



SBTool

SNTool

SCTool

Integrated tools and assessment
methodology for sustainable
Buildings, **N**eighbourhoods and
Cities in MED countries

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Sustainable MED Cities

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Sustainability assessment method for the cities, neighbourhoods and buildings built environment



SCTool MED, SNTool MED and SBTool are assessments systems for measuring the sustainability of Mediterranean cities. It can be used by urban planners to support integrative planning processes and by public authorities to establish performance targets in policies, programs, and action plans. SCTool MED, SNTool MED and SBTool can be contextualized and adapted to any Mediterranean city. It is based on a transnational methodology, the SBE Method, developed through the international research process Green Building Challenge launched in 1998 and coordinated by iiSBE (international initiative for a Sustainable Built Environment). Over time, more than 25 national teams from all the continents contributed to the development of SBE Method and tested it the on hundreds of case studies. SBE Method is based on the “think globally, act locally” concept, acting as a common “language” for assessing the sustainability of the built environment. An assessment tool using the SBE Method, such as SCTool, SNTool, and SBTool can be adapted to any context reflecting local priorities and peculiarities. The use of the tools allows to evaluate, compare, and aggregate the results of sustainability measures deployed locally and, at the same time, to evaluate the progress towards the global sustainability targets, avoiding the uncertainty and confusion generated using different assessment tools. Any public authority can develop its own SCTool MED, SNTool MED and SBTool that will provide sustainability assessment results comparable and aggregable with the results of any other local version of the tools. The project Sustainable MED Cities developed the first assessment tool at city scale based on SBMethod. This publication illustrates the SBE Method, how to contextualise SCTool MED, SNTool MED and SBTool to a specific city, and how to carry out a sustainability assessment using it. The use of the MED Passport and KPIs for comparing the sustainability of Mediterranean cities is also explained. Tools are freely available to any municipality in the Mediterranean willing to develop its own sustainability assessment tool at city scale. The use of the tools contributes to the achievement of the objectives of the Mediterranean Strategy for Sustainable Development.

Andrea Moro

WP3 Coordinator
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1. SBE Method

Sustainable Built Environment Method

Definition:

SBE Method is a multi-criteria analysis method for assessing the sustainability of the built environment.

Starting from a set of assessment criteria, SBE Method provides a final concise score about a cities overall sustainability.

Main elements:

1. A set of assessment criteria.
2. A set of indicators, which allow to quantify the cities performances with respect to each criterion.
3. A normalisation method.
4. An aggregation method.

1.1 Hierarchic levels

The multicriteria analysis method is structured in four hierarchic levels:

1. Issues
2. Categories
3. Criteria
4. Indicators

Issues

1

Describe general themes, recognised as relevant for assessing the sustainability of a building, neighbourhood and city. For instance, the issues of SCTool are:



A - Use of land and biodiversity



B - Energy



C - Water



D - Solid Waste



E Environmental quality



F - Transportation and mobility



G - Social Aspects



H - Economy



I - Climate Change: mitigation and adaptation



J - Governance

2

Categories

Concern particular aspects of issues. For instance, in the SCTool, the issue A-Use of land and biodiversity contains 3 categories: A1-Use of land, A2- Green urban areas and A3- Biodiversity and ecosystems.



- A.1 Use of land
- A.2 Green urban areas
- A.3 Biodiversity and ecosystems



- B.1 Energy infrastructure
- B.2 Energy consump-tions
- B.3 Renewable energy



- C.1 Water infrastruc-ture
- C.2 Water consump-tion
- C.3 Effluents managa-ment



- D.1 Solid waste collec-tion infrastructure
- D.2 Solid waste man-agement



- E.1 Air quality
- E.2 Noise
- E.3 EMF exposure



- F.1 Performance of mobility service
- F.2 Green mobility
- F.3 Safety in mobility



- G.1 Performance of mobility services
- G.2 Housing
- G.3 Availability of public and private facilities and services
- G.4 Education
- G.5 Social inclusion
- G.6 Safety
- G.7 Helath
- G.8 Food security



- H.1 Economic Performance
- H.2 Employment
- H.3 Innovation
- H.4 ICT infrastructure



