AMR applications enable water managers to better know what happens at the point of delivery to the customer in terms of meters characterizations and related errors, customer profile, correspondence of the meters with the expected delivery flowrate, anomalous measurements. Water demand monitoring enables also water managers to perform better water balances detecting leaks when minimum night flow increases in the distribution network overtaking an alarm threshold. Detection of errors in meter enables also to reduce commercial or apparent losses establishing the substitution time accordingly to their age.

Detailed analysis of flowrate and pressure in a distribution network performing pressure management with pressure reduction valves and pressure metering at the critical point (the most distant, the highest from the district inlet section).

Application of the sampling theory to parsimonious models where, using detailed knowledge on household water consumption, only a few metered representative customers (selected on the basis of a statistical sampling of water consumptions) are considered for estimating the water use also in the parts of the water network having a lower density of meters.

Advanced monitoring of leaks as analysis and detection of water transients sources using synchronized high resolution pressure meters including low cost noise loggers feeding on-line correlators supporting the evaluation and localization of real and apparent water losses.

3.17 Stormwater separation

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.

3.17.1 Calculation

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)

Indicator 17 = [(B+C) / (A+B+C)] × 10

A = 127 km (pers. Comm. Mediterranea delle Acque)
B = 263 km (pers. Comm. Mediterranea delle Acque)
C 598 km (pers. Comm. Mediterranea delle Acque)

Indicator 17 = $\frac{263+598}{127+263+598}$ x 10 = **8.71**

3.17.2 Current practices

In Genova combined sewer accounts for about half of the total length of sewer collecting raining water. So drainage function tends to be kept separated from waste water collection.

VI – Climate robustness

3.18 Green space

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).

Definition of green area (EEA, 2012A): 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.

3.18.1 Calculation

City specific: Numbers are provided in %

Country average: Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

Indicator 18 = [(X – 16) / (48 – 16)] × 10

Where X is the share of blue and green area (%).

In Genova

x = **28.2% (EEA 2012)**
Indicator 18 = [(**28.2** – 16) / (48 – 16)] × 10 = **3.81**

3.19 Climate adaptation

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

3.19.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 19.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 19 = Score is 4 (Pers. Comm. Nicola Bazzurro). In Italy the Ministry for the Environment delivered a National Strategy for Climate Change Adaptation, where strategies have been described also for specific sectors of activities and geographical (critical) areas.

3.20 Drinking water consumption

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 authorised 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 authorised 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.

3.20.1 Calculation

The volume is then normalized against maximum and minimum volumes for European cities.

Indicator 20 = [1 – (X – 45.2) / (266 – 45.2)] × 10

Where X is m^3/person/year drinking water consumption.

In Genova

X = 89.6 m3/person/year (pers. Comm. Mediterranea delle Acque)

Indicator 20 = [1 - $\frac{89.6-45.2}{266-45.2}$] * 10 = **7.99**

3.21 Climate robust buildings

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.

3.21.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 21.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 21 = Score is 3 (Pers. Comm. Nicola Bazzurro). The issue is addressed at national level within the Annual Urban Environment Quality Report (ISPRA, High Institute for Environmental Protection and Research, Ministry of Environment).

VII – Governance

3.22 Management and action plans

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. 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).

3.22.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 22.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 22 = Score is 5 Pers. Comm. Nicola Bazzurro). Management and monitoring of Integrated Water Cycle is carried out in Italy at the level of ATO (Optimal Territorial Area). In each ATO water services and water provision and disposal are managed by a water company (having its own plan).

3.23 Public participation

A measure of share of people involved or doing unpaid work

3.23.1 Calculation

The indicator is calculated as follows (for EU countries):

Indicator 23 = (X – 5) / (53 – 5) × 10

X = Involvement in voluntary work

In Genova

X = 25% (EFILWC 2006)

Indicator 23 = (**25** – 5) / (53 – 5) × 10 = **5.2**

3.23.2 Current practices

Harvesting smart meters including ICT, smart meters and home integration: in terms of integrated sensors for digital care, home security, energy, health care aimed at implementing the approach of user empowerment also aware of the energy footprint linked to its behaviour.

3.24 Water efficiency measures

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.

3.24.1 Calculation

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.

The following guidance is proposed to make self-assessment score for Indicator 24.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 24 = Score is 3 (Pers. Comm. Nicola Bazzurro). National Authority for water and energy issued at the beginning of 2016 a document stating the rules for measurement services in the integrated water services.

3.25 Attractiveness

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 harbours 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.

3.25.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 25.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Indicator 25 = Score is 1 (Pers. Comm. Nicola Bazzurro). There are not clear and well defined policies at National level, but all is addressed in terms of guidelines and best practices.

4 City Amberprint

The City Amberprint is a complement to the City Blueprint and the Trends and Pressures Framework. The main goal of the City Amberprint is a baseline assessment of the sustainability of Energy, Transport and ICT in cities. To comply with City Blueprint, indicators that have a score between 0 (there is a concern) to 10 (no concern) are proposed. The quantitative indicators were “normalise” on a scale of 0 to 10, where 10 points were assigned to cities that met or exceeded certain criteria on environmental performance. The overall sustainability of the three aspects is expressed as Amber City Index (ACI). The ACI is the geometric mean of the 22 indicators.

Table 4.1: List of City Amberprint indicators for Genova

Category	No.	Indicator	Score
ENERGY	1	Carbon footprint	6.6
	2	Fuel poverty	9.6
	3	Energy consumption	9.6
	4	Energy self-sufficiency	10
	5	Renewable energy ratio	0.4
	6	Energy efficiency plans	6.0
	7	Energy infrastructure investment	4.1
TRANSPORT	8	Commuting time	0.3
	9	Use of public transport	1.5
	10	Bicycle network	1.0
	11	Transportation fatalities	9.7
	12	Clean energy transport	6.0
	13	Transport-related pollutions	8.5
	14	Transport infrastructure investment	0.3
ICT	15	ICT access	4.8
	16	ICT use households	7.6
	17	ICT use water utilities	8.0
	18	ICT use energy utilities	8.5
	19	ICT use transport	7.5
	20	ICT use waste management	7.3
	21	Digital public service	2.3
	22	ICT infrastructure investment	3.5

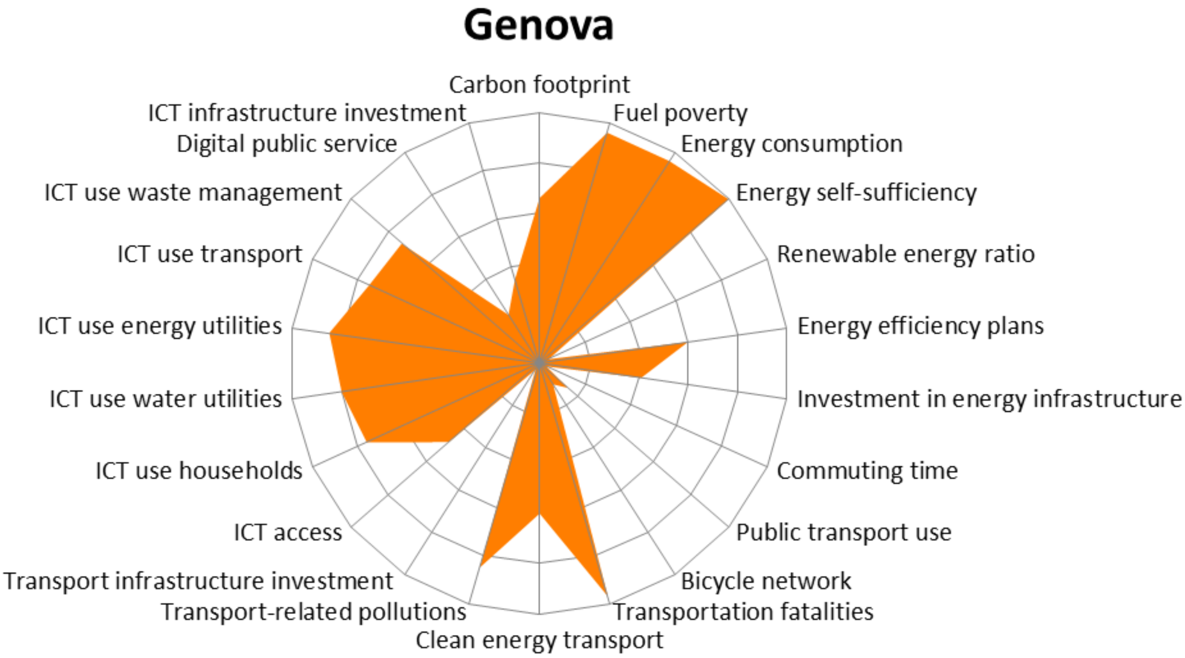

Figure 1.1: City Amberprint of Genova The centre of the circle corresponds to 0 and its periphery to 10. The Amber City Index (ACI) for Genova is 4.4

Energy indicators

4.1 Carbon footprint

How city's carbon footprint (CF) per person per year does compare with the international range? A lower indicator score is given for a larger carbon footprint.

Definition of Carbon Footprint: the total sets of greenhouse gas emissions caused by an organization, event, product or person.

4.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = 10×(16.464 - X) / (16.464 - 0.237),

Where X is the CF/capita/year in the city.

In Genova the CF value is 6.6 tonnes/cap/year (2005):

Indicator 1 = 10×(16.464 **– 6.6**) / (16.464 - 0.237) = **6.08**

4.2 Fuel poverty

What is the proportion of households in the city that are considered to be fuel poor? The lower indicator score is given when the proportion is higher.

Under the Low Income High Costs definition, a household is considered to be fuel poor if:

- they have required fuel costs that are above average (the national median level)
- were they to spend that amount, they would be left with a residual income below the official poverty line.

4.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = (100 - X) / 10,

Where X is the percentage of households in the city considered to be fuel poor.

In Genova

The percentage of households which is considered to be fuel poor is 3.77% (in 2011). Therefore:

Indicator 2 = (100 **– 3.77**) / 10 = **9.6**

4.3 Energy consumption

This indicator presents how does total energy consumption (domestic, industrial and commercial, and transport) per capita in the city compares with the international range (kgoe/cap/yr). A lower indicator score is given where the consumption is greater.

4.3.1 Calculation

The indicator is calculated as follows:

Indicator 3 = 10×(5419 – X) / (5419 – 893.15),

where X is the total energy consumption for the city in kgoe/cap/yr.

In Genova

Total energy consumption is 1084.2 kgoe/cap/yr (in 2013): Therefore:

Indicator 3 = 10×(5419 – **1084.2**) / (5419 – 893.15) = **9.6**

4.3.2 Current practices

Analysis and assessment of energy efficiency in water distribution networks quantifying the energy impact of water losses by means of a specific and integrated energy indicator (WSEE Water Supply Energy Efficiency) split into indicators for the structure of the network, the water losses and the pumping systems.

4.4 Energy self-sufficiency

Measure of the proportion of a city's demand that could be met through indigenous production including renewable resources, waste, and traditional but generated locally in the city. A lower indicator score is given where self-sufficiency is lower.

4.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = 10 × (X / Y),

where X is the the amount of energy generated locally, and Y is the total energy consumption in the city.

In Genova

X= 3106 and Y is 2791 (2009). Therefore:

Indicator 4 = 10 × (**3106 / 2791)** = 11.13 = **10**

Note: No data at city level but only regional.

4.5 Renewable energy ratio

A measure of proportion of total energy derived from renewable sources in the city, as a share of the city's total energy consumption compared to the international range. A lower indicator is given where the percentage is lower.

4.5.1 Calculation

The indicator is calculated as follows:

Indicator 5 = 10 × (X – 1.15) / (98.8 – 1.15),

Where X is the percentage of energy derived from renewable sources.

In Genova

4.98% of energy was derived from renewable sources (in 2005). Therefore:

Indicator 5 = 10 × (**4.98** – 1.15) / (98.8 – 1.15) = **0.4**

4.5.2 Current practices

In Genova renewable energy is produced from hydropower plants everywhere it is possible, waste water (biogas and sludge thermal treatment) and solid waste.

4.6 Energy efficiency plans

Measure of the application of energy efficiency measures by the range of energy users across the city. A lower indicator score is given where efficiency measures are more limited. 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. energy companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the efficiency of energy usage:

- at household level, e.g. efficient household appliances,
- at community level by energy efficient buildings or energy recycling, e.g. heat can be collected in summer, and stored to use it in winter,
- by encouraging people to change their behaviour.

4.6.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 6.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

Tthere is a Sustainable Energy Action Plan which is in force since different years and it is publicly available through web site.

Therefore, Genova is given a score of 6.

4.7 Energy infrastructure investment

A measure of the investment in the infrastructure for energy distribution compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the energy infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = 10 × [(100 × (X / Y) – 0.06) / (2.29 − 0.06)]

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Genova

Total energy infrastructure investment per capita is 257 Euros/capita and GDP per capita in Greece is 26175,8. Therefore:

Indicator 7 = 10 × [(100 × (**257** / 26175.8) – 0.06) / (2.29 − 0.06) = **4.1**

Transport indicators

4.8 Commuting time

A measure of the proportion of time spent on commuting (minutes per day). Includes average time spent in: public transport (bus, coach, train, underground, tram, light railway), car (as driver or passenger), motorcycle, moped, scooter, bicycle, taxi on the way to and from work. A lower indicator score is given where the time spent on commuting is greater.

4.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = 10 × (74.2 – X) / (74.2 – 10.8),

Where X is the average time spent on commuting in the city (or region).

In Genova

The average time spend on commuting per day is 72 minutes (in 2008). Therefore:

Indicator 8 = 10 × (74.2 – **72**) / (74.2 – 10.8) = **0.4**

4.9 Public transport use

Kilometres travelled by public transport and bicycles compared to overall kilometres travel by all means of transport. A lower indicator score is given where the use of public transport and bicycles is higher.

4.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = 10 × (X / Y),

Where X is the kilometres travelled by public transport and cycling (or %) and Y is the overall kilometres travelled by all means of transport (or %).

In Genova

In Greece there was 2889301 km travelled by public transport and cycling versus 19789733 km travelled by all means of transport (in 2014). Therefore:

Indicator 9 = 10 × (**2889301 / 19789733)** = **1.5**

4.10 Bicycle network

Length of bicycle network per inhabitant compared to the international range. The lower indicator score is given where the length of bicycle network per inhabitant is lower.

4.10.1 Calculation

The indicator is calculated as follows:

Indicator 10 = 10 × (X / 2.03),

Where X is the length of bicycle network per capita.

In Genova

There are 122000 metres of designated cycle routes and 587593 inhabitants (in 2015). Therefore, total length of bicycle network in meters per inhabitant is 0.2076 m/cap:

Indicator 10 = 10 × (**0.2076** / 2.03) = **1.0**

4.11 Transportation fatalities

A measure of transportation fatalities per 100 000 population in the city per year. A lower indicator score is given where the number is greater.

4.11.1 Calculation

The indicator is calculated as follows:

Indicator 11 = 10×(33.4 – X/Y)/(33.4 – 3.6)

Where X is the number of fatalities related to transportation of any kind within the city borders and Y is the 100,000 of the city’s total population.

In Genova Province there were 39 transportation fatalities and the population is 884635 (in 2008). Therefore:

Indicator 11 = 10×(33.4 **–39/884635**×100000)/(33.4 – 3.6) = **9.7**

Note: Indicator calculated at regional level

4.12 Clean energy transport

Clean energy transport and clean energy sharing transport. A lower indicator score is given where efficiency measures are more limited. 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. transport companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the transport efficiency by e.g.

- efficient public transport (electric train, subway/metro, tram, cable railway)
- efficient private transport (electric taxis or cars, electric scooter, bicycling)
- and encouragements to use public transport.

4.12.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 12.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Genova

The issue of clean energy transport is addressed within the Plan for Urban Mobility of the Municipality of Genova which is available for public consultation on the web. Therefore, Genova is given a score of 6.

4.13 Transport-related pollutions

Air pollutant emissions (Sulphur oxides (SO_x), Nitrogen oxides (NO_x), Ammonia (NH_3), Non-methane volatile organic compounds, Particulates (PM_{10}) - airborne particulate matter with aerodynamic diameter less than 10 micrometres) from transport measured in kg per capita per year. A lower indicator score is given where the pollutant emissions are greater.

4.13.1 Calculation

The sub-indicators are calculated as follows:

- Sulphur oxides (SO_x):

  $SO_x = 10 \times (2.753 – A) / (2.753 – 0.114)$

  where A is the emissions from the city (t).

- Nitrogen oxides (NO_x):
  $NO_x = 10 \times (0.337 - B) / (0.337 - 0.021)$
  where *B* is the emissions from the city (t).
- Ammonia (NH_3):
  $NH_3 = 10 \times (9{,}153.3 - C) / (9{,}153.3 - 11.3)$
  where *C* is the emissions from the city (t).
- Non-methane volatile organic compounds (Non-mth):
  Non-mth = 10 × (5.643 – D) / (5.643 – 0.432)
  where *D* is the emissions from the city (t).
- Particulates (PM_{10}):
  $PM_{10} = 10 \times (2.197 - E) / (2.197 - 0.169)$
  where E is the emissions from the city (t).

Therefore the indicator is calculated as follows

Indicator 13 = (SO_x + NO_x + NH_3 + Non-mth + PM_{10}) / 5

In Genova

The emissions are as follows: Sulphur oxides – 0,00152009 tons, Nitrogen oxides – 0,01285946 tons, Ammonia 0,00018161 tons, Non-methane volatile organic compounds – 0,01081036 tons Particulates PM10 – 0,00084822 tons (in 2011). Therefore:

Indicator 13 = (10 + 10 + 10 + 10 + 10) / 5 = **10**

4.14 Transport infrastructure investment

A measure of the investment in the transport infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.14.1 Calculation

The indicator is calculated as follows:

Indicator 14 = 10 × (100 × X/Y – 0.02) / (3.89 − 0.02)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Genova

Total transport infrastructure investment per capita is 38,53 Euros/capita and GDP per capita in Italy is 25728,6 (in 2015). Therefore:

Indicator 14 = 10 × (100 × **38,53/25728,6** – 0.02) / (3.89 − 0.02) = **0.3**

ICT indicators

4.15 ICT access

The ICT access is a measure of access to information and communication technology (ICT) in the city. A lower indicator score is given where the ICT access is lower.

4.15.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Mobile-cellular telephone subscriptions per 100 inhabitants, where X is the number of mobile- cellular telephone subscriptions per 100 inhabitants in the city: A = 10 × (X / 120)
- International Internet bandwidth (bit/s) per Internet user, where Y is the International Internet bandwidth (bit/s) per Internet user in the city: B = 10 × Y / 787, 260
- Proportion of households with a computer, where Z is the percentage of households with a computer in the city: C = Z / 10
- Proportion of households with Internet access, where Q is the percentage of households with Internet access in the city: D = Q / 10

The indicator is calculated as follows:

Indicator 15 = (A+B+C+D) / 4.

In Genova

In Italy the values are as follows (2014):

- X = 159, so A = 10 × (**159** / 120) = **13.52 = 10**
- Y = 2,076, so B = 10 × (**2,076** / 787,260) = **0**
- Z = 36,61, so C = (**36,61** / 10) = **3.66**
- Q = 22, so D = **22** / 10 = **2.2**

Therefore:

Indicator 15 = (**10** + **0** + **3.7** + **2.2**) / 4 = **4.0**

<u>Note:</u> No data at a city level.

4.16 ICT use households

The ICT use in households is a measure of use of information and communication technology (ICT) in the city. A lower indicator score is given where the ICT use is lower.

4.16.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Proportion of individuals using the Internet, where X is the percentage of population in the city using the Internet: A = X / 10
- Fixed (wired)-broadband subscriptions per 100 inhabitants, where Y is the number of fixed (wired)-broadband subscriptions per 100 inhabitants in the city: B = 10 × (Y / 60)
- Wireless-broadband subscriptions per 100 inhabitants, where Z is the number of wireless-broadband subscriptions per 100 inhabitants in the city: C = Z / 10

Therefore, the indicator is calculated as follows:

Indicator 15 = (A + B + C) / 3

In Italy the values are as follows (2014):

- X = 48 so A = **48** / 10 = **4.8**

- Y = 22.97, so B = 10 × (**22.97** / 60) = **3.8**
- Z = 141, so C = **141** / 10 = **14.1 = 10**

Therefore:

Indicator 15 = (**4.8** + **3.8** + **10**) / 3 = **6.2**

Note: No data at a city level.

4.17 ICT use water utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.17.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Genova

The following scores were given (2016):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**9**	e.g. SCADA system, energy management
Maintenance	**8**	e.g. asset management data base and GIS
Planning and design	**8**	e.g. optimisation, GIS interface
Customer service	**7**	e.g. smart metering

Therefore the indicator is calculated as follows:

Indicator 17 = (**9** + **8** + **8** + **7**) = **8**

Almost all water management assets are monitored via remote control sensors and SCADA systems. The assets are all mapped into a GIS, developed as software by a dedicated department of IREN, based upon Autodesk map. Water utility networks (water, sewer) are regularly updated in this GIS that is used to plan and monitor maintenance activities and simulate the networks. Smart metering, tested in some pilots in the city, is going to grow.

4.18 ICT use energy utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.18.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Genova
The following scores were given (2016):

Description	Score (0-10) evaluated locally	Comments
Operation	**9**	e.g. SCADA system, energy management
Maintenance	**8**	e.g. asset management data base and GIS
Planning and design	**8**	e.g. optimisation, GIS interface
Customer service	**9**	e.g. smart metering

Therefore the indicator is calculated as follows:
Indicator 18 = (**9** + **8** + **8** + **9**) = **8.5**

Almost all gas distribution assets are monitored via remote control sensors and SCADA systems. The assets are all mapped into a GIS, developed as a software by a dedicated department of IREN, based upon Autodesk map. Gas networks are regularly updated in this GIS that is used to plan and monitor maintenance activities and simulate the networks. Smart metering, tested in some pilots in the city, is going to grow.

4.19 ICT use transport

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.19.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance		e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design		e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service		e.g. mobile bus tickets, online feedback forms

Final indicator is an average of the four values.

In Genova

The following scores were given (2015):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**9**	e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance	**6**	e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design	**7**	e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service	**8**	e.g. mobile bus tickets, online feedback forms

Therefore the indicator is calculated as follows:

Indicator 19 = (**9** + **6** + **7** + **8**) = **7.5**

COA (Operational Automation Center) Office of the Municipality of Genova of the Urban Monility Department, control the functioning status, coordinates and supervises the maintenance interventions of lights and collects all the data about traffic. Moreover manages the information panels about urban mobility, the video cameras for traffic control, integrates the data of traffic with the public transport monitoring system.

The office provides also support to Civil Protection and Local Police in case of extreme meteo events (e.g. floods).

Tickets can be also bought via SMS.

4.20 ICT use waste management

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.20.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. ICT system for logistics of waste collection
Maintenance		e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design		e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service		e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Final indicator is an average of the four values.

In Genova
The following scores were given (2016):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**8**	e.g. ICT system for logistics of waste collection
Maintenance	**7**	e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design	**8**	e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service	**6**	e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Therefore the indicator is calculated as follows:
Indicator 20 = (**8** + **7** + **8** + **6**) / 4 = **7.5**

A GIS system is applied for the management of the waste collection in terms of optimal path to be adopted by the vehicles used for the collection service.