- I.1 Climate change mitigation
- I.2 Adaptation to the climate action: heat-waves and increase of temperature
- I.3 Adaptation to the climatic action: pluvial flood
- I.4 Adaptation to the climatic action:fluvial and coastal flood
- I.5 Adaptation to the climatic action: drought
- I.6 Adaptation to the climatic hazard: wildfire



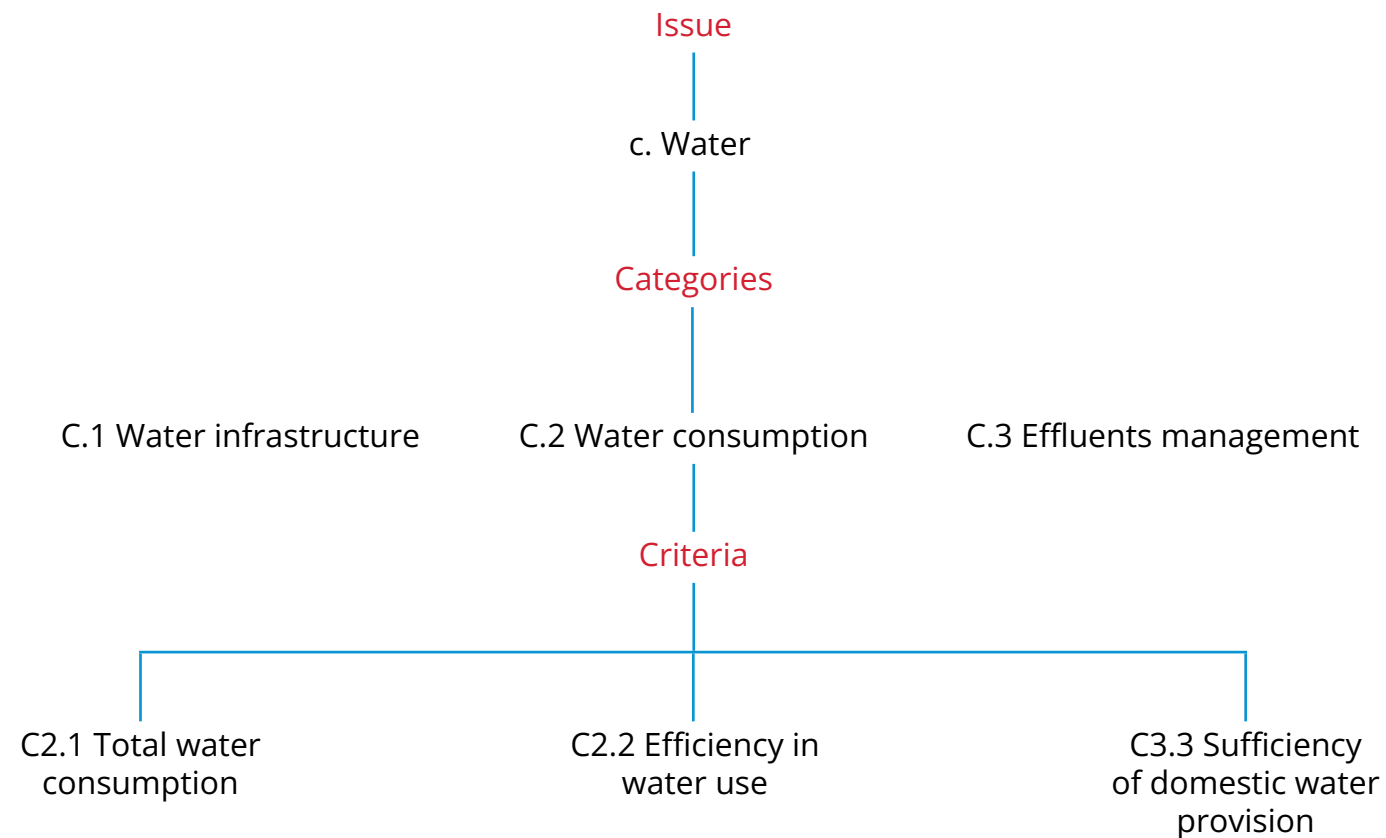
- J.1 Urban planning
- J.2 Management and community involve-ment
- J.3 Public buildings cooperation
- J.4 Equity

Criteria

3

They represent the basic assessment entries used to evaluate the sustainability of the cities.

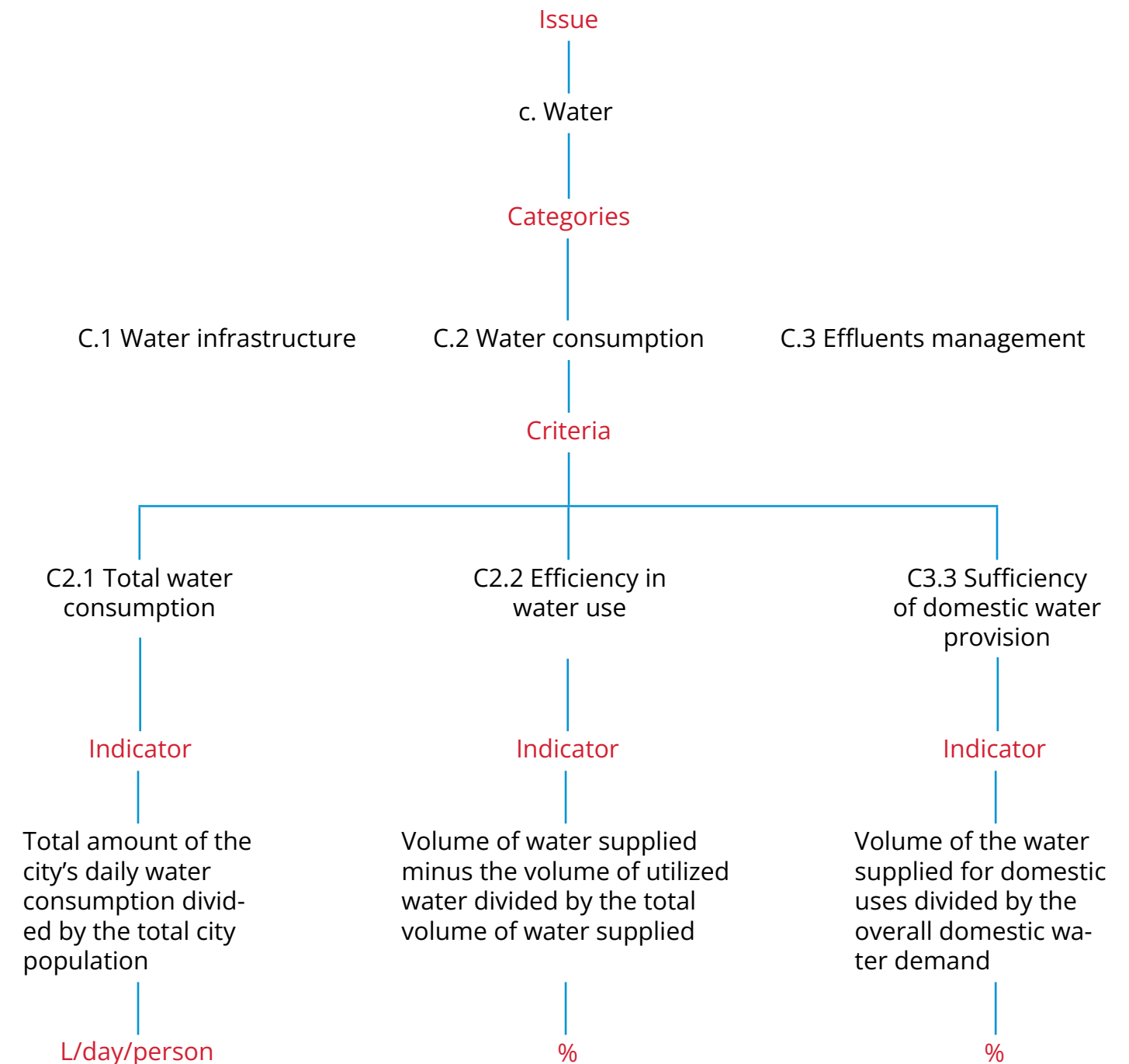
Example:



Indicators

Each criterion is associated to an indicator. They are physical quantities or qualitative scenarios that allow to assess the performance of the cities with respect to the criteria. Quantitative indicators have a unit of measure.