A door to door system aimed at improving the percentage of waste separations has been studied. The new systems have been implemented in small areas and in going to be implemented in the whole metropolitan area.

In this framework the waste collection infrastructure as big cans in the streets will be substituted by small cans to be placed by each buildings front door scheduling a specific collection service in different days of the week for each kind of waste (glass, plastic, metal, paper and organic).

4.21 Digital public service

A measure of ICT implementation within public administration (percentage of Internet users that have engaged with the public administration and exchanged filled forms online) and health system. A lower indicator score is given where there are less ICT tools implemented.

4.21.1 Calculation

Following sub-indicators need to be calculated:

- Proportion of eGovernment Users, A. Percentage of individuals sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet X divided by 10: A = X/10
- Medical Data Exchange, B. Percentage of general practitioners using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists, Y, divided by 10: B = Y/10

Therefore, the indicator is calculated as follows:

Indicator 21 = (A + B) / 2

In Genova

29.8% of individuals is sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet (2014). Therefore:

A = **29.8** / 10 = **3.0.**

16.7% of general practitioners is using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists. Therefore:

B = **16.7** / 10 = **1.7**

The final indicator is:

Indicator 21 = (**3.0** + **1.7**) / 2 = **2.4**.

4.22 ICT infrastructure investment

A measure of the investment in the ICT infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the ICT infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.22.1 Calculation

The indicator is calculated as follows:

Indicator 22 = 10 × [(100 × (X / Y) – 0.09) / (1.5 − 0.09)]

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Genova

Total ICT infrastructure investment per capita is 156.81 Euros/capita and GDP per capita in Italy is 26947.3 (in 2010). Therefore:

Indicator 22 = 10 × [(100 × (**156.81/26947.3)** – 0.09) / (1.5 − 0.09)] = **3.5**

5 Conclusion

At Genova level, the Smart City challenges are to improve the quality of life of every citizen by the diffusion of networks, technological innovations and sustainable economic development.

This is done by rethinking the concept of the city, pursuing the concept of a concrete utopia in an urban space at human scale. The ambition and goal is to build a city that knows how to exploit the potential of high technology creating sustainable development, effective mobility and opportunities for all.

Effective and clean transport links, informed energy consumption, transparent and digital management, proactive and participatory citizen: all of this is achievable, provided that a clear vision of current state of the art technologies and best practices is available, as the present document did.

Planning the city of the future will involve reducing the waste of resources while improving services to citizens. But even before that, it means pioneering new cultural models that will change our development, our economy and ultimately our community.

The reference to “smart” comes from the use of a system which is able to take into account different variables and predict the effects of actions taken in both planning and management, by programming, for example, the effects of climate change, the quality of life, the economic development of choices made in each field.

The smart city knows how to combine Mediterranean creativity with planning elements based on statistical models and analysis of the area that allow predictions to be made about longer-term periods.

Starting from a comprehensive analysis of the degree of smartness of the city, through specific indicators, declined here as Pressure indicators, Blueprint indicators, Amberprint indicators, with reference to different sectors and environmental constraints, allowed to identify major constraints and criticisms at city management level and starting from a valuable base of knowledge to plan future activities within the Genova Smart City challenge.

6 Feedback from city council

Municipality of Genova starts from the first assumption that digital technologies are at the basis for the development of a Smart City. Hence, a close integration among waste, water and energy management with ICT is strong recommended and requested in the smart city strategy.

Smart city means data integration and sharing, that cannot be done without appropriate technologies and technological tools able to connect data from different operators in the respect of privacy and confidentiality.

Another important aspect in view of awarding the smart city challenge, is the involvement of all the stakeholders operating at territorial level, in order to make synergy and share the objectives.

BlueSCities, in such a view, offer a big support because of its clustering activities within the sectors and among different domains (transversal clustering). Public administrations need in fact of a model/guidance that pushed towards the integration of different sectors.

Another important contribution given by the BlueSCities project and the present document, is to favour the positioning of Genova at international level, assessing through standards indicators the smartness level of the city according to other cities in Europe and in the world.

Also, a direct visualization of criticalities and concers as the ones provided by the radar chart and the indicators, is of course useful to define, at administration level, the priorities at city management level, that for now are increasing the resilience at climate changes and improving the energy management.

Finally, the development towards a smart city, following well stated plans and priorities of interventions, must be sought of course through the optimization of resources, the development of new business models, and the Private Public Partnerships. EU resources, in this field, are fundamental to position the Genova city in Europe. Finally, to cope with the EU projects funding manager of the Municipality of Genova "we, as administration, choose to be located towards Europe as a challenger, not just a follower".

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Annex C – Helsinki Report

BlueSCities

Deliverable Title	**D3.2c Report on the Helsinki case study**
Deliverable Lead:	VTT Technical Research Centre of Finland Ltd
Related Work Package:	WP3: City Case Studies
Related Task:	T3.2: Case-studies
Author(s):	Eetta Saarimäki, Mona Arnold
Dissemination Level:	Public/Confidential
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Start Date of Project:	01.02.2015
Duration:	24 months
Abstract	The key objective was to assess the city of Helsinki, Finland using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Helsinki has a Blue City Index score of 7.1 and an Amber City Index of 6.3 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 7.0.

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D3.2 V0.2 Mona Arnold and Eetta Saarimäki, Incorporation of City Blueprint, Trends and Pressures and the Amberprint report into one report 20/03/2016. Trends and pressures were originally provided by Kees van Leeuwen and Stef Koop and checked by Mona Arnold

Comments by Anna Strzelecka 24.03.2016

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Executive Summary

The key objective was to assess the city of Helsinki, Finland using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Helsinki has a Blue City Index score of 7.1, and an Amber City Index of 6.4 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 7.0.

1 Introduction

Helsinki is the capital and largest city of Finland. It is in the region of Uusimaa, in southern Finland, on the shore of the Gulf of Finland, an arm of the Baltic Sea. The city boundaries cover a surface area of 715.48 km2 while the metropolitan region covers 1,489.84 km2. Helsinki has a population of 626,305, making almost half of the overall population of the metropolitan area 1,431,641 (2015). It is the world's northernmost metropolitan area of over one million people, and the city is the northernmost capital of an EU member state. In 2011, the Monocle magazine ranked Helsinki the most liveable city in the world in its "Liveable Cities Index 2011".

Helsinki water area encompasses both extensive sea areas and sweet water sources (Vantaa river, creeks and ponds. Local water quality is affected by stormwater pollutants, scattered nutrient loads, waste water discharged in the outer archipelago and the water quality of the open sea of the Gulf in Finland.

For the protection of the Baltic Sea, In 2007, the City of Helsinki committed to concrete voluntary action for the Baltic Sea. This commitment resulted in the Baltic Sea Challenge, and the Baltic Sea was addressed in the city' strategic work. The joint Action Plan for the Baltic Sea comprised 37 concrete actions divided into nine themes, and approximately a dozen civil service departments and administrative branches were tasked with carrying out these actions.

Helsinki's first water treatment plant was built in 1910. Phosphorous removal was applied from the 1970's and nitrogen removal in the 1990. To mimimise the city's impact on the fragile, highly polluted Baltic sea, the treated waste water is today led via a seven km long discharge pipe to the open sea, where it is efficiently diluted into larger water masses.

Helsinki drinking water is pumped from Päijänne lake situated 100-150 km north of Helsinki. The Päijänne Water Tunnel is the world's second longest tunnel in the USA). It is 120 kilometers long and runs 30–100 meters under the surface in bedrock. In addition to Helsinki, the tunnel provides fresh water for > million people in other cities surrounding Helsinki.

2 Trends and Pressures Framework

The trends and pressure indicators are standardized to a scale of 0-4 and divided in ordinal classes expressed as a 'degree of concern'.

Table 2.1: *Trends and pressures* in Helsinki. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.

			0	1	2	3	4
Trends and pressures	**Social**	**25. Urbanization rate**	▨	▨			
		26. Burden of disease	▨				
		27. Education rate	▨	▨			
		28. Political instability	▨	▨			
	Environmental	**29. Water scarcity**	▨	▨			
		30. Flood risk	▨	▨	▨		
		31. Water quality	▨	▨			
		32. Heat risk	▨				
	Financial	**33. Economic pressure**	▨	▨			
		34. Unemployment rate	🟥	🟥	🟥	🟥	
		35. Poverty rate	▨				
		36. Inflation rate	▨				

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Explanation of the concerns of Helsinki

According to the World Bank (2014), GDP is decreasing in Finland, which is a concern. Inflation is also 0 % and the unemployment rate is increasing. This is a risk to whole economy and thus threatening to environmental issues.

Social Pressures

2.1 Urbanization rate

Percentage of population growth either by birth or migration. The percentages are annually averages per country. Urbanization increases the pressure on integrated water resources management (IWRM) in cities.

Calculation:

The indicator is calculated as follows:

Score urbanization rate = $-0.114\mathbf{X}^2 + 1.3275\mathbf{X} + 0.1611$

Where X is the urbanization rate (%). For urbanization rates lower than 0% the score is also zero and the above formula is not applied.

In Helsinki

Finland's urbanization rate is 0.50%, CIA (2014). Therefore:

X = 0.50%

Score urbanisation rate = $-0.114\ (\mathbf{0.5})^2 + 1.3275\ (\mathbf{0.5}) + 0.1611 = \mathbf{0.80}$

Urbanization rate is not a concern for Finland.

2.2 Burden of disease

The gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability of population growth either by birth or migration. The indicator measures the age-standardized disability-adjusted life years (DALY) per 100,000 people. DALY is the quantification of premature death, burdens of disease and disability in life years. It is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health, e.g. disease, injuries and risk factors (WHO, 2004).

Calculation:

WHO calculation of DALY

Years of premature death: Sum of the number of deaths at each age * [global standard life expectancy for each age – the actual age].

Years lost due to disability: Number of incident cases in that period * average duration of the disease * weight factor.

Years of premature death + Years lost due to disability = DALY

The average DALY per 100,000 people is a strong tool to indicate the burden of disease.

The WHO subdivided these DALY's per 100,000 people into 5 classes. These classes are used to standardize this indicator to a score of 0 to 4 in the CBF analysis as shown below.

DALY per 100,000 people	Score
0 – 20,000	0
20,000 – 40,000	1
40,000 – 60,000	2
60,000 – 80,000	3
80,000 <	4

In Helsinki:

X = 19843 (WHO 2012)

Score is 0 point. The burden of disease is no concern for Helsinki.

2.3 Education rate

Education rate expressed as percentage of children completing their primary education

Calculation:

The indicator is calculated as follows:

Score education rate = $-10^{-5}\mathbf{X}^3 + 0.0012X^2 - 0.0426\mathbf{X} + 4.3057$

Where X is the education rate (%)

In Helsinki

X = 99.0% (World Bank 2013)

$-10^{-5}*99^3 + 0.0012*\mathbf{(99)}^2 - 0.0426*\mathbf{(99)} + 4.3057 = 1.43$.

Education rate is of little concern for Helsinki.

2.4 Political instability (and absence of violence)

The estimated likelihood that the government will be destabilized or overthrown by violent means such as terrorism and politically-motivated violence of population growth either by birth or migration.

Calculation:

The indicator is calculated as follows:

4 – [((Estimated political stability score – 2.5) / (2.5 – 2.5)) × 4] = Score

In Helsinki

X = 1.36

4- [(**1.36** - -2.5)/(2.5- -2.5) x 4] = 0.91 Nationsencyclopedia.com, (2016); Kaufmann et al (2009)

Political instability is not a concern for Helsinki.

Environmental Pressures

2.5 Water scarcity

Indicator 5 consists of three sub-indicators: Fresh water scarcity, Groundwater scarcity, Salinization & seawater intrusion

2.5.1 Fresh water scarcity

The abstracted fresh water as percentage of total renewable resource. This includes surface water and groundwater sources.

The scoring method is in accordance with the European Environmental Agencies classification (OECD, 2004; WRI, 2013).

% of renewable resource abstracted	Score
0. –.2	0
2 – 10	1
10 – 20	2
20 – 40	3
>40	4

In Helsinki

X = 2.7 % (Aquastat 2015)

Score of 1 points.

Fresh water scarcity is of no concern for Helsinki.

2.5.2 Groundwater scarcity

The abstracted groundwater as a percentage of the annual groundwater recharge. This is a measure of the pressure on groundwater resources.

Calculation:

The indicator scoring is in accordance with the classification used by UNESCO.

% abstracted of annual recharge	Score
0.- 2	0
2 - 20	1
20- 50	2
50 - 100	3
>100	4

In Helsinki
X = 6.0 % (Aquastat 2015)
Score of 1 point.
Groundwater scarcity is of little concern for Helsinki.

2.5.3 Salinization & seawater intrusion

Measure of the vulnerability of seawater intrusion and salinization of the soil.

Calculation method:

This indicator score is based on a quick literature check in which seawater and groundwater intrusion are scored as suggested below.

Seawater intrusion

Description	**Score**
No seawater intrusion reported and city not prone to (future) intrusion	0
No seawater intrusion reported and city can experience intrusion in coming century	1
No seawater intrusion reported but city is prone to intrusion in the near future	2
Seawater intrusion reported	3
Seawater intrusion reported and city is particularly prone to intrusion	4

Groundwater salinization

Based on literature studies, here the following scheme is applied to determine a score:

Description	**Score**
No concern	0
Low concern	1
Medium concern	2
Concern	3
Great concern	4

The highest score of both indicators is used as the final score for salinization and seawater intrusion.

In Helsinki

X = Score of 0 points for both seawater intrusion and salinization (Scheidleder et al. 2004).

2.6 Flood risk

The indicator flood risk consists of 4 sub-indicators: Urban drainage flood, Sea level rise, River peak discharges, Land subsidence.

2.6.1 Urban drainage flood

Risk of flooding due to intensive rainfall expressed as the share of urban soil that is sealed.

Calculation method:

Sealed soil cover in the city standardized according to the min-max method. The minimum and maximum values are determined by taking the bottom and the top 10% of the 572 European cities assessed. Green and blue areas refer to 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 (EEA, 2012A).

The indicator is calculated as follows:

$(X - 31.7) / (69.6 - 31.7) * 4 = \text{Score}$

In Helsinki

X = 48.7 (EEA 2015).

$(48.7 - 31.7) / (69.6 - 31.7) * 4 = 1.8$

Urban drainage flooding is a medium concern for Helsinki.

2.6.2 Sea level rise

Measure of the vulnerability of flooding due to sea level rise. Percentage of the city that would flood with 1 meter sea level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams etcetera are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter sea level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
41-100	4

In Helsinki:

X = 3.21% (EEA 2015)

Score is 0 points.

Sea level rise is no concern for Helsinki.

2.6.3 River peak discharges

Measure for the vulnerability of flooding due to river level rise. Also flash floods from outside the city are included in this indicator. Percentage of the city that would flood with 1 meter river level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams etcetera are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter river level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
40-100	4

In Helsinki:

X = 28.8% (EEA 2015)

Score is 3 points.

River peak discharge is a concern for Helsinki.

2.6.4 Land subsidence

Land subsidence increases the risks of river and coastal floods and salt water intrusion. The cause of land subsidence is irrelevant for its impact on flooding.

Calculation method

This score is based on a qualitative assessment according to the following classification:

Score	Description
0	No infrastructure damage, no flood risk
1	Low/medium infrastructure damage expected, no major increase in flood risk expected
2	Experienced infrastructure damage and medium infrastructure damage expected or <0.50m subsidence by 2100 in a substantial area of the city.
3	Serious experienced infrastructural damage or < 1m subsidence by 2100 in a substantial area of the city
4	Serious experienced infrastructure damage, Imminent flooding/ < 2m subsidence by 2100 in a substantial area of the city

In Helsinki

X = Score is 0 points.

No indication of flood risk due to land subsidence has been found in literature for Helsinki.

As for flooding Helsinki has developed a substantial risk assurance plan, but land subsidence is not included, as not considered relevant (Uudenmaan ELY-keskus 2014).

2.7 Water quality

Water quality consists of two sub-indicators: Surface water quality, Biodiversity.

2.7.1 Surface water quality

Measure of relative surface water quality. A lower Indicator score is given for better quality.

Calculation method:

A national surface water quality index (WQI) is available as a measure out of 100. Then, the indicator is calculated as follows:

(100 – WQI) / 25 = score

In Helsinki

X = 87.6 (EPI 2010)

(100 - **87.6**) / 25 = 0.50

Surface water quality is no concern for Finland

2.7.2 Biodiversity

Measure of the biodiversity of aquatic ecosystems in the city. A low indicator score is given where biodiversity is good.

Calculation method

The calculation is based on national or regional data when city-level data are not available. There are many ways of assessing biodiversity, so there is no globally uniform approach.

For EU countries, it is recommended to use data from the European Environment Agency (EEA) on ‘percent of classified waters in less than good ecological status’ as shown in this map – for which a high resolution version is available via the link.

Then apply the following criteria to determine an Indicator score:

% of waters with less than good ecological status or potential	**Indicator value (for EU countries)**
<10%	0
10 to 30%	1
30 to 50%	2
50 to 70%	3
≥ 70%	4

For non-EU countries, it is recommended to use data from software called the Environmental Performance Index (EPI), led by Yale University (epi.yale.edu).

The latest 2012 update does not include the relevant parameter called ‘Water – impact on ecosystem’. This is available from the 2010 version (see also Indicator 4).

The value is obtained from the Country Profiles.

In Helsinki

X = 30-50% (EEA 2012):

Score point is 2.

Biodiversity in surface water is of medium concern for Helsinki.

2.8 Heat risk

Prediction of heat island effects severity on human health

Calculation method

1. Number of combined tropical nights (>20°C) and hot days (>35°C) in the period 2071-2100, where the maximum is set on 50 days. The number is standardized using the following formula:

[Number of combined tropical nights and hot days/50]×4 = score

2. Percentage of green and blue urban area. Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

4 – [(% green and blue area – 16) / (48 – 16) × 4] = score

3. The overall score is the arithmetic average of both standardized scores.

In Helsinki

Number of combined nights higher than 20 °C and days above 35 °C is zero.

X1 = [**0** / 50] × 4 = 0

Green coverage 45.7 % (Arcgis 2015)

X2 =4 - [(**45.7** – 16) / (48 – 16) × 4] = 0.3

The overall score of Helsinki is (**0**+**0.3**) / 2 = 0.15

Heat risk is relatively no concern for Helsinki.

Financial Pressures

2.9 Economic pressure

Gross Domestic Product (GDP) per head of the population is a measure of the economic power of a country. A low GDP per capita implies a large economic pressure.

Calculation method

The country average GDP the world (World Bank 2013) is taken. From all country GDP values the average of the lowest 10% is taken as minimum (514.7 US$/cap/yr) and the average of the highest 10% is taken as maximum (59231.2 US$/cap/yr). The country GDP is standardized according to the min-max method.

Score = 4 – [((**X** – 514.7) / (59231.2 – 514.7))×4]

Where X is GDP per capita per day (US$)

In Helsinki
X = 47219 US$/cap/yr (IMF 2013)
4 - [((**47219** - 514.7) / (59231.2 - 514.7))*4] = 0.8
Economic pressure is a little concern for Helsinki.

2.10 Unemployment rate

Percentage of population of the total labour force without a job.

Calculation method
Score unemployment rate = $0.0002\mathbf{X}^3 – 0.0173\mathbf{X}^2 + 0.5077\mathbf{X} – 0.8356$
Where X is unemployment rate (%)

In Helsinki
X = 8.6% (World Bank 2016)
$0.0002\ (\mathbf{8.6})^3 – 0.0173\ (\mathbf{8.6})^2 + 0.5077\ (\mathbf{8.6}) – 0.8356 = 2.38$
Unemployment rate is a medium concern for Helsinki.

2.11 Poverty rate

Percentage of people that is below the poverty line of 2 US$ a day.

Calculation method
Score poverty rate = –0.0001X2 + 0.0404X + 1.1686
Where X is poverty rate (% less than 2US$ a day)

In Helsinki
X = 0.0% (World Bank 2016)
–0.0001*(0.0)2 + 0.0404*(0.0) + 1.1686 = 1.1686
Poverty rate is no concern of Helsinki.

2.12 Inflation

Percentage inflation per year. High inflation rates may hamper investments.

Calculation method
Score inflation rate = $0.0025\mathbf{X}^3 – 0.0744\mathbf{X}^2 + 0.8662\mathbf{X} + 0.0389$
Where X is the inflation rate (%).

In Helsinki
X = 0.0% (Tilastokeskus, 2016)
$0.0025\ (\mathbf{0.0})^3 – 0.0744\ (\mathbf{0.0})^2 + 0.8662\ (\mathbf{0.0}) – 0.0389 = -0.0389$
Inflation rate is not a concern for Helsinki (Finland), although deflation may be a financial concern.

3 City Blueprint

Table 3.1: List of City Blueprint indicators for Helsinki

Category	No.	Indicator	Score
I	1	Secondary WWT	9.8
	2	Tertiary WWT	9.8
	3	Groundwater quality	9.8
II	4	Solid waste collected	8.7
	5	Solid waste recycled	8.5
	6	Solid waste energy recovered	8.6
III	7	Access to drinking water	10.0
	8	Access to sanitation	9.9
	9	Drinking water quality	10.0
IV	10	Nutrient recovery	9.8
	11	Energy recovery	9.8
	12	Sewage sludge recycling	9.9
	13	WWT Energy efficiency	10.0
V	14	Average age sewer	4.0
	15	Operation cost recovery	7.9
	16	Water system leakages	6.4
	17	Stormwater separation	9.5
VI	18	Green space	9.3
	19	Climate adaptation	7.0
	20	Drinking water consumption	9.0
	21	Climate robust buildings	7.0
VII	22	Management and action plans	8.0
	23	Public participation	5.0
	24	Water efficiency measures	4.0
	25	Attractiveness	8.0

Categories: I – Water quality, II – Solid waste treatment, III – Basic water services, IV – Wastewater treatment, V – Infrastructure, VI Climate robustness, VII - Governance

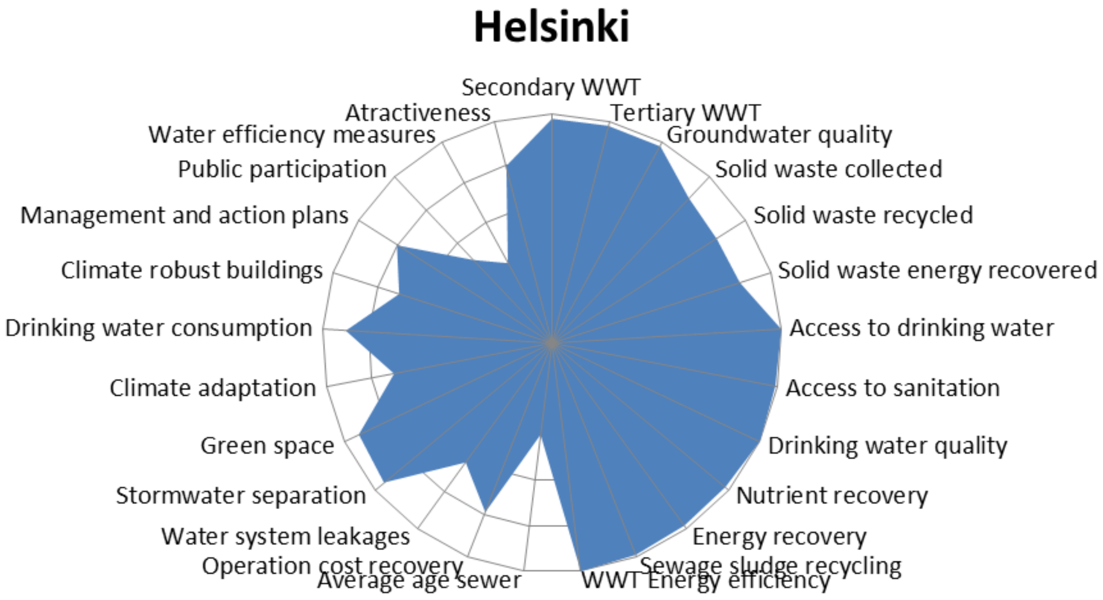

Figure 1.1. City Blueprint of Helsinki. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). Helsinki Blue City Index has a score of 8.2

I – Water quality

3.1 Secondary WWT

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 (biochemical oxygen demand) and nutrient removal.

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).

3.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = **X** / 10,

Where X is the percentage of population connected to secondary sewage treatment. Assumed that there is only tertiary treatment after secondary treatment.

The population of Helsinki water treatment plant area = 1.1 Millions (Helsinki metropolitan area)

Total Waste Water Collected: 130 Mm3/year (HSY 2015a)

X = Helsinki has 98% of secondary treatment. (Fred 2015)

The score for the coverage of secondary WWT becomes: 98 / 10 = 9.8

Indicator 1 = 9.8

3.1.2 Current practices

The treatment process in the centralized wastewater treatment plant is based on an activated sludge method and it has three phases: mechanic, biological and chemical treatment. The efficiency of nitrogen removal has been increased with a biological filter, which is based on the activity of denitrification bacteria. Helsinki Area Environmental Service (HSY) is responsible for both water services and waste management and providing regional and environmental information. Moreover, based on extensive biogas production and landfill gas collection and utilisation, HSY is producing more energy than is needed in its waste and water management operations.

3.2 Tertiary WWT

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 inters the surface water.

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

3.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = **X** / 10,

Where X is the percentage of population connected to tertiary sewage treatment.

In Helsinki

Indicator 2 is the same as for indicator 1, secondary treatment; that is 9.8

Total Waste Water Collected: 130 Mm3/year (HSY 2015b)

Indicator 2 = 9.8

3.2.2 Current practices

- See 3.1.2

3.3 Groundwater quality

Measure of relative groundwater quality. A lower indicator score is given for poorer quality.

3.3.1 Calculation

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’

Indicator 3 = [**X** / (**X** + **Y**)] × 10

Note: for non-EU countries, an alternative method should be applied, depending what data is available indicator is calculated as follows:

Groundwater quality (EEA 2012):

X = 3507
Y = 81
Indicator 3 = [**3507** / (**3507** + **81**)]*10 = 9.8

3.3.2 Current practices

In Helsinki groundwater areas are currently not used to supply water for household consumption in Helsinki. Three groundwater areas (Tattarisuo, Vartiokylä and Vuosaari) are currently Helsinki’s emergency water supply areas, which can be used to supply water in crisis situations (Helsinki City 2014).

Drinking water is drawn from the Päijänne lake through a 120 km long tunnel. It is the world's second longest tunnel and runs 30–100 meters under the surface in bedrock. The purpose of the tunnel is to provide fresh water for the million plus people in Southern Finland in the cities of Helsinki, and its surrounding municipalities.

II – Solid waste treatment

3.4 Solid waste collected

Represents waste collected from households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that threat or dispose of waste at the same used for municipally collected waste (OECD, 2013).

3.4.1 Current practices

Helsinki Region Environmental Services (HSY) is the company responsible for collection of bio-waste and residual waste both from households and public administration]. Recyclable waste collection is organised by private companies– municipal waste management companies In Helsinki a door-to-door separate collection system covers all fractions, except plastics. Plastic is not targeted for recycling, but is instead incinerated together with other mixed waste. The door-to-door system is accompanied with bring systems (except for bio-waste) and civic amenity sites. No co-mingled system is in place in Helsinki. The city is among the top three best performers with respect to capture rate for metals, paper/cardboard and bio-waste. Further improvement is possible by increasing the effectiveness of glass collection and introducing separate collection for plastic wastes.

3.4.2 Calculation

The indicator is calculated as follows:
Indicator 4 = [1 – (**X** – 136.4) / (689.2 – 136.4)] × 10,

Where X is the kg/cap/year of collected solid waste.

In Helsinki

X = Total solid waste collected in Helsinki: 209 kg/cap/yr (HSY 2015a)

Total solid waste collected: 238 029ton/year (HSY 2015a)

The population of Helsinki region = 1 140 000

Indicator 4 = [1 - (**209** - 136.4) / (689.2 - 136.4)] * 10 = 8.7

3.5 Solid waste recycled

Percentage of solid waste that is recycled or composted.

3.5.1 Calculation

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.

Indicator 5 = [(% recycled or composted) / (100 - % used for incineration with energy recovery)] x 10

In Helsinki

Percentage of solid waste that is recycled or composted: 45 %

Percentage of energy recovery is calculated separately and is not part of recycled or composted waste. 47 % (Pksjatevirrat.fi, 2016).

Indicator 5 = [**45** / (100 - **47**)]*10 = 8.5

Indicator 5 = 8.5

3.5.2 Current practices

Helsinki Region Environmental Services HSY is managing the area of water services, waste management and providing regional and environmental information. HSY provides recycling points and advices on sorting and recycling in furthermore, waste prevention information. Its preference in actions are in accordance with the waste hierarchy for material recycling before utilisation as energy. HSY is anyhow producing more energy, than is needed in its waste and water management operations.

In Helsinki a door-to-door separate collection system covers all fractions, except plastics. Plastic is not targeted for recycling at all, but is instead incinerated together with other mixed waste. The door-to-door system is accompanied with bring systems (except for bio-waste) and civic amenity sites. No co-mingled system is in place in Helsinki. The city is among the top three best performers with respect to capture rate for metals, paper/cardboard and bio-waste. Further improvement is possible by increasing the effectiveness of glass collection and introducing separate collection for plastic wastes (.European Commission 2014).

3.6 Solid waste energy recovered

Percentage of solid waste that is incinerated with energy recovery.

3.6.1 Calculation

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

Indicator 6 = (% incinerated with energy recovery) / (100 – % recycled or composted) × 10

In Helsinki;

Total waste generated 284.1 kg/cap; 310795 ton (2013) (European Commisson 2014)

Amount of solid waste incinerated with energy recovery: 320 000 ton/year (HSY, 2012). This number refers to Helsinki region waste incineration plant which also receives waste from other nearby municipalities

Percentage of municipal solid waste that is incinerated with energy recovery: 47 %

Percentage of municipal solid waste is collected separately and is not part of energy recovery 45 % (Pksjatevirrat.fi, 2016)

Indicator 6 = [47 / (100 – 55)]*10 = 85.5

Indicator 6 = 8.6

3.6.2 Current practices

Mixed waste is incinerated at Vantaa Energia's plant north of Helsinki. The operations started in 2014. The plant produces 920 GWH district heating and 600 GWH electricity per year. This corresponds to the heat need of 100 000 Finnish store buildings and electricity consumption of 200 000 two room flats (Massinen 2014).

III – Basic water services

3.7 Access to drinking water

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

3.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = X / 10,

Where X is the percentage of total urban population with access to potable drinking water.

In Helsinki

X = Percentage (%) of total urban population with access to potable drinking water= 100% (World Health Organization and UNICEF, 2013; Fi.wikipedia.org. 2016).

Indicator 7 = 100 / 10

Indicator 7 =10

3.7.2 Current practices

The drinking water from the tap originates from Lake Päijänne. The raw water travels around 120 kilometres in a tunnel from Lake Päijänne to Helsinki. The water is treated at the water treatment plants in Pitkäkoski and Vanhakaupunki before it is released in to the pipes for the residents to use.

The raw water from Päijänne is treated into domestic water in the Pitkäkoski and Vanhakaupunki water treatment plants. The water treatment process is similar in both plants.

First, ferrous sulphate is added to the raw water. It precipitates the organic matter in the water at low pH levels. The precipitation is then stirred so that the small sediment particles bump into each other, growing in size. After this, the precipitation is separated from the water in a horizontal sedimentation tank and sand filters.

Before disinfection, the water’s pH is increased with lime water. The possible microbes in the water are destroyed with ozone, which also improves the water’s odour and taste. Next, carbon dioxide is fed into the water. It increases the water’s alkalinity, thus decreasing corrosion.

Remaining organic matter is removed through a two-phase activated carbon filtering process, after which the water is disinfected with UV light. Finally, bound chlorine, i.e. chloramine, is added to the water in order to limit the growth of microbes in the supply network. The water’s pH is adjusted with lime water and its alkalinity with carbon dioxide.

3.8 Access to sanitation

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.

3.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = X / 10,

Where X is the percentage of total urban population with access to proper sanitation facilities.

In Helsinki

X = Percentage (%) of total urban population with access to proper sanitation facilities= 99% (a careful assessment, most probably 100 %) (Fi.wikipedia.org. 2016; Fred 2015).

Indicator 8 = 99 / 10 = 9.9

3.8.2 Current practices

There are 2 major waste water treatment plants for treating the waste water collected in Helsinki area -Viikinmäki (Helsinki) and Suomenoja (Espoo). Viikinmäki is treating the water of Helsinki City. The Sludge is digested at the WWTs and the digestate is composted and sold out and utilised as soil amendment in parks, gardens etc.

3.9 Drinking water quality

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

3.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = (**X** / **Y**)* 10,

Where X/Y is the ratio of total urban population with access to potable drinking water.

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 = 40

X (WHO Standard) = 40

X (EPA Standard) = 40

X (EU Standard) = 40

In Helsinki

According to Helsinki Region Environmental Services Authority HSY, the quality of drinking water is high and it fulfils the requirements of authorities (HSY 2015b).

Indicator 9 = (**40** / **40**)*10 = **10**

3.9.2 Current practices

The water quality is high in the Helsinki Metropolitan Area. The household water we produce easily fulfils the quality requirements and recommendations set by the Ministry of Social Affairs and Health in its related decree (STMa 461/2000).

Helsinki region environmental services (HSY) monitor the microbiological, physico-chemical and sensory quality of water provided by the three water treatment plants every weekday in their laboratory. In addition to HSY's own control samples, the health protection authorities of municipalities monitor the water quality in the supply network in accordance with the control research programme

IV – Solid waste treatment

3.10 Nutrient recovery

Measure of the level of nutrient recovery from the wastewater system.

3.10.1 Calculation

A. Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Mm3 year-1)

B. Total amount of wastewater passing the wastewater treatment plants (Mm3 year-1)

Indicator 10 = [A / B] × [% secondary WWT coverage / 100] × 10

In Helsinki

Helsinki has 98 % of secondary and tertiary treatment. Very occasionally the process is bypassed (e.g. severe flooding events) (Hsy.fi, 2016). Furthermore, all sewage sludge is reused for agricultural purposes. Leading to a A/B ratio of 1.0.

Indicator 10 = [(1.0) * (**98** / 100)]*10 = 9.8

3.10.2 Current practices

Helsinki citizen's waste water is treated basically in one centralised waste water treatment plant, Viikinmäki, treating the waste water of 800 000 people. The treatment process in Viikinmäki wastewater treatment plant is based on an activated sludge method and it has three phases: mechanic, biological and chemical treatment. The efficiency of nitrogen removal has been increased with a biological filter, which is based on the activity of denitrification bacteria. 95 % of solid and oxygen-consuming matter and phosphorus are removed from the wastewater as well as 90 % of nitrogen.

3.11 Energy recovery WWT

Measure of energy recovery from the wastewater system.

3.11.1 Calculation

A) Total volume of wastewater treated with techniques to recover energy (Mm3/year).

B) Total volume of water produced by the city (Mm^3/year).

[A / B] × 10 = 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^3/year).

D) Total volume of wastewater treated in wastewater treatment plants (Mm^3/year).

Indicator 11 = [(C / D) × (% secondary WWT coverage / 100)] × 10,

In Helsinki

% secondary WWT coverage = 98%

C) Total volume of wastewater treated with techniques to recover energy 130 (Mm^3/year).

D) Total volume of wastewater treated in wastewater treatment plants = 130 Mm^3/year

Biogas production 14.1 milj.m^3 from waste water.

Indicator 11 = [(**130** / **130**) * **98**) / 100] * 10 = 9.8 (HSY 2015b)

3.11.2 Current practices

All sludge generated in WWT is digested and the biogas utilised for CHP production in the internal processes at the site. Very occasionally the process is bypassed (e.g. severe flooding events)

3.12 Sewage sludge recycling

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.

3.12.1 Calculation

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)

Indicator 12 = [(**C** + **D**) / **A**] × [% 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.

In Helsinki
A= Dry weight of sludge produced in wastewater treatment plants serving the city: 86,389,000 kg/year (HSY, 2015b)
B= Dry weight of sludge going to landfill: 0
C= Dry weight of sludge thermally processed:
D= Dry weight of sludge disposed in agriculture: 86,389,000 kg/year (composted)
E= Dry weight of sludge disposed by other means:
(As a check, A should = B + C + D +E)

Indicator 12 = [((**0** + **86389**) / **86389**) x (**98** / 100)] x 10 (HSY 2015b)
Indicator 12 = 9.8

3.12.2 Current practices

The majority of the digested and dewatered sludge is composted and used as substratum.

3.13 WWT Energy efficiency

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

3.13.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 13.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The score of Indicator 13 is 10. (Fred 2015)

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. Activity is in place and further plans drawn for the next three years (see 3.13.2). the bioas from sludge is also utilised in CHP production (conversion rate +90 %) and part is upgraded to vehicle fuel.

3.13.2 Current practices

The main efforts of the Helsinki Region Environmental Service Authorities (HSY) at the moment in investments is to WWT energy efficiency. Currently HSY is producing more energy, than is needed in its waste and water management operations. The major part of its energy production is CHP (combined heat and power) production from landfill gas.

V – Infrastructure

3.14 Average age sewer

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

3.14.1 Calculation

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.

Indicator 14 = (60 – **X**) / (60 – 10) × 10

Where X is the average age sewer

X = Average age sewer= There is no official local document for this data. Nevertheless, it is estimated by experts to be 40 years (Haapakoski 2014).

Indicator 14 = (60 - **40**) / (60 - 10) x 10 = 4.0

3.14.2 Current practices

Helsinki Region has drawn up a plan for the renovation of the water network 2013-2020. Total investments are 158.4 M€. The investment is covered by the water fees collected from the inhabitants. The main drinking water pipeline (120 km) from Päijänne lake has been renovated in two parts (2001 and 2008).

3.15 Operating costs recovery (ratio)

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.

3.15.1 Calculation

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

Operating cost recovery (ratio) = (Total annual operational revenues)/(Total annual operating costs)

Total annual operating costs: Total annual operational expenditures for drinking water

Total annual operational revenues: Total annual income from tariffs and charges for drinking water and sanitation services (US$/year)

Therefore the indicator is calculated as follows:

Indicator 15 = [(**X** – 0.33) / (2.34 – 0.33)[×10

Where X is operating cost recovery (ratio).

In Helsinki

Total annual operational revenues (of HSY operations): 344.2 M€/a (HSY, 2015b)

Total annual operating costs (of HSY operations): 178.7 M€/a (HSY, 2015b)

Operating cost recovery (ratio) = Total annual operational revenues/ Total annual operating costs

Operating cost recovery (ratio) = 344.2 /178.7 = 1.93

X = Operating cost recovery (ratio) = 1.93

Indicator 17 = [(1.93 - 0.33) / (2.34-0.33)] x 10

Indicator 17 = 7.9

3.16 Water system leakages

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

3.16.1 Calculation

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.

Indicator 16 = (50 **– X**) / (50 – 0) × 10

Where X is water system leakages (%).

In Helsinki

Drinking water produced in Helsinki area (HSY 2015a) = 89.4 Mm^3

Drinking water sold in Helsinki area (HSY 2015a) = 73 Mm^3

– Difference assumed as leakage

X = Water system leakages in Helsinki (%) = 18%

Indicator 16 = [(50 - **18**) / (50 - 0)] x 10 = 6.4

3.16.2 Current practices

In order to maintain the functionality of the water service networks, HSY takes preventative maintenance measures, such as flushing, cleaning and inspecting the networks. This way, HSY aims to prevent disturbances and risks in the water service and sewer network. HSY minimises the duration of disturbances with a 24-hour standby system.

Service piping and service sewers belong to the property, and therefore their maintenance is the property owner’s responsibility. The functionality and condition of service piping should be inspected at least once in a decade.

HSY renovates water pipes and sewers that are in bad condition due to aging or some other reason. The condition of the sewer network can be inspected with TV filming, where the sewers are filmed from inside with the help of a robot camera. There are no similar methods for inspecting the water service network, but water leakages are sought actively by utilising devices that register the noises caused by leakages. One current R & D project targets on-line monitoring and control of water leakages, and such are expected to be installed in a couple of years.

HSY is the biggest renovator of underground pipes in Finland. There is no one renovation method suitable to all situations: The technically and financially most affordable method is decided on a case-by-case basis.

3.17 Stormwater separation

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.

3.17.1 Calculation

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)

Indicator 17 = [(**B** + **C**) / (**A** + **B** + **C**)] × 10

In Helsinki,

A. Total length of combined sewers managed by the utility (km) = 250

B. Total length of stormwater sewers managed by the utility (km) = 2238

C. Total length of sanitary sewers managed by the utility (km) = (2781 - 250)

B is counted into C (separate figures not available)

Indicator 17 = (**2237** + **2238**) / (**2781** + **250** + **2238**) x 10

Indicator 17 = 9.5

VI – Climate robustness

3.18 Green space

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).

Definition of green area (EEA, 2012A): 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.

3.18.1 Calculation

City specific: Numbers are provided in %

Country average: Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

Indicator 18 = (**X** – 16) / (48 – 16)] ×10

Where X is the share of blue and green area (%) (Arcgis (2015).

In Helsinki X = 45.7 %

Indicator 18 = (**45.7** - 16) / (48 - 16) x 10 = 9.3

3.18.2 Current practices

Helsinki is a forrested maritime city with a close connection to nature. Over one third of the cities surface area is covered by green spaces. Within Helsinki's borders, there are approximately 3,800 hectares of forested green areas. In addition the City of Helsinki owns over 10,000 hectares of forest across over 10 municipalities in the southern province Uusimaa.

3.19 Climate adaptation

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

3.19.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 19.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The score is 7 (Susan Lyytikäinen written communication)

See 3.19.2 for further justification

3.19.2 Current practices

City of Helsinki joined the Covenant of Mayors agreement in January 2009. Helsinki agreed then to reduce the CO_2 emissions by at least 20% by 2020, through the implementation of a Sustainable Energy Action Plan. Helsinki collected comments from the citizen and other stakeholders to the City of Helsinki SEAP action plan. The discussion was open from June 7th to June 28th 2011

Current target for Helsinki is to decrease its emission 30% by 2020 and become carbon neutral year 2050. In 2014, Helsinki's emissions had diminished 18% compared to the level 1990. As a matter of fact, Helsinki has already reached its targets for 2030, that is in 2013 the emission per capita a -34% when the per capita target is -39%. (Stadinilmasto.fi, 2014)

3.20 Drinking water consumption

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 authorised 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 authorised 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.

3.20.1 Calculation

The volume is then normalized against maximum and minimum volumes for European cities.

Indicator 20 = [1 – ((**X** – 45.2) / (266 – 45.2))] × 10

Where X is m^3/person/year drinking water consumption.

In Helsinki:

X = 66.4 m3/person/year drinking water consumption (HSY, 2015a)

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

Indicator 20 = [1 – ((66.4 - 45.2) / (266 - 45.2))] * 10 = 9.0

3.20.2 Current practices

- Drinking water provided by HSY is of high quality (see chapter 3.9). Consumption is managed by leak control and promoting water saving closets and taps.

3.21 Climate robust buildings

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.

3.21.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 21.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The score of Indicator 21 is 7. (see 3.21.2.)(Susan Lyytikäinen, written communication and Helsinki 2015).

3.21.2 Current practices

In Helsinki's strategic climate programme 2013–2016 the target for CO2 emission reduction is 30 % by 2020, compared to the level 1990.
Helsinki city council has decided on a + 2 % yearly energy saving target. 2015 the target was a 8% saving compared to 2011 energy consumption level

The yearly target for energy savings in public buildings is 2%. This target is ambitious compared to the national target for energy saving in buildings (+1 % yearly). Around 2/3 of CO_2 emissions are due to energy consumptions in the built environment. Energy efficiency of buildings is stipulated by national construction regulations which are tightened every other year. From 2018 onwards construction permits will be given only for close to zero energy buildings (Helsinki 2015).

VII – Governance

3.22 Management and action plans

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. 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).

3.22.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 22.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The score of Indicator 22 is 8. (Fred 2015) See 3.22.2

3.22.2 Current practices

Helsinki City stormwater strategy includes actions for promoting and constructing nature based stromwater management, to include stormwater management in city planning, and building up a separate sewerage system for stormwater. (Helsinki City Construction Department 2008). In addition, smart alarm systems for flooding events have been developed in RDI projects.

3.23 Public participation

A measure of share of people involved or doing unpaid work

3.23.1 Calculation

The indicator is calculated as follows (for EU countries):

Indicator 23 = (**X** – 5) / (53 – 5) × 10

X = Involvement in voluntary work

In Helsinki

X = 29 % (2009, within 4 weeks) (Statistics Finland 2009)

Indicator 23 = (**29** - 5) / 53 - 5) x 10 = 5.0

3.23.2 Current practices

According to Statistics Finland's Time Use Survey, 29 % of the population aged 10 or over in Finland had done voluntary work in 2009. At the level of the whole population, participation in voluntary work has remained unchanged over the past decade. However, children's and young people's participation in voluntary work has diminished considerably. Most voluntary work is done in sports and athletics clubs.

3.24 Water efficiency measures

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.

3.24.1 Calculation

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.

The following guidance is proposed to make self-assessment score for Indicator 24.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

Helsinki:

The score of Indicator 24 is 4. The topic is addressed at the national and local level especially in connection to energy efficiency, water management involving energy intensive operations. Helsinki participates in several projects developing monitoring of leak detection and leak prevention. To note is that the availability of high quality water in Helsinki is rather high and the Water exploitation index in Helsinki region is of the lowest in Europe (< 5 %) (Fred 2015 and Anon 2016)

3.24.2 Current practices

Saving drinking water is not very actively communicated subject, and of less concern than some e.g. water quality issues. This is due to Helsinki’s very high availability of good quality water.

Water exploitation index of Finland is < 5 %. However, water consumption is very linked to energy savings which is high on Helsinki's agenda.

3.25 Attractiveness

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 harbours 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.

3.25.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 25.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The score of Indicator 25 is 8 (Personal communication with Susan Lyytikäinen Helsinki region environmental services (HSY), Helsinki EPA, and the Finnish Environment Institute). Helsinki is situated at the Baltic Sea and offers services and attractions at the shore and in the nearby archipelago. Charter cruises and water taxi services in Helsinki's archipelago are available as well as public water buses and public areas for camping and picnics.