Example:

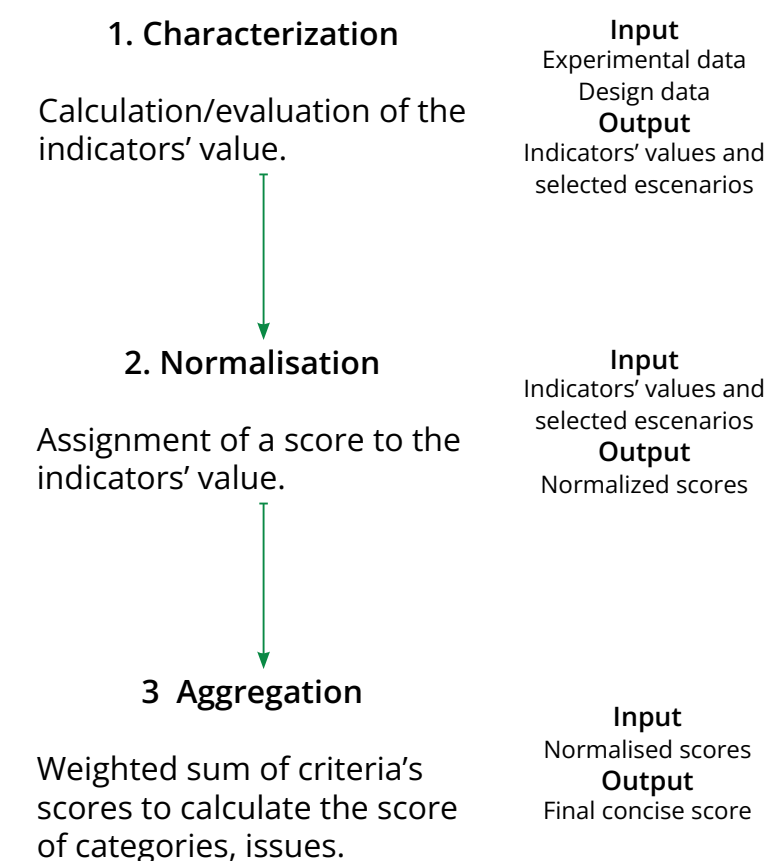


1.2 Assessment process

Definition and objective:

The main goal of the SBEMethod is to provide a final concise score, which summarises the overall performance of the cities with respect to all criteria.

The assessment procedure is articulated in 3 main steps:



Step 1: Characterisation

In the first stage of the assessment process, the values of all the quantitative indicators in building, neighbourhood and city are calculated.

For each criterion, building, neighbourhood and city provides the description of an “Assessment Method” that specifies the calculation procedure.

For the qualitative indicators, the performance of the building, neighbourhood and city is assessed through the selection of a reference scenario.

Example:

Code	Criterion	Indicator	Unit of measure	Value
A3.1	Variation of the number of bird species	Percentage change in the number of bird species	%	55
B2.2	Residential final thermal energy consumption	Total consumption of final thermal energy divided by the total number of city inhabitants	MWh/inhabitant/yr	195
C3.2	Household sanitation	Percentage of households with access to basic sanitation facilities	%	93
D1.1	Availability of solid waste collection	Percentage of population with regular solid waste collection	%	81
E1.2	Particulate matter (PM ₁₀) concentration	Annual average fine particulate matter (PM ₁₀) concentration	µg/m ³	230
F2.6	Green public vehicles	Total number of low emission public vehicles divided by total number of public vehicles	%	43
G1.3	Accessibility of public transport network	Percentage of public transport vehicles that are accessible disabled persons	%	66
H4.2	Wireless Broadband Coverage	Percentage of the city served by wireless broadband (3G, 4G, 5G)	%	23
I4.1	Flood risk	Percentage of population exposed to flood risk	%	17
J2.1	Involvement of residents in community affairs	Percentage of resident population above 16 years having an involvement in community affairs	%	57

Step 2: Normalisation

In the second stage of the assessment process, a performance score is associated to the value or scenario of each indicator. This process is named “normalisation”. The indicators are normalised in the interval (-1,+5), where -1 corresponds to a negative performance and +5 to an excellent performance. The better the performance, the higher the normalised score. The values of quantitative indicators are normalised through linear functions of two kinds: H.I.B. (High Is Better) and L.I.B. (Low is Better). Qualitative indicators are normalised using discrete values corresponding to the reference scenarios.