3.25.2 Current practices

In 2011, the Monocle magazine ranked Helsinki the most liveable city in the world in its "Liveable Cities Index 2011 (Monocle 2011)

4 City Amberprint

The City Amberprint is a complement to the City Blueprint and the Trends and Pressures Framework. The main goal of the City Amberprint is a baseline assessment of the sustainability of Energy, Transport and ICT in cities. To comply with City Blueprint, indicators that have a score between 0 (there is a concern) to 10 (no concern) are proposed. The quantitative indicators were "normalise" on a scale of 0 to 10, where 10 points were assigned to cities that met or exceeded certain criteria on environmental performance. The overall sustainability of the three aspects is expressed as Amber City Index (ACI). The ACI is the geometric mean of the 22 indicators.

Table 4.1: List of City Amberprint indicators for Helsinki

Category	No.	Indicator	Score
ENERGY	1	Carbon footprint	6.8
	2	Fuel poverty	9.1
	3	Energy consumption	7.6
	4	Energy self-sufficiency	3.5
	5	Renewable energy ratio	0.8
	6	Energy efficiency plans	8.0
	7	Energy infrastructure investment	1.2
TRANSPORT	8	Commuting time	4.3
	9	Use of public transport	2.7
	10	Bicycle network	9.4
	11	Transportation fatalities	10.0
	12	Clean energy transport	7.0
	13	Transport-related pollutions	9.6
	14	Transport infrastructure investment	2.6
ICT	15	ICT access	7.4
	16	ICT use households	7.6
	17	ICT use water utilities	8.5
	18	ICT use energy utilities	9.0
	19	ICT use transport	8.0
	20	ICT use waste management	8.8
	21	Digital public service	8.1
	22	ICT infrastructure investment	10

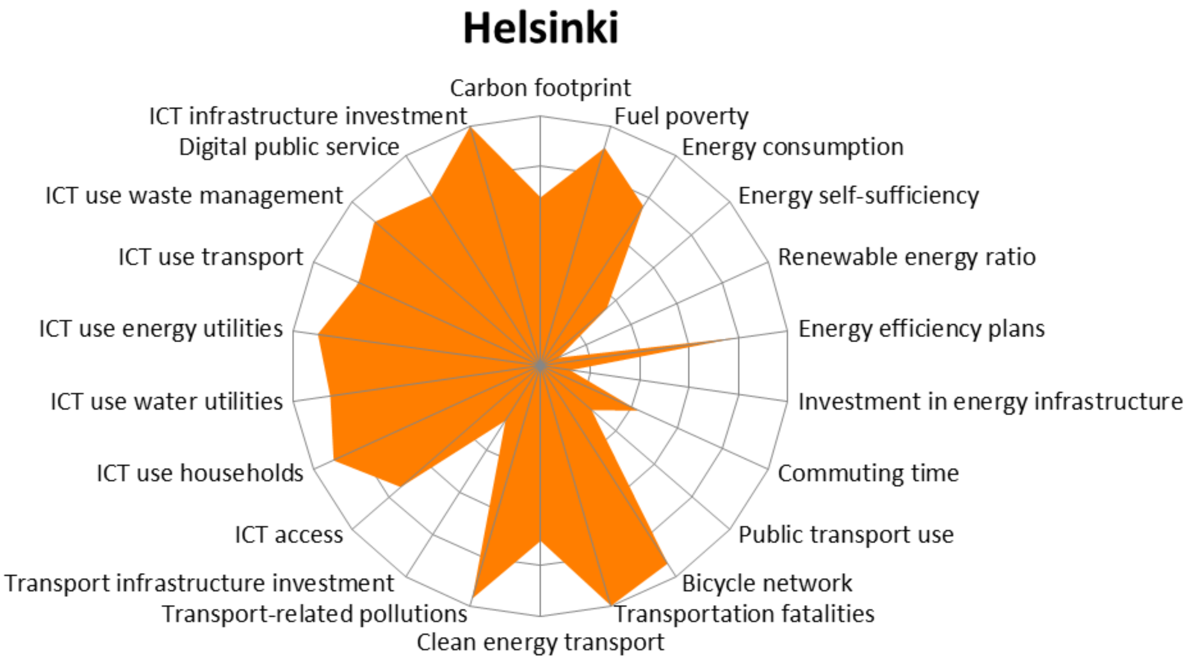

Figure 1.1: City Amberprint Helsinki The centre of the circle corresponds to 0 and its periphery to 10. The Amber City Index (ACI) for Helsinki is 6.1.

Energy indicators

4.1 Carbon footprint

How city's carbon footprint (CF) per person per year does compare with the international range? A lower indicator score is given for a larger carbon footprint.

Definition of Carbon Footprint: the total sets of greenhouse gas emissions caused by an organization, event, product or person.

4.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = 10 × (16.464 - **X**) / (16.464 - 0.237),

Where X is the CF/capita/year in the city.

In Helsinki the CF value is 5.5 tonnes/cap/year (2014). (Nikunen 2015) Therefore:

Indicator 1 = 10 × (16.464 - **5.5**)/(16.464 - 0.237) = **6.75**

4.1.2 Current practices

- Helsinki Metropolitan Area climate strategy: per-capita emissions from transport and traffic should be cut by 20% from the 1990 level by 2030.
- Efficient CHP production and central heating. Helsinki is producing the heat and the power in the most energy efficient way in the world (Nikunen 2015)
- Climate Partners –network between the City and Helsinki businesses was established in 2012,with 52 members. □180 Climate commitments signed with the Mayor of Helsinki Several common projects have developed among others on energy storage (Nikunen 2015).

- Low-emission vehicles can be parked at half the price
- No carbon dioxide emissions from Helsinki rail transport
- Helsinki City Transport shifted to zero-carbon hydropower in its rail transport in 2012.
- Renewable energy such as hydrogen or electricity can be used in public and private transport.

4.2 Fuel poverty

What is the proportion of households in the city that are considered to be fuel poor? The lower indicator score is given when the proportion is higher.

Under the Low Income High Costs definition, a household is considered to be fuel poor if:

- they have required fuel costs that are above average (the national median level)
- were they to spend that amount, they would be left with a residual income below the official poverty line.
-

4.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = (100 - **X**) / 10,

Where X is the percentage of households in the city considered to be fuel poor.

For Helsinki the percentage of households which is considered to be fuel poor is 8.7% (in 2013 (BPIE 2014). Therefore:

Indicator 2 = (100 **– 8.7**) / 10 = **9.1**

4.2.2 Current practices

Central heating systems installed 60 years ago, more than 90 % of Helsinki households are connected.

4.3 Energy consumption

This indicator presents how does total energy consumption (domestic, industrial and commercial, and transport) per capita in the city compares with the international range (kgoe/cap/yr).(kg of oil equivalent) A lower indicator score is given where the consumption is greater.

4.3.1 Calculation

The indicator is calculated as follows:

Indicator 3 = 10 × (5419 **– X**) / (5419 – 893.15),

where X is the total energy consumption for the city in kgoe/cap/yr.

In Helsinki energy consumption is 1977 kgoe/cap/yr (in 2015) (Anon 2016b). Therefore:

Indicator 3 = 10 × (5419 – **1977**) / (5419 – 893.15) = **7.6**

4.3.2 Current practices

- Household appliances should be energy efficient in accordance with regulation sand directives
- Sludge and municipal waste is treated in waste to energy plants for energy recovery. The energy is mainly utilised in CHP production with >90 % conversion efficiency

- Energy efficiency programmes for housing, goal: zero energy houses. Construction permits will be given only for zero energy houses from 2018 onwards

4.4 Energy self-sufficiency

Measure of the proportion of a city's demand that could be met through indigenous production including renewable resources, waste, and traditional but generated locally in the city. A lower indicator score is given where self-sufficiency is lower.

4.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = 10 × (**X** / **Y**),

where X is the amount of energy generated locally, and Y is the total energy consumption in the city.

In Helsinki, the total energy consumption was 14400 GWh/year (= 100%) (in 2014). The amount of energy generated locally was 35 % (in 2014 (enon 2016b); Arola 2014). Therefore:

Indicator 4 = 10 × (**35** / **100**) = **3.5**

4.4.2 Current practices

- Landfill gas is collected and biogas is produced at waste water treatment plants and converted to energy (CHP, biofuels).
- Increased use of biomass.

4.5 Renewable energy ratio

A measure of proportion of total energy derived from renewable sources in the city, as a share of the city's total energy consumption compared to the international range. A lower indicator is given where the percentage is lower.

4.5.1 Calculation

The indicator is calculated as follows:

Indicator 5 = 10 × (**X** – 1.15) / (98.8 – 1.15),

Where X is the percentage of energy derived from renewable sources.

In Helsinki the percentage of total energy derived from renewable sources was 9 % in 2015 (Helen 2016). Therefore:

Indicator 5 = 10×(**7** – 1.15) / (98.8 – 1.15) = **0.8**

4.5.2 Current practices

- Electric vehicles and trains (electricity from hydropower), Biogas buses.
- Landfill gas to power
- Intermittent target for renewable's share in energy production in Helsinki is 20% by 2020. The share of renewable energy will significantly increase in the coming years. Biofuled based heat production is planned to complement and substitute existing fossil fuel based plants. Also the wider utilisation of solar energy, geothermal heat and heat pumps is investigated. Wood pellets substitute already coal in two major power plants.

4.6 Energy efficiency plans

Measure of the application of energy efficiency measures by the range of energy users across the city. A lower indicator score is given where efficiency measures are more limited. 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. energy companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the efficiency of energy usage:

- at household level, e.g. efficient household appliances,
- at community level by energy efficient buildings or energy recycling, e.g. heat can be collected in summer, and stored to use it in winter,
- by encouraging people to change their behaviour.

4.6.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 6.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki
Local policy plan is provided in a publicly available document, the topic is also addressed at the local website and the subsidies are made available to implement the plans.

Therefore, Helsinki is given a score of 8 (2015) (Mutikainen et al 2014).

4.6.2 Current practices

- Efficient use of materials and recycling of waste materials are some of the climate change mitigation measures included in the climate strategy for the Helsinki capital Region.
- Helsinki Region Environmental Services Authority (HSY) plan to transform the Ämmässuo landfill into a versatile waste treatment centre, and the recovery of biogas from landfill sites and sewage treatment processes.

4.7 Energy infrastructure investment

A measure of the investment in the infrastructure for energy distribution compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the energy infrastructure. Investment can be in:

- a new infrastructure
- maintaining and
- refurbishing the existing one.

4.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = 10 × [(100 × (**X** / **Y) –** 0.06) / (2.29 − 0.06)]

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Helsinki total energy infrastructure investment per capita is 123 000 000€/620715 inhabitants = 198 €/capita (2014) and GDP per capita in Finland is 37 800 € (2015) (Helen 2015) . Therefore:

Indicator 7 = 10 × [(100 × (**198** / **37800**) – 0.06) / (2.29 − 0.06)] = **2.1**

Transport indicators

4.8 Commuting time

A measure of the proportion of time spent on commuting (minutes per day). Includes average time spent in: public transport (bus, coach, train, underground, tram, light railway), car (as driver or passenger), motorcycle, moped, scooter, bicycle, taxi on the way to and from work. A lower indicator score is given where the time spent on commuting is greater.

4.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = 10 × [(74.2 **– X**) / (74.2 – 10.8)],

Where X is the average time spent on commuting in the city (or region). In Helsinki an average time spend on commuting each day is 47 minutes (Pääkkönen 2011). Therefore:

Indicator 8 = 10 × [(74.2 **– 47**) / (74.2 – 10.8)] = **4.3**

4.9 Public transport use

Kilometres travelled by public transport and bicycles compared to overall kilometres travel by all means of transport. A lower indicator score is given where the use of public transport and bicycles is higher.

4.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = 10 × (**X** / **Y**),

Where X is the kilometres travelled by public transport and cycling (or %) and Y is the overall kilometres travelled by all means of transport (or %).

In Helsinki: 10.3 km was travelled by public transport and cycling compared to 38.6 km travelled by all means of transport (in 2011) (Mutikainen et al. 2014, Liikennevirasto.fi 2012). Therefore:

Indicator 9 = 10 × (**10.3** / **38.**6) = **2.7**

4.9.2 Current practices

Fast high quality network for cyclists. Cycle parks near metro and train stations. Citybikes provided by the city summertime.

Arrangements required in the priorisation of public transport in the Helsinki city region (e.g. public transport lanes and traffic light programming) will be implemented.

4.10 Bicycle network

Length of bicycle network per inhabitant compared to the international range. The lower indicator score is given where the length of bicycle network per inhabitant is lower.

4.10.1 Calculation

The indicator is calculated as follows:

Indicator 10 = 10 × (**X** / 2.03),

Where X is the length of bicycle network per capita. In Helsinki there are 1200000 metres (in 2008) of designated cycle routes and 626305 inhabitants (in 2014).

Length of designated bicycle routes in meters per inhabitant in Helsinki was 1.92 m/cap.

(City of Helsinki 2014) Therefore:

Indicator 10 = 10 × (**1.92** / 2.03) = **9.4**

4.10.2 Current practices

- Fast direct lanes for cyclists.
- Bicycle centre in the city centrum
- Bicycle parking is increased in public spaces and construction
- Studies: The investment of one euro in facilitating and promoting cycling will pay back to the city eight euros due to improved health among the bikers.
- Journey planner for cycling and walking city bikes from 2015

4.11 Transportation fatalities

A measure of transportation fatalities per 100 000 population in the city per year. A lower indicator score is given where the number is greater.

4.11.1 Calculation

The indicator is calculated as follows:

Indicator 11 = 10 × [(33.4 – (**X**/**Y**)) / (33.4 – 3.6)],

Where X is the number of fatalities related to transportation of any kind within the city borders and Y is the 100,000 of the city's total population.

In Helsinki there were 6 transportation fatalities and the population is 626305 (in 2014) (City of Helsinki Urban Facts 2015) . Therefore:

Indicator 11 = 10 × (33.4 – 100000 × (**6**/**626305)**) / (33.4 – 3.6) = **10.89 = 10**

4.11.2 Current practices

- Mandatory yearly vehicle inspection for cars.

4.12 Clean energy transport

Clean energy transport and clean energy sharing transport. A lower indicator score is given where efficiency measures are more limited. 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. transport companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the transport efficiency by e.g.

- efficient public transport (electric train, subway/metro, tram, cable railway)
- efficient private transport (electric taxis or cars, electric scooter, bicycling) and
- encouragements to use public transport.

4.12.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 12.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Helsinki

The topic is addressed in a chapter at the national and local level, the topic is also addressed at the local website and plans are implemented and clearly communicated to the public.

Therefore, Helsinki is given a score of 7 (HSL 2015).

4.12.2 Current practices

The electricity for metro and tram is produced by Nordic wind or hydropower (zero emissions). The electricity for local trains is produced by hydropower (no emissions). The investment into electric buses is under evaluation. Significant amount of buses are gas driven (less emissions compared to diesel)

4.13 Transport-related pollutions

Air pollutant emissions (Sulphur oxides (SO_x), Nitrogen oxides (NO_x), Ammonia (NH_3), Non-methane volatile organic compounds, Particulates (PM_{10}) - airborne particulate matter with aerodynamic diameter less than 10 micrometres) from transport measured in kg per capita per year. A lower indicator score is given where the pollutant emissions are greater.

= (SO_x + NO_x + NH_3 + Non-mth + PM_{10}) / 5

In Helsinki

The emissions are as follows: A: Sulphur oxides – 0.2235 kg/cap/yr, B:Nitrogen oxides – 4.5952 kg/cap/yr, D: Non-methane volatile organic compounds 1.1528 kg/cap/yr E: Particulates PM_{10} – 0.1772 kg/cap/yr (in 2014). Ammonia is not measured, but considered not significant (almost non-existent agricultural activities, no active biowaste centers or landfills inside the city borders (HSY 2015c; HSL 2015a, HSL 2011). Therefore:

Indicator 13 = (SO_x + NO_x + $NH_{3)}$ + Non-mth + PM_{10}) / 5 = **9.7**

4.13.1 Calculation

The sub-indicators are calculated as follows:

- Sulphur oxides (SO_x):
  SO_x = 10 × [(2.753 – **A**) / (2.753 – 0.114)]
  where A is the emissions from the city (kg/cap/yr).
- Nitrogen oxides (NO_x):
  NO_x = 10 × [(0.337 – **B**) / (0.337 – 0.021)]
  where *B* is the emissions from the city (kg/cap/yr).
- Ammonia (NH_3):
  NH_3 = 10 × [(9,153.3 – **C**) / (9,153.3 – 11.3)]
  where *C* is the emissions from the city (kg/cap/yr).
- Non-methane volatile organic compounds (Non-mth):
  Non-mth = 10 × [(5.643 – **D**) / (5.643 – 0.432)]
  where *D* is the emissions from the city (kg/cap/yr).
- Particulates (PM_{10}):
  PM_{10} = 10 × [(2.197 – **E**) / (2.197 – 0.169)]
  where E is the emissions from the city (kg/cap/yr).

Therefore the indicator is calculated as follows

Indicator 13

= (**9.6** + **9.9** + **10** + **8.6** + **10**) / 5 = **9.6**

4.13.2 Current practices

- Electricity to metro and tram produced from Nordic wind or hydropower (no emissions). Electricity to local trains produced from hydropower (no emissions).
- The extension of the metroline in Helsinki region will substitute a significant number of bus lines, thus emissions from public transportation are expected to decrease further in the near future.
- The largest problem are the particulate emission in the spring arising from the dry sand from sanding streets throughout the winter which is done in order to cope with slippery, icy sidewalks. The situation has improved the last years by faster and earlier street cleaning campaigns by Helsinki City.

4.14 Transport infrastructure investment

A measure of the investment in the transport infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining and refurbishing the existing one.

4.14.1 Calculation

The indicator is calculated as follows:

Indicator 14 = 10 × [(100 × (**X** / **Y**) **–** 0.02) / (3.89 − 0.02)]

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

X = 393 €/cap

Y = 37800 €/cap

In Helsinki region, 393 €/cap was invested in transport infrastructure 2013 and GDP per capita in Finland is 37800 (in 2015) (HSL 2015b; Statistics Finland 2015). Therefore:

Indicator 14 = 10 × [(100 × (**16.5** / **37800)** **–** 0.02) / (3.89 − 0.02)] = **2.6**

4.14.2 Current practices

The goals of the overall investments emphasize the accessibility of the region, flow of traffic as well as social, economic and ecological sustainability policies effectively address challenges in different parts of the region within the limits of funding available. The key is to make the region more effective and competitive by utilizing the existing structure to the full and investing in the public transport trunk network and its service level. Measures are primarily targeted to support a more coherent urban structure. They improve the overall performance of the transport system and support land use development in which construction is primarily concentrated in the broad main center of the region and in the existing and emerging rail corridors. The use of the transport system is made a more responsible by making efficient use of traffic management tools and examining vehicular traffic pricing as a steering and financing tool.

The current average wherewithal to transport is ca 1.3 billion €/a of which a third are investments 430 billion €. However, due to high recent and investments in rail traffic the last years investments have been considerably higher.

In these calculations we are using 2013 level 550 billion €, equivalent to 393 €/capita (Helsinki region).

ICT indicators

4.15 ICT access

The ICT access is a measure of access to information and communication technology (ICT) in the city. A lower indicator score is given where the ICT access is lower.

4.15.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Mobile-cellular telephone subscriptions per 100 inhabitants, where X is the number of mobile-cellular telephone subscriptions per 100 inhabitants in the city: A = 10 × X/120
- International Internet bandwidth (bit/s) per Internet user, where Y is the International Internet bandwidth (bit/s) per Internet user in the city: B = 10 × Y/787 260
- Proportion of households with a computer, where Z is the percentage of households with a computer in the city: C = Z/10
- Proportion of households with Internet access, where Q is the percentage of households with Internet access in the city: D = Q/10

The indicator is calculated as follows:

Indicator 15 = (**A** + **B** + **C** + **D**) / 4.

In Helsinki

The values are as follows (2014/2015):

- X = 92.72, so A = 10 × (96 / 120) = 8
- Y = 172175 b/s in Finland , so B = 10 × (172175 / 787,260) = 2.2
- Z = 62.1, so C = 93,5 / 10 = 9.4 (Internet World Stats 2015)
- Q = 61.4, so D = **100** / 10 = **10** (Statistica 2015)

Therefore:

Indicator 15 = (**8** + **8.3** + **9.4** + **10**) / 4 = **7.4**

4.15.2 Current practices

- Helsinki free public WiFi available to every citizen 24.04 Mb/s
- For €35 (about £27) a month, a phone subscriber will get 50 gigabytes of high-speed data in Finland

4.16 ICT use households

The ICT use in households is a measure of use of information and communication technology (ICT) in the city. A lower indicator score is given where the ICT use is lower.

4.16.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Proportion of individuals using the Internet, where X is the percentage of population in the city using the Internet: A = X / 10
- Fixed (wired)-broadband subscriptions per 100 inhabitants, where Y is the number of fixed (wired)-broadband subscriptions per 100 inhabitants in the city: B = 10 × (Y / 60)
- Wireless-broadband subscriptions per 100 inhabitants, where Z is the number of wireless-broadband subscriptions per 100 inhabitants in the city: C = Z / 10

Therefore, the indicator is calculated as follows:

Indicator 17 = (A + B + C) / 3

In Helsinki the values are as follows (2012) (Stat.fi, 2016):

- X = 63.3, so A = **78** / 10 = **7.8**
- Y = 32.2, so B = 10 × (**87** / 60) = **14.5 (capped at 10)**
- Z = 46.5, so C = **49** / 10 = **4.9**

Therefore:

Indicator 17 = (7.8 + 10 + 4.9) / 3 = 7.6

4.16.2 Current practices

- Finland is one of the top users of internet in Europe. In 2011 89 % of the Finnish people used internet and the use was more common only in the Netherlands, Luxembourg and Scandinavian countries. The use among elderly is increasing and e.g. between 2009 and 2011 the increase was 8 %. In the age group < 45 years the usage is 100%.

4.17 ICT use water utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.17.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Helsinki the following scores were given (2015) (HSY 2015d).

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**9**	automated, fully covering SCADA
Maintenance	**10**	Asset management data base and GIS are in place
Planning and design	**9**	e.g. optimisation, GIS interface
Customer service	**6**	e.g. smart metering for inhabitants and clients are planned Aqua-on-line ICT based client feedback system in place

Further justification are given in 4.17.2.

Therefore the indicator is calculated as follows:

Indicator 17 = (**9** + **10** + **9** + **6**) / 10 = **8.5**

4.17.2 Current practices

- Plant operations: automated, fully covering SCADA
- Network: NIS, maintenance management system
- NIS and other GIS based information systems
- No smart customer metering, no electric contracts
- Several smart metering, operating, analysis and design system development projects are ongoing.

4.18 ICT use energy utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.18.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Helsinki the following scores were given (2015):

Description	Score (0-10) evaluated locally	Comments
Operation	9	SCADA system in place
Maintenance	10	ICT enabled maintenance and Supply Security, and GIS
Planning and design	9	ICT enabled optimisation and GIS interface
Customer service	8	The ICT based client interface is continuously upgraded based on customer satisfaction surveys and internal strategy.

Therefore the indicator is calculated as follows:

Indicator 18 = (**9** + **10** + **9** + **8**) / 10 = **9.0**

4.19 ICT use transport

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.19.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance		e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design		e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service		e.g. mobile bus tickets, online feedback forms

Final indicator is an average of the four values.

In Helsinki the following scores were given (2016):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**7**	e.g. coverage of installation of road sensing terminals and traffic control in the city image based control system for traffic jam control and support for fluent traffic in development. Several image based systems and apps for parking maintenance and traffic lights in place. .
Maintenance	**7**	ICT system for planning the road maintenance and public transport vehicles
Planning and design	**9**	ICT system for planning transport infrastructure expansion and improvement
Customer service	**9**	e.g. mobile bus tickets, online feedback forms, arrival times predictions at bus and tram stops

Therefore the indicator is calculated as follows:

Indicator 19 = (**7**+**7**+**9**+**9**) / 10 = **8.0**

Source: Internal evaluation at Helsinki Region Transport by Kerkko Vanhanen, the head of Information Systems Group

4.19.2 Current practices

- Use ICT solutions to improve the usability of public transport services and the related user experience to world-class standards. e.g. www.reittiopas.fi/en
- For developers: dev.hsl.fi
- The next generation New Open Journey Planner: www.digitransit.fi

4.20 ICT use waste management

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.20.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. ICT system for logistics of waste collection
Maintenance		e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design		e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service		e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Final indicator is an average of the four values.

In Helsinki the following scores were given (2016):

Description	Score (0-10) evaluated locally	Comments
Operation	**10**	ICT system for logistics of waste collection in place
Maintenance	**8**	e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design	**8**	ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service	**9**	Online feed- back forms, citizen engagement Helsinki City has developed websites for engaging citizens in sustainable lifestyle pages giving suggestions for environmentally friendly living and transport that can be applied in various modes of housing and office work. The pages suggest hundreds of concrete environmentally friendly actions.t

Therefore the indicator is calculated as follows:

Indicator 20 = (**10** + **8** + **8** + **9**) / 10 = **8.3**

Source: Vantaan Energia Oy, Kuusakoski Oy, Stena Oy, Ekokem Oyj ja Rinki Oy, HSY

4.20.2 Current practices

- ICT based waste collection system
- Waste recovery in electricity and heat production, sorting and recycling of the raw materials in effective way.
- Processing of bio-based waste for recycling.

4.21 Digital public service

A measure of ICT implementation within public administration (percentage of Internet users that have engaged with the public administration and exchanged filled forms online) and health system. A lower indicator score is given where there are less ICT tools implemented.

4.21.1 Calculation

Following sub-indicators need to be calculated:

- Proportion of e-Government Users, A. Percentage of individuals sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet X divided by 10: A = X/10
- Medical Data Exchange, B. Percentage of general practitioners using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists, Y, divided by 10: B = Y/10

Therefore, the indicator is calculated as follows:

Indicator 21 = (**A** + **B**) / 2

In Helsinki

61% of individuals is sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet (2013). Therefore:

A = **61** / 10 = **6.1**

100% of general practitioners is using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists. Therefore:

B = **100** / 10 = **10** (Statistics Finland 2014; Holopainen 2015; Kela 2014)

The final indicator is:

Indicator 21 = (**6.1** + **10**) / 2 = **8.05**

4.21.2 Current practices

- Private sector practitioners obligatory to transfer prescriptions to pharmacists over electronic networks (Law of electronic prescriptions 2.2.2007/61)
- People have access to their own medical history.
- All medical information in hospitals is ICT based.§
- Tax declarations etc. are all made electronically.
- In 2014 41 % of Finnish people have submitted a e-form via Internet
- Nordic countries and the Netherlands are the highest user of digital public services
- Finnish people are generally satisfied with digital public services provided by authorities.

4.22 ICT infrastructure investment

A measure of the investment in the ICT infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.22.1 Calculation

The indicator is calculated as follows:

Indicator 22 = 10 × [(100 × (**X** / **Y) –** 0.09) / (1.5 − 0.09)]

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country (Teknologiateollisuus 2014; Stat.fi 2016).

In Helsinki

X = 790 €/capita

Y = 37800 €/capita (2015)

Indicator 22 = 10 × [(100 × (**790 / 37800**) – 0.09) / (1.5 − 0.09)] = 14.2 (capped at 10)

4.22.2 Current practices

Finland uses the cloud more than any other European country. The EC's Digital Economy and Society Index ranked Denmark, Sweden and Finland as first, second and fourth most digital European nation (Millar 2015) .

Helsinki Investments in ICT: 790 €/cap and year

5 Conclusion

The main scope of this report is to explore the sustainability of multiple services of the Helsinki metropolitan city based on two assessments. Firstly, the city's sustainability of urban water resources management is assessed based on the City Blueprint and Trends and Pressures Framework. Additionally, the city's sustainability of the energy, transport and ICT services is assessed following the City Amberprint.

The assessment of the Trends and Pressures Index ranks Helsinki 8 out of a total of 45 cities from all around the world (Figure 6.1). Helsinki performs rather well in all three assessments, although financial situation of Finland has been challenging for years.

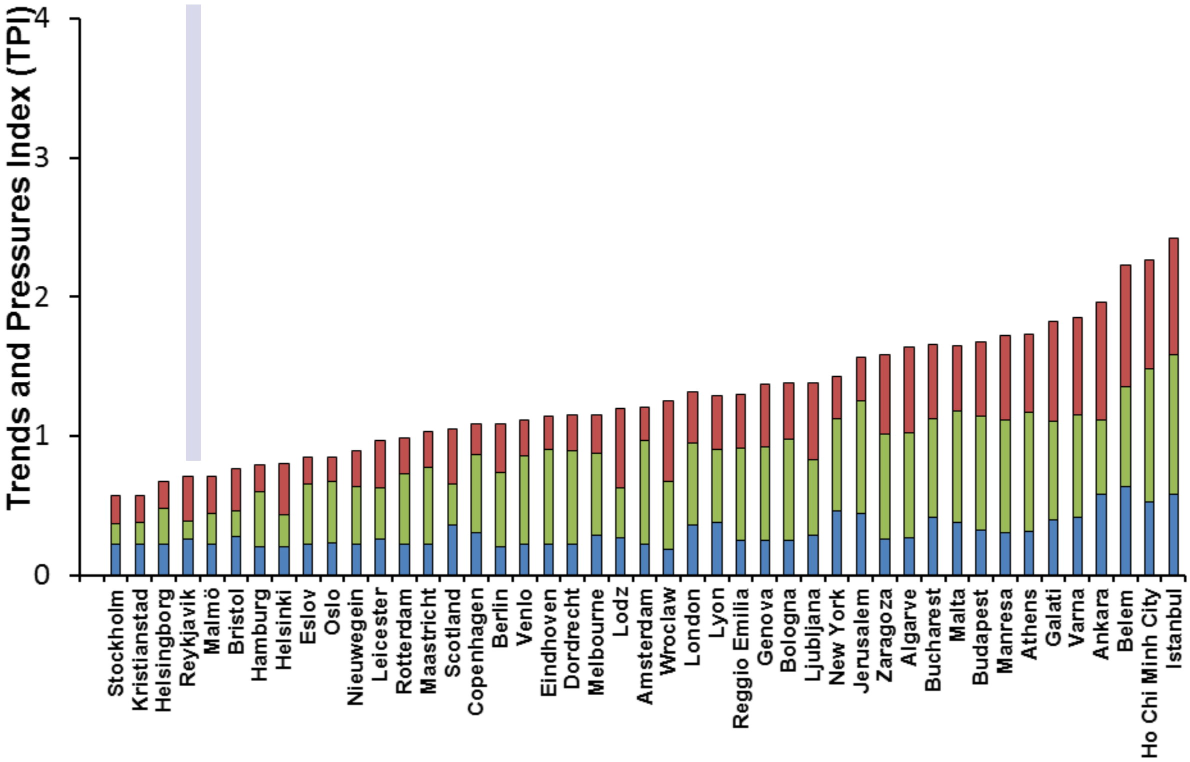

Figure 5.1. Trends and Pressures Index for 45 countries Figure drawn from (Bluescities project Deliverable 2.2 Application of the improved city blueprint framework in 45 municipalities and regions)

The city of Helsinki ranks 9th out of 45 cities from all around the world with a score of 7.1 in the Blue City Index (Figure 5.2).

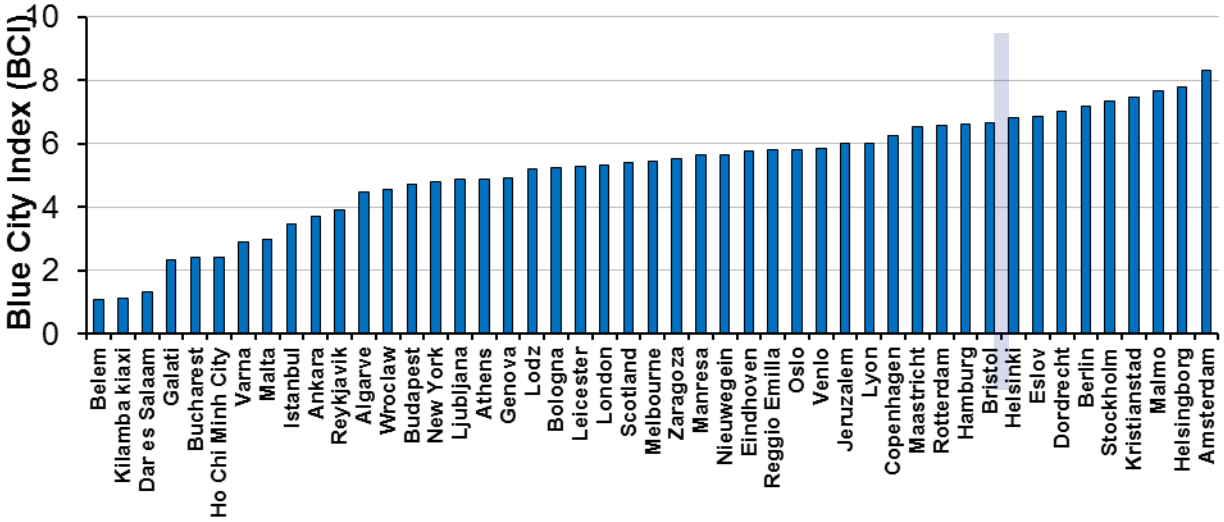

Figure 5.2. Blue City Index for 45 countries Figure drawn from (Bluescities project Deliverable 2.2 Application of the improved city blueprint framework in 45 municipalities and regions)

(Annexes)

Contact Persons:

City	Contributions from	Institution	Primary Contact
Helsinki Region	Tommi Fred department director, Water management	Helsinki Region Environmental Services Authority HSY Helsinki Water and Sewerage Administration	tommi.fred@hsy.fi
Helsinki Region	Susan Lyytikäinen, Manager of climate unit	Helsinki Region Environmental Services Authority HSY, Region and environmental data	Susan.Lyytikainen@hsy.fi
Helsinki Region (Helsinki)	Outi Väkevä	Finnish Environment Institute (SYKE), Transport related pollutions	Outi.Vakeva@hel.fi
Helsinki Region	Aninka Urho	Helsinki Region Environmental Services Authority HSY, ICT use water utilities	Aninka.Urho@hsy.fi
Helsinki Region	Kerkko Vanhanen, Information systems team leader	Helsinki Region Transport HSL, ICT use transport	Kerkko.Vanhanen@hsl.fi
Helsinki Region	Juha Kiuru	Helsinki Region Environmental Services Authority HSY, ICT use in waste management	Juha.Kiuru@hsy.fi
Helsinki Region (Finland)	Marja Huotari	City of Helsinki urban facts statistics, research and databases services, Digital public service	Marja.Huotari@hel.fi

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Annex D – Istanbul Report

Deliverable Title	**D3.2d Report on the Istanbul case study**
Deliverable Lead:	Istanbul University
Related Work Package:	WP3: City Case Studies
Related Task:	T3.2: Case-studies
Author(s):	Cevza Melek Kazezyılmaz Alhan, Sezar Gülbaz
Dissemination Level:	Public/Confidential
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Duration:	24 months
Abstract	The key objective was to assess the city of Istanbul, Turkey using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Istanbul has a Blue City Index score of 3.4 and an Amber City Index of 4.1 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 3.8.

Project funded by the European Commission as part of the EU Framework Programme for Research and Innovation

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Executive Summary

The key objective was to assess the city of Istanbul, Turkey using the developed methodology including the Trends and Pressures and City Blueprint and the City Amberprint assessments. Istanbul has a Blue City Index score of 3.4 and an Amber City Index of 4.1 with all of the three assessed sectors (energy, transport and ICT) receiving an average score of 3.8.

1 Introduction

Istanbul is located in the north-west Marmara Region of Turkey. It encloses the southern Bosphorus which places the city on two continents: the western portion of Istanbul is in Europe, while the eastern portion is in Asia. The city boundaries cover a surface area of 1,830.92 km^2 while the metropolitan region covers 6,220 km^2. The city forms the largest urban agglomeration in Europe and is classified as a megacity (a city with a population of over 10 million people). Furthermore, Istanbul is one of the most rapidly growing cities in Europe. The annual population growth is 2.8%. Providing water to this vast number itself is already a problem but the city faces further problems regarding water management. Water problems of Istanbul are due to the unplanned urbanization, uncontrolled settlements in protection zones, inadequate green land, inadequate and damaged infrastructure and combined sewer and storm water system.

Watersheds used currently are threatened by urbanization, pollution and industry. Therefore, their protection and improvement is a prime concern for water managers of the city, who have to consider population increase and uncertainty of precipitation (extreme events such as drought and flood) due to climate change. Moreover, the watersheds within the borders of the city are not enough to meet the current demand. The majority of resources are located on the Asian side in contrast to the urban density, the water reservoirs are linked into an integrated system including water from adjacent catchment areas of other cities connected to secure water supply for the city at a high cost. The Melen Project is a good example of this. Water from Düzce city is transmitted to Istanbul via a pipeline of 151 km in length, which begins from the Asian side, passes under the Bosphorus Strait with a 5.5 km long tunnel and 135 m under the sea and reaches the European side of the city. Regarding drought conditions, provision of water from another city would create conflicts between Istanbul and that city, which must also be considered by the water authorities.

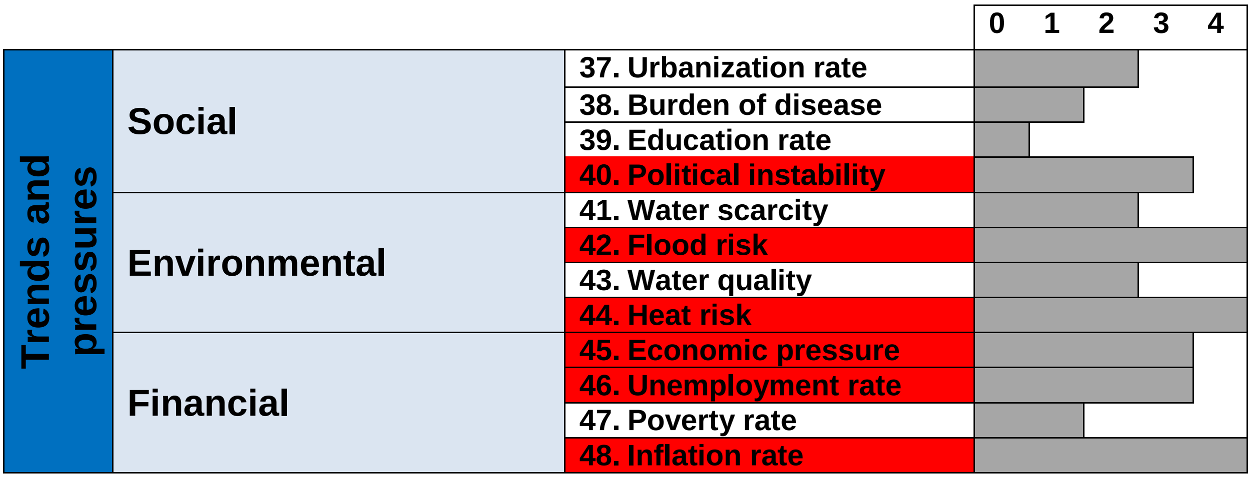
In Istanbul, the share of wastewater treated increased from 9% in 1993 to 95% in 2004. Although the storm water and sewage system have been implemented separately in recent years, a major portion of them are still combined which affects drinking water qualityIn addition, uncontrolled domestic and excavation wastes are other problems for watersheds. Along with population, growing industry is another factor for deteriorating quality of watersheds, and availability of drinking water. A good example of this is the Küçükçekmece Watershed, which has not been used since 1997 due to industrial wastes.

Istanbul is a very old and historic city. Among many other historical water structures, the Basilica Cistern (Yerebatan Sarnıcı) and the Valens Aqueduct (Bozdoğan Kemeri) are the most famous historical water structures present in Istanbul. The Basilica Cistern is located in the historical peninsula of Istanbul next to the Hagia Sophia and was built in the 6th century. It is an underground chamber of 143 m by 65 m, can hold 80,000 m^3 of water, and covers an area of 9,800 m^2. Currently, it is used only as a touristic place and many tourists visit the Basilica Cistern each year. The Valens Aqueduct is a Roman aqueduct completed in the late 4th century and was the major water-providing system of the city. It has a length of 971 m and height of 29 m. The water was feeding the zone of the imperial palace. The daily discharge in the 1950s amounted to 6,120 m^3. Currently, it is a historical place that tourists can visit and a major road is still passing underneath the aqueduct.

2 Trends and Pressures Framework

The trends and pressure indicators are standardized to a scale of 0-4 and divided in ordinal classes expressed as a 'degree of concern'.

Table 2.1: *Trends and pressures* in Istanbul. In this table a short summary is provided of the key indicators of concern or great concern and how these affect Urban Water Cycle Services.



			0 1 2 3 4
Trends and pressures	**Social**	**37. Urbanization rate**	2
		38. Burden of disease	1
		39. Education rate	0
		40. Political instability	3
	Environmental	**41. Water scarcity**	2
		42. Flood risk	4
		43. Water quality	2
		44. Heat risk	4
	Financial	**45. Economic pressure**	3
		46. Unemployment rate	3
		47. Poverty rate	1
		48. Inflation rate	4

0	No concern	1	Low concern	2	Medium concern	3	Concern	4	Great Concern

Explanation of the concerns of Istanbul

According to the World Bank (2014), the political stability of Turkey is a concern. This may hinder effective urban IWRM. Due to reductions in runoff, increased withdrawals in response to higher demand, and as a result of sea level rise, saltwater intrusion is one of the key threats for Istanbul. Two big lagoons (Büyücekmece and Kücükcekmece) and the Halic estuary that separates old town from the business district in Istanbul are vulnerable to salinization (Karaca and Nicholls 2008). Furthermore, flood vulnerability is a great concern of Istanbul. Moreover, the capacity of flood protection works is insufficient to ensure long term flood safety (Duman et al. 2005). The sea level rise together with the reporting of land subsidence pose imminent threats (Karaca and Nicholls 2008). Furthermore, the percentages of the soil that is sealed with impermeable concrete and asphalt is high making the city vulnerable to urban drainage flooding. Because of this lack of green space and due to the moderate increase in the number of hot days and tropical night, Istanbul is vulnerable to the urban heat island effect (Siemens 2015; EEA 2012A). The GDP per capita of Istanbul is 18,636 US$ per person per year (IMF 2013) which is relatively low. Finally, the inflation rate of Turkey is high (World Bank 2014B), which may impede long term investments in water infrastructure, flood protection measures and heat adaptation measures.

Social Pressures

2.1 Urbanization rate

Percentage of population growth either by birth or migration. The percentages are annually averages per country. Urbanization increases the pressure on integrated water resources management (IWRM) in cities.

Calculation:

The indicator is calculated as follows:

Score urbanization rate = $-0.114X^2 + 1.3275X + 0.1611$

Where X is the urbanization rate (%). For urbanization rates lower than 0% the score is also zero and the above formula is not applied.

In Istanbul urbanization rate is 2.40%, CIA (2014). Therefore:

$X = 2.40\%$

Score urbanization rate = -0.114 (2.40)2 + 1.3275 (2.40) + 0.1611 = **2.69**

Urbanization rate is of concern for Istanbul.

Scale: National.

2.2 Burden of disease

The gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability of population growth either by birth or migration. The indicator measures the age-standardized disability-adjusted life years (DALY) per 100,000 people. DALY is the quantification of premature death, burdens of disease and disability in life years. It is a time-based measure that combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health, e.g. disease, injuries and risk factors (WHO, 2004).

Calculation:

WHO calculation of DALY

Years of premature death: Sum of the number of deaths at each age * [global standard life expectancy for each age – the actual age].

Years lost due to disability: Number of incident cases in that period * average duration of the disease * weight factor.

Years of premature death + Years lost due to disability = DALY

The average DALY per 100,000 people is a strong tool to indicate the burden of disease.

The WHO subdivided these DALY's per 100,000 people into 5 classes. These classes are used to standardize this indicator to a score of 0 to 4 in the CBF analysis as shown below.

DALY per 100,000 people	Score
0 – 20,000	0
20,000 – 40,000	1
40,000 – 60,000	2
60,000 – 80,000	3
80,000 <	4

For Istanbul:

X = 29027 (WHO 2014)
Score is 1 point. The burden of disease is little concern for Istanbul.

Scale: National.

2.3 Education rate

Education rate expressed as percentage of children completing their primary education

Calculation:

The indicator is calculated as follows:

Score education rate = $-10^{-5}X^3 + 0.0012X^2 - 0.0426X + 4.3057$

Where X is the education rate (%)

For Istanbul
X = 101.0% (World Bank 2014C)
Is higher than 100% and therefore a score of 0 points.
Education rate is of no concern for Istanbul.

2.4 Political instability (and absence of violence)

The estimated likelihood that the government will be destabilized or overthrown by violent means such as terrorism and politically-motivated violence of population growth either by birth or migration.

Calculation:

The indicator is calculated as follows:

$4 - [(\text{Estimated political stability score} - 2.5)/(2.5 - 2.5)\times 4\ ] = \text{Score}$

For Istanbul
X = -1.19 (World Bank 2014A)
4- [(1.17--2.5)/(2.5--2.5) x 4]= **2.95**
Political instability is a concern for Istanbul.

Environmental Pressures

2.5 Water scarcity

Indicator 5 consists of three sub-indicators: Fresh water scarcity, Groundwater scarcity, Salinization & seawater intrusion

2.5.1 Fresh water scarcity

The abstracted fresh water as percentage of total renewable resource. This includes surface water and groundwater sources.

The scoring method is in accordance with the European Environmental Agencies classification (OECD, 2004; WRI, 2013).

% of renewable resource abstracted	Score
0 – 2	0
2 – 10	1
10 – 20	2
20 – 40	3
>40	4

For Istanbul

X = 18.93% (Aquastat 2015)

Score of 2 points.

Fresh water scarcity is of medium concern for Istanbul.

2.5.2 Groundwater scarcity

The abstracted groundwater as a percentage of the annual groundwater recharge. This is a measure of the pressure on groundwater resources.

Calculation:

The indicator scoring is in accordance with the classification used by UNESCO.

% abstracted of annual recharge	Score
0 - 2	0
2 - 20	1
20- 50	2
50 - 100	3
>100	4

For Istanbul

X = 18.9% (Aquastat 2015)

Score of 1 point.

Groundwater scarcity is of little concern for Istanbul.

2.5.3 Salinization & seawater intrusion

Measure of the vulnerability of seawater intrusion and salinization of the soil.

Calculation method:

This indicator score is based on a quick literature check in which seawater and groundwater intrusion are scored as suggested below.