For each indicator, the normalisation function depends on two parameters: the thresholds assigned to score 0 and 5. These parameters are named “benchmarks” and they define the value or scenario of the indicator associated to the “minimum acceptable performance” (score zero) and to the “excellent and ideal performance” (score five).

Scoring scale:

-1

The score corresponds to a value of the indicator that is under the minimum acceptable performance.

0

The score corresponds to a value of the indicator that represents the minimum acceptable performance. It is usually defined on the base of regulations and standards.

1

The score corresponds to a value of the indicator that represents a minimum increase of performance with regards to the minimum acceptable performance.

2

The score corresponds to a value of the indicator that represents a substantial increase of performance with to the minimum acceptable performance.

3

The score corresponds to a value of the indicator that represents a best practice.

4

The score corresponds to a value of the indicator that represents an improvement towards the best practice level.

5

The score corresponds to a value of the indicator that represents an excellent and ideal performance.

Normalisation H.I.B. Criteria (Higher Is Better)

All criteria such that the higher the numerical value of the corresponding indicator, the higher the performance level.

Since the normalised score must fulfil the requirement “the better the performance, the higher the normalized score”, normalisation functions associated with H.I.B. criteria must be increasing functions.

The normalised score is -1 if the value of the indicator is lower than the benchmark corresponding to score 0.

The normalised score is 5 if the value of the indicator is equal of higher than the benchmark corresponding to score 5.

In the other cases, the value of the indicator is normalised through an interpolation.

Normalisation L.I.B. Criteria (Lower Is Better)

All criteria such that the lower the numerical value of the corresponding indicator, the higher the performance level. Normalisation functions associated with L.I.B. criteria must be decreasing functions.

The normalised score is 5 if the value of the indicator is equal or lower than the benchmark corresponding to score 5.

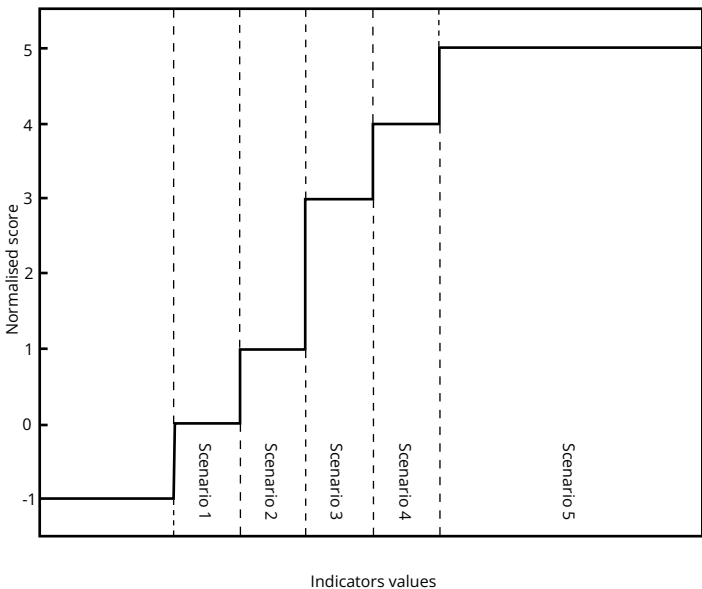
The normalised score is -1 if the value of the indicator is higher than the benchmark corresponding to score 0.

In the other cases, the value of the indicator is normalised through an interpolation.

Normalisation qualitative criteria

All criteria such that the normalised score can only attain discrete values in the normalisation interval, each of them corresponding to a reference scenario defined by the corresponding indicator.

The normalised score is computed by comparing the neighbourhood’s performance with reference scenarios which are defined by the indicator associated with the criterion.