Seawater intrusion

Description	**Score**
No seawater intrusion reported and city not prone to (future) intrusion	0
No seawater intrusion reported and city can experience intrusion in coming century	1
No seawater intrusion reported but city is prone to intrusion in the near future	2
Seawater intrusion reported	3
Seawater intrusion reported and city is particularly prone to intrusion	4

Groundwater salinization

Based on literature studies, here the following scheme is applied to determine a score:

Description	**Score**
No concern	0
Low concern	1
Medium concern	2
Concern	3
Great concern	4

The highest score of both indicators is used as the final score for salinization and seawater intrusion.

For Istanbul

X = Score of 3 points for seawater intrusion (Scheidleder et al. 2004).

Scale: National.

2.6 Flood risk

The indicator flood risk consists of 4 sub-indicators: Urban drainage flood, Sea level rise, River peak discharges, Land subsidence.

2.6.1 Urban drainage flood

Risk of flooding due to intensive rainfall expressed as the share of urban soil that is sealed.

Calculation method:

Sealed soil cover in the city standardized according to the min-max method. The minimum and maximum values are determined by taking the bottom and the top 10% of the 572 European cities assessed. Green and blue areas refer to 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 (EEA, 2012A).

For Istanbul

X = Data lacking but since it is a very dense city it is assumed to be similar to Athens. Hence belonging to the lowest 10% cities regarding the share of blue and green area in their city center.

Score is 4 points.

Urban drainage flooding is a great concern for Istanbul

2.6.2 Sea level rise

Measure of the vulnerability of flooding due to sea level rise. Percentage of the city that would flood with 1 meter sea level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams *etcetera* are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter sea level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
41-100	4

For Istanbul

X = Data for Istanbul is lacking but based on Turoglu (2009) it is estimated that sea level rise is of great concern for Istanbul since more than 40% is likely to be flooded by 1 meter sea level rise.

2.6.3 River peak discharges

Measure for the vulnerability of flooding due to river level rise. Also flash floods from outside the city are included in this indicator. Percentage of the city that would flood with 1 meter river level rise. Only environmental circumstances are considered. Protection measures such as dikes, dams etcetera are not considered (that would be a performance).

Calculation method

In accordance with the European Environmental Agency (2012) the following classification is used to standardize the area being affected by a 1 meter river level increase without flood protection on a scale from 1 to 5.

Urban area affected (%)	Score
0-5	0
6-10	1
11-20	2
21-40	3
40-100	4

More than 40% of Istanbul will flood if the river level would increase with 1 meter. The city therefore receives a score of 4.

For Istanbul

X = Data for Istanbul is lacking but based on Turoglu (2009) it is estimated that river peak discharge is of great concern for Istanbul since more than 40% is likely to be flooded by 1 meter river level rise.

2.6.4 Land subsidence

Land subsidence increases the risks of river and coastal floods and salt water intrusion. The cause of land subsidence is irrelevant for its impact on flooding.

Calculation method

This score is based on a qualitative assessment according to the following classification:

Score	**Description**
0	No infrastructure damage, no flood risk
1	Low/medium infrastructure damage expected, no major increase in flood risk expected
2	Experienced infrastructure damage and medium infrastructure damage expected or <0.50m subsidence by 2100 in a substantial area of the city.
3	Serious experienced infrastructural damage or < 1m subsidence by 2100 in a substantial area of the city
4	Serious experienced infrastructure damage, Imminent flooding/ < 2m subsidence by 2100 in a substantial area of the city

For Istanbul

X = Score is 2 points.

Flood risk due to subsidence is a medium concern for Istanbul.

2.7 Water quality

Water quality consists of two sub-indicators: Surface water quality, Biodiversity.

2.7.1 Surface water quality

Measure of relative surface water quality. A lower Indicator score is given for better quality.

Calculation method:

A national surface water quality index (WQI) is available as a measure out of 100. Then, the indicator is calculated as follows:

(100 – WQI)/25 = score

For Istanbul

X = 57.9 (EPI 2010)

(100-57.9)/25=1.68

Surface water quality is of medium concern for Istanbul

2.7.2 Biodiversity

Measure of the biodiversity of aquatic ecosystems in the city. A low indicator score is given where biodiversity is good.

Calculation method

The calculation is based on national or regional data when city-level data are not available. There are many ways of assessing biodiversity, so there is no globally uniform approach.

For EU countries, it is recommended to use data from the European Environment Agency (EEA) on 'percent of classified waters in less than good ecological status' as shown in this map – for which a high resolution version is available via the link.

Then apply the following criteria to determine an Indicator score

% of waters with less than good ecological status or potential	**Indicator value (for EU countries)**
<10%	0
10 to 30%	1
30 to 50%	2
50 to 70%	3
≥ 70%	4

For non-EU countries, it is recommended to use data from software called the Environmental Performance Index (EPI), led by Yale University (epi.yale.edu).

The latest 2012 update does not include the relevant parameter called 'Water – impact on ecosystem'. This is available from the 2010 version (see also Indicator 4).

The value is obtained from the Country Profiles.

For Istanbul

X = no data are provided by the EEA (2012): Water (impact on ecosystem) = 62.8 (EPI 2010). This leads to the following score: [100 – 62.8] / 25 = 1.49. This score implies that (aquatic) biodiversity is an issue of medium concern in Istanbul.

2.8 Heat risk

Prediction of heat island effects severity on human health

Calculation method

1. Number of combined tropical nights (>20°C) and hot days (>35°C) in the period 2071-2100, where the maximum is set on 50 days. The number is standardized using the following formula:

[Number of combined tropical nights and hot days/50]×4 = score

2. Percentage of green and blue urban area. Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

4 – [(% green and blue area – 16)/(48 – 16)×4] = score

3. The overall score is the arithmetic average of both standardized scores.

For Istanbul

X1 = 28 (Arcgis 2015)

X2 = No data available but assumed to be lower or equal to Athens 14.1%.

[28/ 50] x 4 = 2.24

4 - [(14.1 – 16) / (48 -16) x 4] = 4.0

Heat risk is a great concern for Istanbul.

Financial Pressures

2.9 Economic pressure

Gross Domestic Product (GDP) per head of the population is a measure of the economic power of a country. A low GDP per capita implies a large economic pressure.

Calculation method

The country average GDP the world (World Bank 2013) is taken. From all country GDP values the average of the lowest 10% is taken as minimum (514.7 US$/cap/yr) and the average of the highest 10% is taken as maximum (59231.2 US$/cap/yr). The country GDP is standardized according to the min-max method.

Score = 4 – [((X – 514.7)/(59231.2 – 514.7))×4]

Where X is GDP per capita per day (US$)

For Istanbul

X = 18363 US$/cap/yr (IMF 2013)

4- [((18363 - 514.7)/(59231.2-514.7))*4] = 2.8

Economic pressure is a concern for Istanbul.

2.10 Unemployment rate

Percentage of population of the total labor force without a job.

Calculation method

Score unemployment rate = $0.0002X^3 – 0.0173X^2 + 0.5077X – 0.8356$

Where X is unemployment rate (%)

For Istanbul

X = 9.2% (World Bank 2015)

0.0002 (9.2)3 – 0.0173 (9.2)2 + 0.5077 (9.2) – 0.8356 = 2.53

Unemployment rate is a concern for Istanbul.

2.11 Poverty rate

Percentage of people that is below the poverty line of 2 US$ a day.

Calculation method

Score poverty rate = $–0.0001X^2 + 0.0404X + 1.1686$

Where X is poverty rate (% less than 2US$ a day)

For Istanbul

X = 9.2% (World Bank 2015)

0.0002 (9.2)3 – 0.0173 (9.2)2 + 0.5077 (9.2) – 0.8356 = 2.53

Unemployment rate is a concern for Istanbul.

2.12 Inflation

Percentage inflation per year. High inflation rates may hamper investments.

Calculation method

Score inflation rate = $0.0025X^3 – 0.0744X^2 + 0.8662X + 0.0389$

Where X is the inflation rate (%).

For Istanbul

X = 9.2% (World Bank 2015)

0.0002 (9.2)3 – 0.0173 (9.2)2 + 0.5077 (9.2) – 0.8356 = 2.53

Unemployment rate is a concern for Istanbul.

3 City Blueprint

Table 3.1: List of City Blueprint indicators for Istanbul

Category	No.	Indicator	Score
I	1	Secondary WWT	3.5
	2	Tertiary WWT	3.4
	3	Groundwater quality	4.0
II	4	Solid waste collected	4.9
	5	Solid waste recycled	0.1
	6	Solid waste energy recovered	0.0
III	7	Access to drinking water	10.0
	8	Access to sanitation	10.0
	9	Drinking water quality	10.0
IV	10	Nutrient recovery	1.2
	11	Energy recovery	0.2
	12	Sewage sludge recycling	3.5
	13	WWT Energy efficiency	5.0
V	14	Average age sewer	8.0
	15	Operation cost recovery	3.6
	16	Water system leakages	5.0
	17	Stormwater separation	2.4
VI	18	Green space	1.3
	19	Climate adaptation	4.0
	20	Drinking water consumption	9.7
	21	Climate robust buildings	2.0
VII	22	Management and action plans	4.0
	23	Public participation	2.0
	24	Water efficiency measures	4.0
	25	Attractiveness	7.0

Categories: I – Water quality, II – Solid waste treatment, III – Basic water services, IV – Wastewater treatment, V – Infrastructure, VI Climate robustness, VII - Governance

Figure 1.1. City Blueprint of Istanbul. A score of 0 (inner circle) means that further attention is needed and a score of 10 is an excellent score (outer circle). The Blue City Index has a score of 3.4.

I – Water quality

3.1 Secondary WWT

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 (biochemical oxygen demand) and nutrient removal.

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).

3.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = X / 10,

Where X is the percentage of population connected to secondary sewage treatment. Assumed that there is only tertiary treatment after secondary treatment has been done.

In Istanbul

The population of Istanbul = 14,377,018

Total Waste Water Collected: 1,183,634,077 m^3/year

The flow rate for Secondary Waste Water Treatment plant (Biological WWT plant): 9,756,574 m3/year (ARIWSA, 2014)

Istanbul has 0.82% of only secondary treatment.

The flow rate for Tertiary Waste Water Treatment plant (Advanced Biological WWT plant includes secondary treatment): 402,132,797 m3/year (ARIWSA, 2014)

Istanbul has 33.97% of their waste water treated with tertiary treatment.

X = Total secondary treatment = 0.82+33.97 = 34.8 %

Indicator 1 = X / 10 = 34.8 / 10
Indicator 1 = **3.48**

3.1.2 Current practices

- Secondary waste water treatment plants are implemented by Istanbul Water and Sewerage Administration (IWSA). Moreover, the maintenance and control of the plants are done by IWSA.

3.2 Tertiary WWT

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 inters the surface water.

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

3.2.1 Calculation

The indicator is calculated as follows:
Indicator 2 = X/10,
Where X is the percentage of population connected to tertiary sewage treatment.

In Istanbul

Total Waste Water Collected: 1,183,634,077 m^3/year (ARIWSA, 2014)

The flow rate for Tertiary Waste Water Treatment plant (Advanced Biological WWT plant): 402,132,797 m^3/year (ARIWSA, 2014)

X = 33.97% of Istanbul waste water is treated with tertiary treatment.

Indicator 2 = X/10 = 33.97 / 10
Indicator 2 = **3.4**

3.2.2 Current practices

- Tertiary waste water treatment plants are implemented by Istanbul Water and Sewerage Administration (IWSA). Moreover, the maintenance and control of the plants are done by IWSA.

3.3 Groundwater quality

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

3.3.1 Calculation

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’

Indicator 3 = X / (X + Y) × 10

Note: for non-EU countries, an alternative method should be applied, depending what data is available indicator is calculated as follows:

In Istanbul

Groundwater quality

Groundwater, not in the area of Istanbul, but in the western European part of Turkey (Trace region) was studied for the quality by Aydin (2006). It was found that from the 40 groundwater samples, all samples had microbiological values and some chemical values above the limits set by EU DWD and TFC-DWD (drinking water direction). The existence of indicator bacteria in high amounts demonstrates that there may be pathogenic bacteria such as important pathogens like E. coli, Salmonella sp. which were present so that it is necessary to disinfect the groundwater before human use. The high number of indicator microorganism counts observed reflected the poor quality of water being used by these communities served by groundwater. (Aydin, 2006). The proposed score is 4.

X = 16
Y = 24
Indicator 3 = [16 / (16 + 24)] ×10
Indicator 3 = **4**

3.3.2 Current practices

- Wild landfill area is converted into the sanitary landfill site in Istanbul. Therefore, ground water contamination has decreased since volume of leachate decreases with this implementation. Karakiraz and Göktürk two sanitary landfill sites in Istanbul.

II – Solid waste treatment

3.4 Solid waste collected

Represents waste collected from households, small commercial activities, office buildings, institutions such as schools and government buildings, and small businesses that threat or dispose of waste at the same used for municipally collected waste (OECD, 2013).

3.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = [1 – (X – 136.4)/(689.2 – 136.4)]×10,

Where X is the kg/cap/year of collected solid waste.

In Istanbul

Total solid waste collected in Istanbul: 16,500 ton/day

Total solid waste collected: 6,022,500 ton/year

The population of Istanbul =14,377,018

X = kg/cap/year of collected solid waste in Istanbul=418.9 kg/cap/year

Indicator 4 = [1 - (418.9 - 136.4) / (689.2 - 136.4)*10]

Indicator 4 = **4.9**

3.4.2 Current practices

- In the past, wild landfill area was one of the biggest problems in Istanbul. However, sanitary landfill areas are constructed in Istanbul in the last two decades. Karakiraz and Göktürk two sanitary landfill sites in Istanbul. Odayeri/Göktürk landfill site is located on European side of Istanbul on an area of 89 hectars and 8500 tons of waste is transferred to this site per day. Kömürcüoda/Karakiraz landfill site is located on Anatolian side of Istanbul on an area of 60 hectars and 4500 tons of waste is transferred to this site per day. Waste is disposed at these sites by various methods such as incineration or compost.
- The district municipalities collect waste and bring them into solid waste transport stations. 3 of these stations are located on European side of Istanbul which are Yenibosna, Halkalı and Silivri. 4 of these stations are located on Anatolian side of Istanbul which are Hekimbaşı, Aydınlı, Küçükbakkalköy and Baruthane.
- There are waste reuse and recycling encouragement programs in district municipalities in Istanbul.

3.5 Solid waste recycled

Percentage of solid waste that is recycled or composted.

3.5.1 Calculation

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.

Indicator 5 = (% recycled or composted)/(100-% used for incineration with energy recovery) x 10

In Istanbul;

Amount of solid waste that is recycled or composted: 45,542 ton/year

Percentage of solid waste that is recycled or composted: 0.76 %

Indicator 5 = 0.76 / (100 - 0.0073)*10
Indicator 5 = **0.1**

3.5.2 Current practices

- In Istanbul, solid waste recycling is made by private companies under the control of Istanbul Metropolitan Municipality. In addition, district municipalities collect recycled waste by a special truck.

3.6 Solid waste energy recovered

Percentage of solid waste that is incinerated with energy recovery.

3.6.1 Calculation

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

Indicator 6 = (% incinerated with energy recovery)/(100 – % recycled or composted)×10

In Istanbul;

Amount of solid waste incinerated with energy recovery: 440 ton/year

Percentage of solid waste that is incinerated with energy recovery: 0.0073%

Indicator 6 = 0.0073 / (100 - 0.076)*10
Indicator 6 = **0.000073**

III – Basic water services

3.7 Access to drinking water

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

3.7.1 Calculation

The indicator is calculated as follows:
Indicator 7 = X / 10,
Where X is the percentage of total urban population with access to potable drinking water.

In Istanbul

X = Percentage (%) of total urban population with access to potable drinking water = 100%
(TSI, 2012)

Indicator 7 = 100/10

Indicator 7 = **10**

3.7.2 Current practices

- Drinking watersheds are controlled and protected by Istanbul Water and Sewerage Administration. There are seven drinking watersheds in Istanbul. 4 of them are located on European side which are Büyükçekmece, Sazlıdere, Alibeyköy, and Terkos. 3 of them are located on Anatolian side which are Ömerli, Elmalı and Darlık.
- With the big Melen project, good quality of drinking water is supplied to Istanbul by using water collectors. Water from Düzce city is transmitted to Istanbul via a pipeline of 151 km in length, which begins from the Asian side, passes under the Bosphorus Strait with a 5.5 km long tunnel and 135 m under the sea and reaches the European side of the city. In addition, Melen Dam is under construction. Therefore, it is estimated that in Istanbul there will be no water problems for households for the next 50 years.

3.8 Access to sanitation

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.

3.8.1 Calculation

The indicator is calculated as follows:
Indicator 8 = X / 10
Where X is the percentage of total urban population with access to proper sanitation facilities.

In Istanbul

X = Percentage (%) of total urban population with access to proper sanitation facilities=100%

(TSI, 2012)

Indicator 8 = 100/10
Indicator 8 = **10**

3.8.2 Current practices

- There are six big waste water treatment plants for treating the waste water collected in Istanbul. They are Ambarlı, Ataköy, Baltalimanı, Paşaköy, Terkos, and Tuzla.

3.9 Drinking water quality

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

3.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = (X / Y) * 10,

Where X is the percentage of total urban population with access to potable drinking water.

In Istanbul

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=40

X (Turkish Standard)= 40

X (WHO Standard)= 40

X (EPA Standard)= 40

X (EU Standard)= 40

Indicator 9 = (40 / 40) * 10

Indicator 9 = **10**

3.9.2 Current practices

- There are six big drinking water treatment plants for treating the drinking water supplied to all households in Istanbul. These are Kâğıthane, Ömerli, İkitelli (FSMH), Büyükçekmece, Cumhuriyet and Elmalı. These plants supply water with good quality to the whole population of Istanbul. These plants are controlled and maintained by Istanbul Water and Sewerage Administration.
- The big Melen project brings water to Istanbul from another city called Düzce with a pipeline of 150 km long. The Melen Dam is currently under construction and the target of this project is to supply sufficient amount of water with good quality until 2070.

IV – Solid waste treatment

3.10 Nutrient recovery

Measure of the level of nutrient recovery from the wastewater system.

3.10.1 Calculation

A. Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Mm3 year-1)

B. Total amount of wastewater passing the wastewater treatment plants (Mm3 year-1)

Indicator 10 = [A/B]×[% secondary WWT coverage/100]×10,

In Istanbul

A=Wastewater treated with nutrient recovering techniques at the wastewater treatment plants (Nutrients removal in advanced WWT) (m3/year): 402,132,797 m3/year (ARIWSA, 2014)

B= Total amount of wastewater passing the wastewater treatment plants (m3 /year): 1,183,634,077 m3/year (ARIWSA, 2014)

Istanbul has 0.82% of only secondary treatment.

Istanbul has 33.97% of their waste water treated with tertiary treatment.

Totally secondary treatment 0.82 + 33.97 = 34.8 %

Indicator 10 = A / B x % secondary WWT coverage x 10 = (402,132,797 / 1,183,634,077) x 0.348 x 10

Indicator 10 = **1.2**

3.10.2 Current practices

- There are six big waste water treatment plants which are Ambarlı, Ataköy, Baltalimanı, Paşaköy, Terkos, and Tuzla for treating the waste water collected from the households in Istanbul. In these plants, nutrient recovery is made.

3.11 Energy recovery WWT

Measure of energy recovery from the wastewater system.

3.11.1 Calculation

A) Total volume of wastewater treated with techniques to recover energy (Mm3/year).

B) Total volume of water produced by the city (Mm3/year).

[A / B]×10 = 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 (Mm3/year).

D) Total volume of wastewater treated in wastewater treatment plants (Mm3/year).

Indicator 11 = [C/D]×[% secondary WWT coverage/100]×10,

In Istanbul

Total volume of wastewater treated with techniques to recover energy: 71,018,044 m3/year (ARIWSA, 2014)
Total volume of water produced by the city: 1,183,634,077 m3/year (ARIWSA, 2014)

Indicator 11 = C/D * (% secondary WWT coverage) / 100 * 10

Indicator 11 = (71,018,044) / (1,183,634,077) * (34.8) / 100 * 10
Indicator 11 = **0.2**

3.11.2 Current practices

- A small part of sludge and gas produced in waste water treatment plant is used for energy recovery under the control of Istanbul Water and Sewerage Administration in Istanbul.

3.12 Sewage sludge recycling

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.

3.12.1 Calculation

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)
Indicator 12 = [(C+D)/A]×[% 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.

In Istanbul

A= Dry weight of sludge produced in wastewater treatment plants serving the city: 96,131,344 kg/year (ARIWSA, 2014)
B= Dry weight of sludge going to landfill: 0
C= Dry weight of sludge thermally processed: 96,131,344 kg/year (ARIWSA, 2014)
D= Dry weight of sludge disposed in agriculture: 0

E= Dry weight of sludge disposed by other means: 0

(As a check, A should = B + C + D +E)

Indicator 12 = [(C+D)/A] x [% secondary WWT coverage/100] x10

Indicator 12 = [(96,131,344 + 0) / 96,131,344] x [34.8 100] x 10

Indicator 12 = **3.5**

3.12.2 Current practices

- A small part of sewage sludge produced as a result of waste water treatment plant is used in recycling process under the control of Istanbul Water and Sewerage Administration in Istanbul.

3.13 WWT Energy efficiency

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

3.13.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 13.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 13 is **5**.

Istanbul Water and Sewerage Administration (ISKI) has a local policy plan and available document. It is possible to reach these plans and documents.

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration.

3.13.2 Current practices

- Istanbul Water and Sewerage Administration and Istanbul Metropolitan Municipality have local policy plans related to WWT energy efficiency.

V – Infrastructure

3.14 Average age sewer

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

3.14.1 Calculation

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.

Indicator 14 = (60 – X)/(60 – 10)×10

Where X is the average age sewer

In Istanbul

X = Average age sewer= This is a little bit hard to estimate. There is no official local document for this data. However, we talked with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration. He said that there exists sewer systems which are more than 500 years old especially in historical district of Istanbul but this is a small portion. However, about %90 of the sewer system of the city is renewed in the last 15-20 years. Thus, we conclude that 20 years may be a good estimate for the average age sewer of Istanbul.

Indicator 14 = (60 - 20) / (60 - 10) x 10

Indicator 14 = **8.0**

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration.

3.14.2 Current practices

- There exist sewer systems which are more than 500 years old especially in historical district of Istanbul but this is a small portion. However, about %90 of the sewer system of the city is renewed in the last 15-20 years by Istanbul Water and Sewerage Administration in Istanbul.

3.15 Operating costs recovery (ratio)

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.

3.15.1 Calculation

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

Operating cost recovery (ratio) = (Total annual operational revenues)/(Total annual operating costs)

Total annual operating costs: Total annual operational expenditures for drinking water

Total annual operational revenues: Total annual income from tariffs and charges for drinking water and sanitation services (US$/year)

Therefore the indicator is calculated as follows:

Indicator 15 = (X – 0.33)/(2.34 – 0.33)×10

Where X is operating cost recovery (ratio).

In Istanbul

Total annual operational revenues: Total annual income from tariffs and charges for drinking water and sanitation services (US$/year): 4,217,066,371 TL/year = 1,565,878,122US$/year (1US$/ =2.7 TL) (ARIWSA, 2014)

Total annual operating costs: Total annual operational expenditures for drinking water and sanitation services (US$/year): 4,043,960,918 TL/year= 1,501,600,727US$/year (ARIWSA, 2014)

Operating cost recovery (ratio) = Total annual operational revenues/ Total annual operating costs

Operating cost recovery (ratio) = 1,565,878,122/1,501,600,727=1.043

X = Operating cost recovery (ratio) = 1.043

Indicator 15 = (X - 0.33) / (2.34 - 0.33) x 10

Indicator 15 = **3.6**

3.15.2 Current practices

- Istanbul Water and Sewerage Administration has annual budget for infrastructure maintenance.

3.16 Water system leakages

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

3.16.1 Calculation

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.

Indicator 16 = (50 – X)/(50 – 0) × 10

Where X is water system leakages (%).

In Istanbul

X = Water system leakages in Istanbul (%) = 25% (ARIWSA, 2014)
http://suyonetimi.ormansu.gov.tr/Libraries/su/%C4%B0SK%C4%B0_Sunum_1.sflb.ashx)

Indicator 16 = [(50 - 25) / 50] x 10

Indicator 16 = **5**

3.16.2 Current practices

- SCADA has recently established as part of the Leak Detection System (LDS) by Istanbul Water and Sewerage Administration and it is currently under testing stage.
- People communicate with the Help Desk of Istanbul Metropolitan Municipality if they observe any leakage in a pipeline.

3.17 Stormwater separation

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.

3.17.1 Calculation

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)

Indicator 17 = [(B+C)/(A+B+C)]×10

In Istanbul,

A. Total length of combined sewers managed by the utility (km)= 14,626.72
B. Total length of stormwater sewers managed by the utility (km)= 3,539.71
C. Total length of sanitary sewers managed by the utility (km)= 0

(İSKABİS, ARIWSA, 2014).

Indicator 17 = (3,539.71 + 0) / (14,626.72 + 3,539.71 + 0) x 10

Indicator 17 = **2.4**

3.17.2 Current practices

- Istanbul Water and Sewerage Administration separates storm water from the wastewater in new urbanized areas by implementing storm water collectors. In addition, Istanbul Water and Sewerage Administration renews old combined systems with separated systems where possible.

VI – Climate robustness

3.18 Green space

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).

Definition of green area (EEA, 2012A): 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.

3.18.1 Calculation

City specific: Numbers are provided in %

Country average: Share of green and blue areas is available for all European cities. The EEA city database presents data for of 367 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. A best estimate is given by comparing this city to a similar European city. It is important for these cities to provide better information on the share of green area.

Indicator 18 = (X – 16)/(48 – 16)×10

Where X is the share of blue and green area (%).

In Istanbul

X = 20.16

Indicator 18 = (20.16 - 16) / (48 - 16) x 10

Indicator 18 = **1.3**

3.18.2 Current practices

- District municipalities in collaboration with Istanbul Metropolitan Municipality implement green parks in the city and cover the embankments of the highways with grass.

3.19 Climate adaptation

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.

3.19.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 19.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 19 is **4**.

Turkish State Meteorological Service and the Scientific and Technological Research Council of Turkey and Istanbul Water and Sewerage Administration address climate adaptation topics at the national and local level. It is possible to reach related documents in their websites.

3.19.2 Current practices

- Projection of climate change maps are produced for years of 2070 and 2100 in national level by Turkish State Meteorological Service and the Scientific and Technological Research Council of Turkey.
- Istanbul Water and Sewerage Administration takes measures against water scarcity due to the climate change by implementing water supply projects which will provide drinking water of the city for the next 50 years.

3.20 Drinking water consumption

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 authorised 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 authorised 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.

3.20.1 Calculation

The volume is then normalized against maximum and minimum volumes for European cities.

Indicator 20 = [1 – (X – 45.2) / (266 – 45.2)] × 10

Where X is m^3/person/year drinking water consumption.

X = 52.9 m3/person/year drinking water consumption (ARIWSA, 2014)

The volume is then normalized against maximum and minimum volumes for European cities. The minimum is for Rotterdam at 45.2 m3/person/yr. The maximum is for Kiev at 266 m3/person/yr (European Green City Index).

Indicator 20 = [1 - (52.9 - 45.2) / (266 - 45.2)] * 10

Indicator 20 = **9.7**

3.20.2 Current practices

- Drinking water quality provided by Istanbul Water and Sewerage Administration to customers is very good since drinking watersheds are controlled and protected by Istanbul Water and Sewerage Administration.
- With the big Melen project, good quality of drinking water is supplied to Istanbul by using water collectors.

3.21 Climate robust buildings

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.

3.21.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 21.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 21 is 2.

This topic is new for Istanbul and there are limited policy documents.

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration (ARIWSA, 2015).

VII – Governance

3.22 Management and action plans

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. 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).

3.22.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 22.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 22 is **4**.

Turkish State Meteorological Service, the Scientific and Technological Research Council of Turkey and Istanbul Water and Sewerage Administration address climate adaptation topics at the national and local level. It is possible to reach related documents in their websites.

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration (ARIWSA, 2015).

3.22.2 Current practices

- General Directorate of Water Management is the major organization responsible for coordination, policy and legislation of water management in Turkey. Planning and evaluation on water use, water quality & quantity and investments on water are also exclusively under the responsibility of this Government Agency. Protection of watershed and preparation of watershed management plans, watershed protection action plans, watershed management plans, legislation related to surface water quality for drinking water and water pollution control are made by this agency.
- Istanbul Water and Sewerage Administration coordinates the preparation of flood hazard maps.

3.23 Public participation

A measure of share of people involved or doing unpaid work.

3.23.1 Calculation

The indicator is calculated as follows (for EU countries):

Indicator 23 = (X – 5)/(53 – 5) × 10

X = Involvement in voluntary work

In Istanbul

Non-EU countries: X = Rule of law score

X = 0.6573 * 55.9 – 22.278 = 14.47

Indicator 23 = (14.47 - 5) / (53 -5) x 10

Indicator 23 = **2.0**

3.23.2 Current practices

- Istanbul Water and Sewerage Administration organizes workshops in schools to educate children about the importance of water to increase awareness.
- Istanbul Water and Sewerage Administration organizes school competitions to disseminate the importance of water.
- There are 33 district municipalities in Istanbul and they organize events to increase awareness.

3.24 Water efficiency measures

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.

3.24.1 Calculation

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.

The following guidance is proposed to make self-assessment score for Indicator 24.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 24 is **4.**

Istanbul Water and Sewerage Administration addresses water efficiency measures topics at the national and local level. It is possible to reach the related documents in its website.

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration (ARIWSA, 2015).

3.24.2 Current practices

- There are public service announcements in TV/radio/webpage related to efficient usage of water.

3.25 Attractiveness

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 harbours 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.

3.25.1 Calculation

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).

The following guidance is proposed to make self-assessment score for Indicator 25.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul

The score of Indicator 25 is **7**.

Istanbul attracts a lot of tourists, since it is a historical and beautiful place of the world. Especially, Bosphorus Strait and Golden Horn are very attractive places in Istanbul. Republic of Turkey Ministry of Culture and Tourism and Istanbul Metropolitan Municipality implement plans for touristic areas, make videos and advertisements to promote Istanbul in international level. It is possible to reach this information in its website.

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration (ARIWSA, 2015).

3.25.2 Current practices

- There are many boat trips on Bosphorus strait, and there are pubs and restaurants next to the Bosphorus strait.
- There are many restaurants nearby Golden Horn.
- The Basilica Cistern is a historical water structure used in history as a water reservoir. Now, it is used as a touristic place.

4 City Amberprint

The City Amberprint is a complement to the City Blueprint and the Trends and Pressures Framework. The main goal of the City Amberprint is a baseline assessment of the sustainability of Energy, Transport and ICT in cities. To comply with City Blueprint, indicators that have a score between 0 (there is a concern) to 10 (no concern) are proposed. The quantitative indicators were "normalise" on a scale of 0 to 10, where 10 points were assigned to cities that met or exceeded certain criteria on environmental performance. The overall sustainability of the three aspects is expressed as Amber City Index (ACI). The ACI is the geometric mean of the 22 indicators.

Table 4.1: List of City Amberprint indicators for Istanbul

Category	No.	Indicator	Score
ENERGY	1	Carbon footprint	6.4
	2	Fuel poverty	8.8
	3	Energy consumption	2.5
	4	Energy self-sufficiency	0.2
	5	Renewable energy ratio	3.6
	6	Energy efficiency plans	5.0
	7	Energy infrastructure investment	5.7
TRANSPORT	8	Commuting time	3.5
	9	Use of public transport	0.0
	10	Bicycle network	0.3
	11	Transportation fatalities	10.0
	12	Clean energy transport	6.0
	13	Transport-related pollutions	10.0
	14	Transport infrastructure investment	0.0
ICT	15	ICT access	5.0
	16	ICT use households	5.4
	17	ICT use water utilities	8.3
	18	ICT use energy utilities	7.5
	19	ICT use transport	7.8
	20	ICT use waste management	6.3
	21	Digital public service	7.0
	22	ICT infrastructure investment	7.2

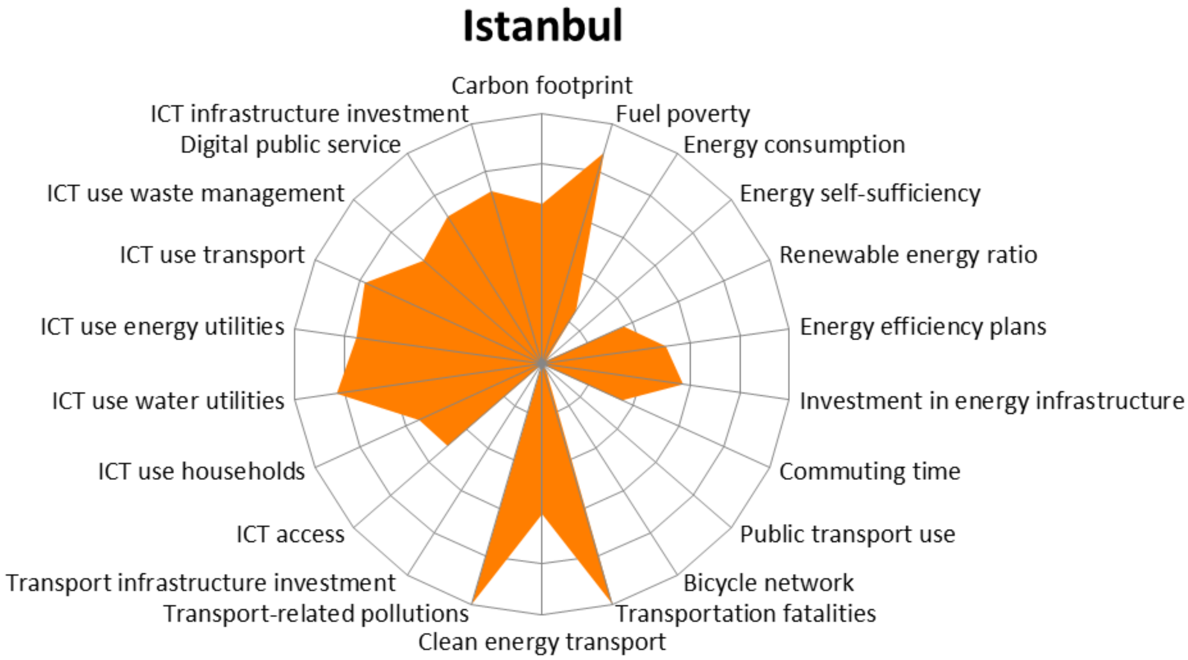


Figure 1.1: City Amberprint of Istanbul The centre of the circle corresponds to 0 and its periphery to 10. The Amber City Index (ACI) for Istanbul is 4.1.

Energy indicators

4.1 Carbon footprint

How city's carbon footprint (CF) per person per year does compare with the international range? A lower indicator score is given for a larger carbon footprint.

Definition of Carbon Footprint: the total sets of greenhouse gas emissions caused by an organization, event, product or person.

4.1.1 Calculation

The indicator is calculated as follows:

Indicator 1 = 10×(16.464 - X)/(16.464 - 0.237),

Where X is the CF/capita/year in the city.

In Turkey the CF value is 6.04 tonnes/cap/year (2013). Therefore:

Indicator 1 = 10×(16.464 - **6.04**)/(16.464 - 0.237) = **6.42**

Note: No data at a city level.

4.1.2 Current practices

- In some regions of the city, instead of chemical waste water treatment plants, natural treatment methods, such as constructed wetlands or retention ponds are used for waste water treatment. For example, Küçükçekmece Lake wetland site receives industrial and domestic waste water.
- A portion of public transport in the city uses electricity which results in relatively low carbon emission.

4.2 Fuel poverty

What is the proportion of households in the city that are considered to be fuel poor? The lower indicator score is given when the proportion is higher.

Under the Low Income High Costs definition, a household is considered to be fuel poor if:

- they have required fuel costs that are above average (the national median level)
- were they to spend that amount, they would be left with a residual income below the official poverty line.
-

4.2.1 Calculation

The indicator is calculated as follows:

Indicator 2 = (100-X)/10,

Where X is the percentage of households in the city considered to be fuel poor.

For Istanbul the percentage of households which is considered to be fuel poor is 11.57% (in 2014). Therefore:

Indicator 2 = (100 **–** **11.57**)/10 = **8.8**

4.2.2 Current practices

- Instead of conventional heating systems, new heating systems should be used. Central heating systems are more efficient than private heating systems. In Istanbul, centralized heating systems are used in new high rise buildings.

- Thermal isolation systems should be used in buildings. In Istanbul, mandatory energy performance certificates for buildings will take place after 2017.
- Istanbul Metropolitan Municipality provides free coal to Istanbul inhabitants with low income.
- Istanbul Metropolitan Municipality provides shelters (e.g. sports hall) to homeless people in winter.

4.3 Energy consumption

This indicator presents how does total energy consumption (domestic, industrial and commercial, and transport) per capita in the city compares with the international range (kgoe/cap/yr). A lower indicator score is given where the consumption is greater.

4.3.1 Calculation

The indicator is calculated as follows:

Indicator 3 = 10×(5419 **–** X)/(5419 **–** 893.15),

where X is the total energy consumption for the city in kgoe/cap/yr.

In Istanbul energy consumption is 4300 kgoe/cap/yr (in 2015). Therefore:

Indicator 3 = 10×(5419 **–** **4300**)/(5419 **–** 893.15) = **2.5**

4.3.2 Current practices

- Household appliances should be energy efficient.
- Waste should be recycled in WWT plants for energy recovery. In Istanbul, some of the WWT plants have the capacity of producing energy from waste.

- Isolation of new constructed buildings in Istanbul is mandatory. For old buildings, there is financial encouragement by government: the house owners, who make isolation for their homes, pay reduced taxes.

4.4 Energy self-sufficiency

Measure of the proportion of a city's demand that could be met through indigenous production including renewable resources, waste, and traditional but generated locally in the city. A lower indicator score is given where self-sufficiency is lower.

4.4.1 Calculation

The indicator is calculated as follows:

Indicator 4 = 10×X/Y,

where X is the the amount of energy generated locally, and Y is the total energy consumption in the city.

In Istanbul, the total energy consumption was 4300 kgoe/cap/yr (in 2013). The amount of energy generated locally was 66.134 kgoe/cap/yr (in 2013). Therefore:

Indicator 4 = 10×66.134/4300 = **0.15**

4.4.2 Current practices

- Methane gas can be produced in landfill which can be converted into energy. In Istanbul, there are systems at landfill sites for energy production.
- Energy can be generated from water waves, sun via solar panels, wind via wind turbines. These kinds of systems are recently constructed in Istanbul.

4.5 Renewable energy ratio

A measure of proportion of total energy derived from renewable sources in the city, as a share of the city's total energy consumption compared to the international range. A lower indicator is given where the percentage is lower.

4.5.1 Calculation

The indicator is calculated as follows:

Indicator 5 = 10×(X – 1.15)/(98.8 – 1.15),

Where X is the percentage of energy derived from renewable sources.

In Istanbul the percentage of total energy derived from renewable sources was 36.1 % in 2013. Therefore:

Indicator 5 = 10×(**36.1** – 1.15)/(98.8 – 1.15) = **3.6**

4.5.2 Current practices

- Investment in renewable energy systems is co-financed by the Turkish Republic Government for encouragement.

4.6 Energy efficiency plans

Measure of the application of energy efficiency measures by the range of energy users across the city. A lower indicator score is given where efficiency measures are more limited. 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. energy companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the efficiency of energy usage:

- at household level, e.g. efficient household appliances,
- at community level by energy efficient buildings or energy recycling, e.g. heat can be collected in summer, and stored to use it in winter,
- by encouraging people to change their behaviour.

4.6.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 6.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

In Istanbul, Renewable Energy General Directory in “Republic of Turkey Ministry of Energy and Natural Resources” is working on detailed inventory related to energy usage, management and efficiency. The documents are not published online but can be reached upon request from Information Desk in Istanbul Metropolitan Municipality.

Therefore Istanbul is given a score of **5**.

4.6.2 Current practices

- Local policy plan is financed by Istanbul Metropolitan Municipality.

4.7 Energy infrastructure investment

A measure of the investment in the infrastructure for energy distribution compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the energy infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.7.1 Calculation

The indicator is calculated as follows:

Indicator 7 = 10×(100 × X/Y – 0.06)/(2.29 − 0.06)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Istanbul total energy infrastructure investment per capita is 92 Euros/capita (2014) and GDP per capita in Turkey is 6885 Euros (2014). Therefore:

Indicator 7 = 10×(100 × **92**/**6885** – 0.06)/(2.29 − 0.06) = **5.7**

4.7.2 Current practices

- Istanbul Metropolitan Municipality finances part of the new investments in energy infrastructure.

Transport indicators

4.8 Commuting time

A measure of the proportion of time spent on commuting (minutes per day). Includes average time spent in: public transport (bus, coach, train, underground, tram, light railway), car (as driver or passenger), motorcycle, moped, scooter, bicycle, taxi on the way to and from work. A lower indicator score is given where the time spent on commuting is greater.

4.8.1 Calculation

The indicator is calculated as follows:

Indicator 8 = 10×(74.2 – X)/(74.2 – 10.8),

Where X is the average time spent on commuting in the city (or region). In Istanbul an average time spend on commuting each day is 52 minutes (in 2014). Therefore:

Indicator 8 = 10×(74.2 – **52**)/(74.2 – 10.8) = **3.5**

4.8.2 Current practices

Public transportation is encouraged. Since Istanbul is a very old and historical city, excavation is a problem and therefore metro construction is not easy and sometimes impossible. Recently, "Metrobus" started to run along the main line of the city. It is simply a bus which runs on a private lane in the highway with 1-2 minutes frequency.

4.9 Public transport use

Kilometres travelled by public transport and bicycles compared to overall kilometres travel by all means of transport. A lower indicator score is given where the use of public transport and bicycles is higher.

4.9.1 Calculation

The indicator is calculated as follows:

Indicator 9 = 10×X/Y,

Where X is the kilometres travelled by public transport and cycling (or %) and Y is the overall kilometres travelled by all means of transport (or %).

No data is available for Istanbul. Therefore:

Indicator 9 = **0**

4.9.2 Current practices

- In Istanbul, metrobus has become the major public transport. With metrobus, the distance travelled by public transport line has increased significantly.
- In Istanbul, sea transport is frequently used as the public transport. There are many ferry boat lines in Bosphorus and Marmara Sea. In addition, there are “sea taxis” running on Bosphorus.

4.10 Bicycle network

Length of bicycle network per inhabitant compared to the international range. The lower indicator score is given where the length of bicycle network per inhabitant is lower.

4.10.1 Calculation

The indicator is calculated as follows:

Indicator 10 = 10×(X/2.03),

Where X is the length of bicycle network per capita. In Istanbul there are 1004000 metres (in 2008) of designated cycle routes and 14377018 inhabitants (in 2014).

Length of designated bicycle routes in meters per inhabitant in Istanbul was 0.07 m/cap. Therefore:

Indicator 10 = 10×(**0.07**/2.03) = **0.3**

4.11 Transportation fatalities

A measure of transportation fatalities per 100 000 population in the city per year. A lower indicator score is given where the number is greater.

4.11.1 Calculation

The indicator is calculated as follows:

Indicator 11 = 10×(33.4 – X/Y)/(33.4 – 3.6)

Where X is the number of fatalities related to transportation of any kind within the city borders and Y is the 100,000 of the city’s total population. In Istanbul there were 260 transportation fatalities and the population is 14160467 (in 2013). Therefore:

Indicator 11 = 10×(33.4 – 100000×**260**/14160467)/(33.4 – 3.6) = **10.6=10**

4.11.2 Current practices

A major portion of the inhabitants uses public transport in Istanbul. In addition, due to the high traffic, the average speed of the vehicles are very low most of the time. Therefore, although many accidents occur, in most of the cases only vehicles are damaged.

4.12 Clean energy transport

Clean energy transport and clean energy sharing transport. A lower indicator score is given where efficiency measures are more limited. 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. transport companies, cities, provincial or national authorities). It should consider plans, measures and their implementation to improve the transport efficiency by e.g.

- efficient public transport (electric train, subway/metro, tram, cable railway)
- efficient private transport (electric taxis or cars, electric scooter, bicycling)
- and encouragements to use public transport.

4.12.1 Calculation

The following guidance is proposed to make self-assessment score for Indicator 12.

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 very high priority implemented at the level of the local community
10	as 9 and the activity is in place for = 3 years

- Istanbul Electrical, Tramvay and Train Administration uses electricity in public transport and plans increasing electricity usage in public transport.
- The Scientific and Technological Research Council of Turkey in coordination with Republic of Turkey Ministry of Science, Industry and Technology have produced the prototype of private electrical cars and will start mass-production cars.

Therefore, Istanbul is given a score of **6.**

4.12.2 Current practices

- Clean energy transport vehicles are used by Istanbul Metropolitan Municipality.

4.13 Transport-related pollutions

Air pollutant emissions (Sulphur oxides (SO_x), Nitrogen oxides (NO_x), Ammonia (NH_3), Non-methane volatile organic compounds, Particulates (PM_{10}) - airborne particulate matter with aerodynamic diameter less than 10 micrometres) from transport measured in kg per capita per year. A lower indicator score is given where the pollutant emissions are greater.

4.13.1 Calculation

The sub-indicators are calculated as follows:

- Sulphur oxides (SO_x):
  $SO_x = 10×(2.753 – A)/(2.753 – 0.114)$
  where A is the emissions from the city (kg/cap/yr).
- Nitrogen oxides (NO_x):
  $NO_x = 10×(0.337 – B)/(0.337 – 0.021)$
  where *B* is the emissions from the city (kg/cap/yr).
- Ammonia (NH_3):
  $NH_3 = 10×(9{,}153.3 – C)/(9{,}153.3 – 11.3)$
  where *C* is the emissions from the city (kg/cap/yr).
- Non-methane volatile organic compounds (Non-mth):
  Non-mth = 10×(5.643 – D)/(5.643 – 0.432)
  where *D* is the emissions from the city (kg/cap/yr).
- Particulates (PM_{10}):
  $PM_{10} = 10×(2.197 – E)/(2.197 – 0.169)$
  where E is the emissions from the city (kg/cap/yr).

Therefore the indicator is calculated as follows

Indicator 13 = (SO_x + NO_x + NH_3 + Non-mth + PM_{10})/5

In Istanbul the emissions are as follows: Sulphur oxides – 0.001971 kg/cap/yr, Nitrogen oxides – 0.0057 kg/cap/yr, Ammonia – 0 kg/cap/yr, Non-methane volatile organic compounds – 0 kg/cap/yr Particulates PM_{10} – 0.0028032 kg/cap/yr (in 2015). Therefore:

Indicator 13 = (10 + 10 + 10 + 10 + 10)/5 =10

4.13.2 Current practices

- Republic of Turkey Ministry of Environment and City Planning regulates periodic gas emission and mandatory usage of air filtration in vehicles and its maintenance.

4.14 Transport infrastructure investment

A measure of the investment in the transport infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure

- maintaining
- and refurbishing the existing one.

4.14.1 Calculation

The indicator is calculated as follows:

Indicator 14 = 10×(100 × X/Y – 0.02)/(3.89 − 0.02)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

X=1700000/14377018

Y=6885 Euro

In Istanbul, 1700000 Euros was invested in transport infrastructure. Population of Istanbul is 14377018. Therefore, in Istanbul, transport infrastructure investment per capita is 0.118 Euros/capita and GDP per capita in Turkey is 6885 (in 2014). Therefore:

Indicator 14 = 10×(100 × **0.118**/**6885** – 0.02)/(3.89 − 0.02) = **0**

4.14.2 Current practices

- Megaprojects in Istanbul are regulated by Republic of Turkey, Ministry of Transport, Maritime Affairs and Communications and Istanbul Metropolitan Municipality. Some of these projects have just been completed such as Marmaray (underwater railway tunnel passes under Bosphorus) and Istanbul-Ankara High Speed Train. Some of the ongoing projects are underwater tunnel for vehicles which will pass under Bosphorus, third International Airport for Istanbul, third Bosphorus Bridge between European and Anatolian Side of Istanbul. Some of the planned projects are Canal Istanbul which will be a canal that will pass parallel to the Bosphorus Strait and connect Marmara and Black Sea for vessel passage.

ICT indicators

4.15 ICT access

The ICT access is a measure of access to information and communication technology (ICT) in the city. A lower indicator score is given where the ICT access is lower.

4.15.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Mobile-cellular telephone subscriptions per 100 inhabitants, where X is the number of mobile- cellular telephone subscriptions per 100 inhabitants in the city: A = 10 × X/120
- International Internet bandwidth (bit/s) per Internet user, where Y is the International Internet bandwidth (bit/s) per Internet user in the city: B = 10 × Y/787, 260
- Proportion of households with a computer, where Z is the percentage of households with a computer in the city: C = Z/10
- Proportion of households with Internet access, where Q is the percentage of households with Internet access in the city: D = Q/10

The indicator is calculated as follows:

Indicator 15 = (A+B+C+D)/4.

In Istanbul the values are as follows (2013):

- X = 92.72, so A = 10 × **92.72**/120 = **7.73**
- Y = 19.087, so B = 10 × **19.087**/787, 260 = **0**
- Z = 62.1, so C = **62.1**/10 = **6.21**
- Q = 61.4, so D = **61.4**/10 = **6.14**

Therefore:

Indicator 15 = (**7.73**+**0**+**6.21**+**6.14**)/4 = **5.02**

4.15.2 Current practices

- Republic of Turkey Ministry of Education manages a project called “FATIH”. The aim of this project is to provide ICT equipment to classes in order to achieve the ICT supported teaching in related to the goals that take place in the Strategy Document of the Information Society, the Development Report, the Strategy Plan of Ministry of Education and The Policy Report of ICT that have described all activities of our country in the process of being an information society and have been formed within the scope of the e-transformation of Turkey.
- ICT access is encouraged by the government as a policy. For example, Republic of Turkey Ministry of Education provides free internet access in all public schools and Universities.

4.16 ICT use households

The ICT use in households is a measure of use of information and communication technology (ICT) in the city. A lower indicator score is given where the ICT use is lower.

4.16.1 Calculation

Following sub-indicators need to be calculated and an average value is taken.

- Proportion of individuals using the Internet, where X is the percentage of population in the city using the Internet: A = X/10
- Fixed (wired)-broadband subscriptions per 100 inhabitants, where Y is the number of fixed (wired)-broadband subscriptions per 100 inhabitants in the city: B = 10×Y/60
- Wireless-broadband subscriptions per 100 inhabitants, where Z is the number of wireless-broadband subscriptions per 100 inhabitants in the city: C = Z/10

Therefore, the indicator is calculated as follows:

Indicator 15 = (A + B + C)/3

In Istanbul the values are as follows (2013):

- X = 63.3, so A = **63.3**/10 = **6.33**
- Y = 32.2, so B = 10×**32.2**/60 = **5.37**
- Z = 46.5, so C = **46.5**/10 = **4.65**

Therefore:

Indicator 16 = (**6.33**+**5.37**+**4.65**)/3 = **5.4**

4.16.2 Current practices

- All official transactions can be made through government official website. Government encourages usage of this website: https://www.turkiye.gov.tr/
- Internet access should be free in public and private buildings.

4.17 ICT use water utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.17.1 Calculation

The indicator is calculated as follows:

Description	Score (0-10) evaluated locally	Comments
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Istanbul the following scores were given (2015):

Description	Score (0-10) evaluated locally	Comments
Operation	**7**	e.g. SCADA system, energy management
Maintenance	**10**	e.g. asset management data base and GIS
Planning and design	**8**	e.g. optimisation, GIS interface
Customer service	**8**	e.g. smart metering

Therefore the indicator is calculated as follows:

Indicator 17 = (**7**+**10**+**8**+**8**) = **8.3**

Istanbul Water and Sewerage Administration (ISKI) uses SCADA system in drinking water supply. ISKI has GIS data base to maintain, plan and design drinking water system. ISKI uses ISKABIS which is a software program to control all customers (http://www.iski.gov.tr/web).

Personal communication with the Director of Sewer System Department of Istanbul at Istanbul Water and Sewerage Administration.

4.17.2 Current practices

- ISKI gives information about water quality and water cut online and people can pay their invoice online.

- ISKI uses SCADA system to control and check any cracks and leakage in drinking water pipe network.
- Water quality parameters are monitored by ICT in water treatment plants in Istanbul.

4.18 ICT use energy utilities

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.18.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. SCADA system, energy management
Maintenance		e.g. asset management data base and GIS
Planning and design		e.g. optimisation, GIS interface
Customer service		e.g. smart metering

Final indicator is an average of the four values.

In Istanbul the following scores were given (2015):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**5**	e.g. SCADA system, energy management
Maintenance	**8**	e.g. asset management data base and GIS
Planning and design	**8**	e.g. optimisation, GIS interface
Customer service	**9**	e.g. smart metering

Therefore the indicator is calculated as follows:

Indicator 18 = (**5**+**8**+**8**+**9**) = **7.5**

- Electricity Distributors use SCADA system in energy management. In addition, they have good planning and design and the customer services for Istanbul European Side and Istanbul Anatolian Side. Rebublic of Turkey Ministry of Natural Resources is working on detailed inventory related to energy usage, management and efficiency.

4.18.2 Current practices

- Electricity Distributors give information about electricity cut online and people can pay their invoice online:
- http://www.bedas.com.tr/ (Istanbul European Side)
- https://www.ayedas.com.tr/ (Istanbul Anatolian Side

4.19 ICT use transport

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.19.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance		e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design		e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service		e.g. mobile bus tickets, online feedback forms

Final indicator is an average of the four values.

In Istanbul the following scores were given (2016):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**9**	e.g. coverage of installation of road sensing terminals and traffic control in the city
Maintenance	**5**	e.g. is there ICT system for planning the road maintenance and public transport vehicles?
Planning and design	**8**	e.g. is there ICT system for planning transport infrastructure expansion and improvement?
Customer service	**9**	e.g. mobile bus tickets, online feedback forms

Therefore the indicator is calculated as follows:

Indicator 19 = (**9**+**5**+**8**+**9**) = **7.8**

In Istanbul, traffic density, information about public transport, and information about sea transport are provided online. People can access this information by using their internet and mobile phone applications. There are road sensing terminals and traffic control system in the city. Moreover, people provide feedback with online forms to the related public transport office.

4.19.2 Current practices

- Istanbul Metropolitan Municipality gives traffic density online.
- Istanbul Electricity Tramvay Train Administration provides information about public transport in Istanbul.
- Istanbul Sea Transportation provides info about sea transport online.

4.20 ICT use waste management

A measure of ICT implementation at the city utility level. A lower indicator score is given where there are less ICT tools implemented. 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).

4.20.1 Calculation

The indicator is calculated as follows:

Description	**Score (0-10) evaluated locally**	**Comments**
Operation		e.g. ICT system for logistics of waste collection
Maintenance		e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design		e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service		e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Final indicator is an average of the four values.

In Istanbul the following scores were given (2015):

Description	**Score (0-10) evaluated locally**	**Comments**
Operation	**8**	e.g. ICT system for logistics of waste collection
Maintenance	**5**	e.g. is there ICT system for the pro-active maintenance of waste collection infrastructure?
Planning and design	**5**	e.g. is there ICT system for planning future enhancements and improvement of waste infrastructure?
Customer service	**7**	e.g. smart labelling of waste bags, online feed-back forms, citizen engagement

Therefore the indicator is calculated as follows:

Indicator 20 = (**8**+**5**+**5**+**7**) = **6.3**

ICT system for logistics of waste collection and transportation are used in district municipalities in Istanbul. And the data about amount of waste collected and transported is saved and sent electronically to the Istanbul Metropolitan Municipality. ICT system for planning future enhancements and improvement of waste infrastructure is planned in Istanbul Metropolitan Municipality. Moreover, people provide feedback with online forms to the related department in Istanbul Metropolitan Municipality.

4.20.2 Current practices

- Istanbul Metropolitan Municipality gives information about waste management.

4.21 Digital public service

A measure of ICT implementation within public administration (percentage of Internet users that have engaged with the public administration and exchanged filled forms online) and health system. A lower indicator score is given where there are less ICT tools implemented.

4.21.1 Calculation

Following sub-indicators need to be calculated:

- Proportion of e-Government Users, A. Percentage of individuals sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet X divided by 10: A = X/10
- Medical Data Exchange, B. Percentage of general practitioners using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists, Y, divided by 10: B = Y/10

Therefore, the indicator is calculated as follows:

Indicator 21 = (A + B)/2

In Istanbul 53.3% of individuals is sending filled forms over the internet to public authorities, or contacting public authorities by e-mail or website, or obtaining information from public authorities over the internet (2013). Therefore:

A = **53.3**/10 = **5.33**

86% of general practitioners is using electronic networks to exchange medical data with other health care providers and professionals and to transfer prescriptions to pharmacists. Therefore:

B = **86**/10 = **8.6**

The final indicator is:

Indicator 21 = (**5.33** + **8.6**)/2 = **7.0**

4.21.2 Current practices

- People have access to the information, online appointment system and forms of many public offices through the internet such as hospitals, tax offices, passport offices, municipalities etc.
- Prescriptions are saved electronically in related webpages which can be accessed only by pharmacists.

4.22 ICT infrastructure investment

A measure of the investment in the ICT infrastructure compared to the international range. A lower indicator score is given where the investment is lower. The infrastructure investment is an indication of the commitment to regularly invest in the transport infrastructure. Investment can be in:

- a new infrastructure
- maintaining
- and refurbishing the existing one.

4.22.1 Calculation

The indicator is calculated as follows:

Indicator 22 = 10×(100 × X/Y – 0.09)/(1.5 − 0.09)

Where X is the investment in the city/region in a year (values of the investment over the last 5 years should be taken and average value per year used) divided by local population of the city/region and Y is GDP per capita in the country.

In Istanbul total ICT infrastructure investment per capita is 76.4 Euros/capita (in 2015) and GDP per capita in Turkey is 6885 Euros/capita (in 2014). Therefore:

Indicator 22 = 10×(100 × **76.4**/**6885 –** 0.09)/(1.5 − 0.09)= **7.2**

4.22.2 Current practices

- New investment is financed by government and Istanbul Metropolitan Municipality.

5 Conclusion

The main scope of this report is to explore the sustainability of multiple services of the Istanbul metropolitan city based on two assessments. Firstly, the city's sustainability of urban water resources management is assessed based on the City Blueprint and Trends and Pressures Framework. Additionally, the city's sustainability of the energy, transport and ICT services is assessed following the City Amberprint.

The assessment of the Trends and Pressures Index ranks Istanbul 45 out of a total of 45 cities from all around the world (Figure 6.1). Istanbul performs worse on the environmental assessment with flood and heat risk being the main concerns and on the financial assessment with the inflation rate being the main concerns. The city of Istanbul performs better on the social assessment.

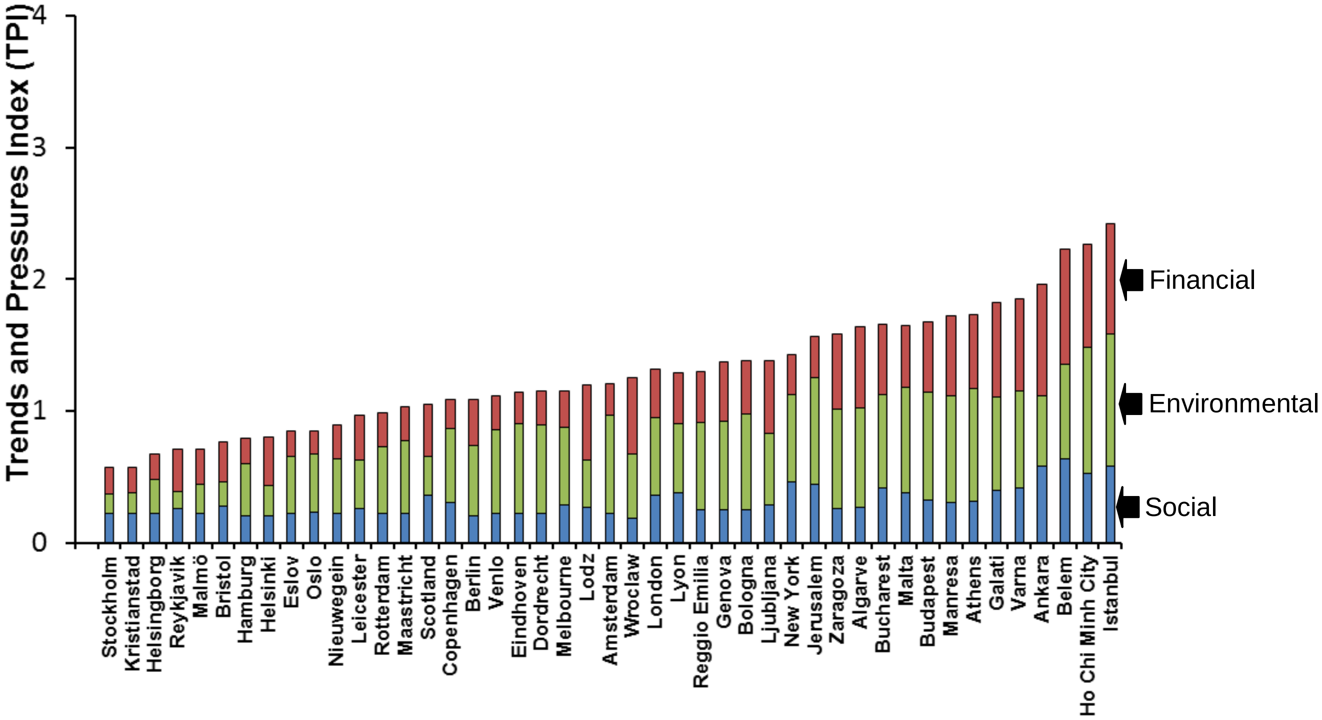


Figure 6.1. Trends and Pressures Index for 45 cities (Koop, S.H.A. and Van Leeuwen, C.J. 2015)

The city of Istanbul ranks 39nd out of 47 cities from all around the world with a score of 3.4 in the Blue City Index (Figure 6.2). The city performs best in basic water services and water quality and worst in the solid waste treatment of the waste water treatment plants (Figure 6.3).

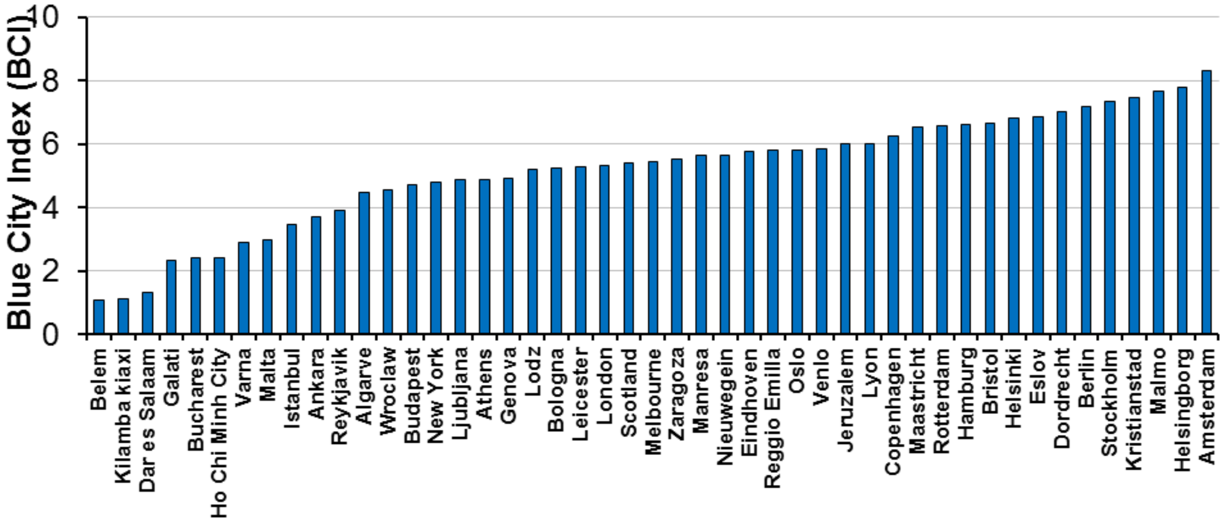


Figure 6.2. Blue City Index for 47 cities (Koop, S.H.A. and Van Leeuwen, C.J. 2015).)

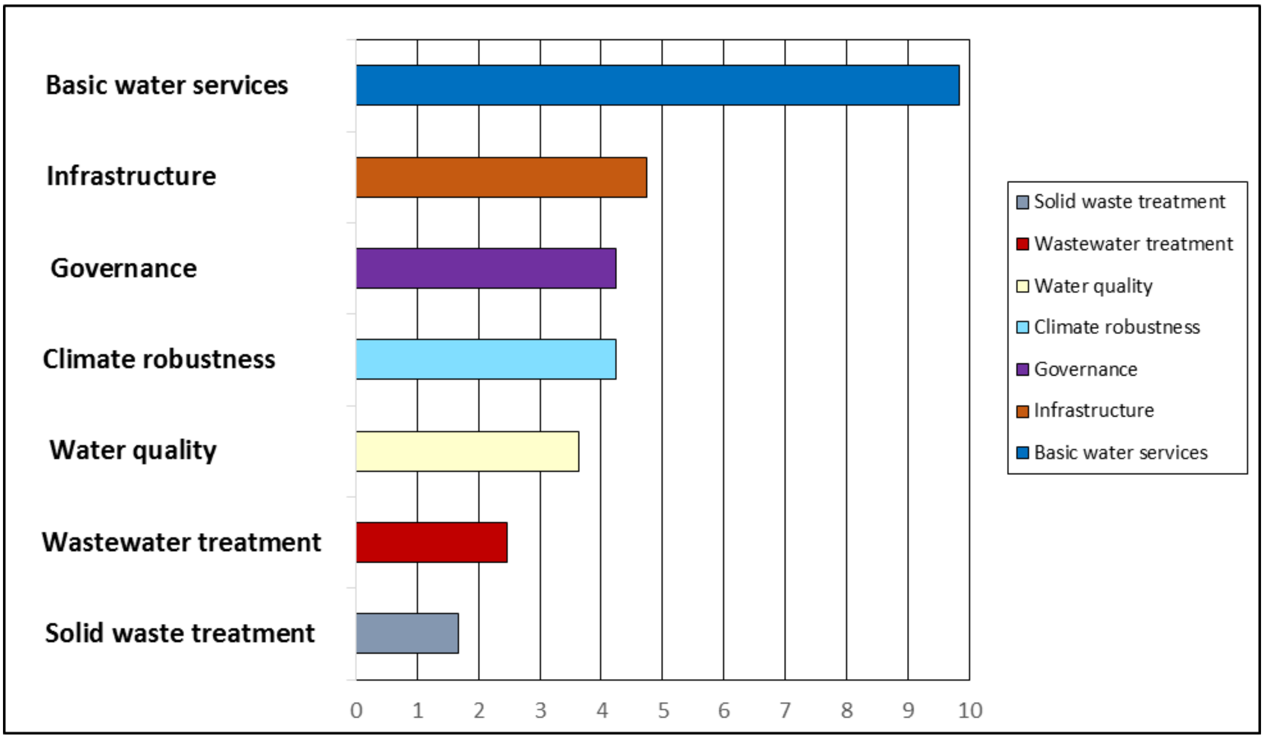


Figure 6.3. Performance of Istanbul in the different assessment categories of the Blue City Index.

Finally, the Amber City Index the city performs almost equally and mediocre to all three assessed services, energy, transport and ICT with a score of around 4.1.

Feedback from city council

Istanbul Metropolitan Municipality has contacted regarding the data needed for City Blueprint and City Amberprint. Two main contact people are from Istanbul Water and Sewerage Administration and Department of Road Maintenance and Infrastructure Coordination of Istanbul Metropolitan Municipality. They helped us reach the relevant data within the context of BluesCities project and made the following comments:

“Increase in population and thus urbanization affects the land use and ecology of the world and causes climate change and global warming. I think that BlueSCities Project is very significant and is helpful in finding solutions for problems due to the urbanization such as water contamination and carbon gas emission. The protection of our natural resources, energy conservation, and viable environment are possible only with blue cities. In addition, efficient use of water, water reuse and recycle are also vital for sustainable life. The aim of BlueSCities project covers these important items and therefore this project should be supported.”

Mehmet Dikici

Istanbul Metropolitan Municipality

Istanbul Water and Sewerage Administration

“BlueSCities project evaluates water, waste, energy, transport and ICT management in cities by using some indicators. This project can supply the coordination between the cities and also contribute to the cities. Some important parameters used in indicators are drinking water, waste water and solid waste, recovery, energy, transport and ICT. These selected indicators have significant impacts on people daily life. I think that BlueSCities project can provide important feedback to the City Council about strategic implementation plans. This project can be also a helpful tool for the coordination between the stakeholders such as between researchers and users, decision-makers and consumers, industry, SMEs and national and international authorities, municipality and related administration. Therefore, I found BlueSCities project very good and worth to be supported.”

Cumhur İlter

Istanbul Metropolitan Municipality

Department of Road Maintenance and Infrastructure Coordination

Annexes

Contact Persons:

City	Contributions from	Institution	Primary Contact
Istanbul	Mehmet Dikici	Istanbul Metropolitan Municipality Istanbul Water and Sewerage Administration	mdikici@iski.gov.tr
Istanbul	Cumhur Ilter	Istanbul Metropolitan Municipality Department of Road Maintenance and Infrastructure Coordination	cumhurilter@iston.com.tr

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