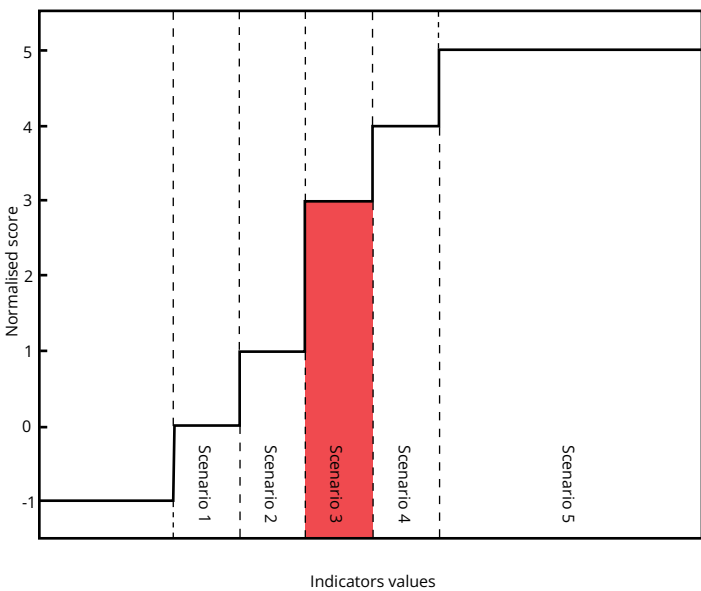


Example:

Criterion:

Community involvement in urban planning activities

Normalisation of the indicator’s value: 3



Step 3: Aggregation

In the third step the normalised scores of criteria are aggregated to calculate the overall sustainability score of the building, neighbourhood and city.

The aggregation takes place in 3 phases:

3.1 Aggregation through criteria: the scores of the criteria in the same category are aggregated to calculate the score of each category.

3.2 Aggregation through categories: the scores of the categories in the same issue are aggregated to calculate the score of each issue.

3.3 Aggregation through issues: the scores of the issues are aggregated to calculate the overall sustainability score of the city.

In what follows are used the symbols:

- a. X_i the i -th issue. The issues in SCTool are 10, consequently $i=1,10$. N_I is the number of the issues included in SNTTool
- b. $C_{i,j}$ the j -th category of the issue X_i , $j=1, \dots, N_c^{(i)}$, where $N_c^{(i)}$ is the number of the categories in the i -th issue
- c. $c_{i,j,k}$ is the k -th criterion of the j -th category in the i -th issue, $k=1, \dots, N_c^{(i,j)}$, where $N_c^{(i,j)}$ is the number of the criteria in the category $C_{i,j}$

Through criteria

The main goal of aggregation through criteria is to provide a single normalised score for each category. This is computed for each category aggregating the normalised score of all criteria included in that category.

Aggregation is performed by linear aggregation of scores through weights. These quantify the relative weight of each criterion in percentage with respect to all criteria in the same category.

$$S_{i,j} = \sum_{k=1}^{N_c^{(i,j)}} w_{i,j,k} s_{i,j,k}$$

$w_{i,j,k}$: the weight of the criterion $c_{i,j,k}$ in the category $C_{i,j}$

$s_{i,j,k}$: the score of the criterion $c_{i,j,k}$ in the category $C_{i,j}$

$S_{i,j}$: the score of resulting from the aggregation of criteria's scores included in the category $C_{i,j}$.

Through categories

The scores of categories are aggregated to calculate the score of each issue (A,B,C,D,E,F,G,H,I,J). The calculation consists in a linear aggregation of the scores of the categories included in that issue.

$w_{i,j}$: the weight of each category included in issue X_i ;

$S_{i,j}$: the score of each category included in issue X_i ;

S_i : the score resulting from the aggregation of the categories' scores included in issue X_i .

$$S_i = \sum_{j=1}^{N_c^{(i)}} w_{i,j} S_{i,j}$$

Through issues

The scores of issues are aggregated to calculate the overall sustainability score of the city). The calculation consists in a linear aggregation of the scores of the issues include in SCTool.

W_i = the weight of each issue included in SCTool

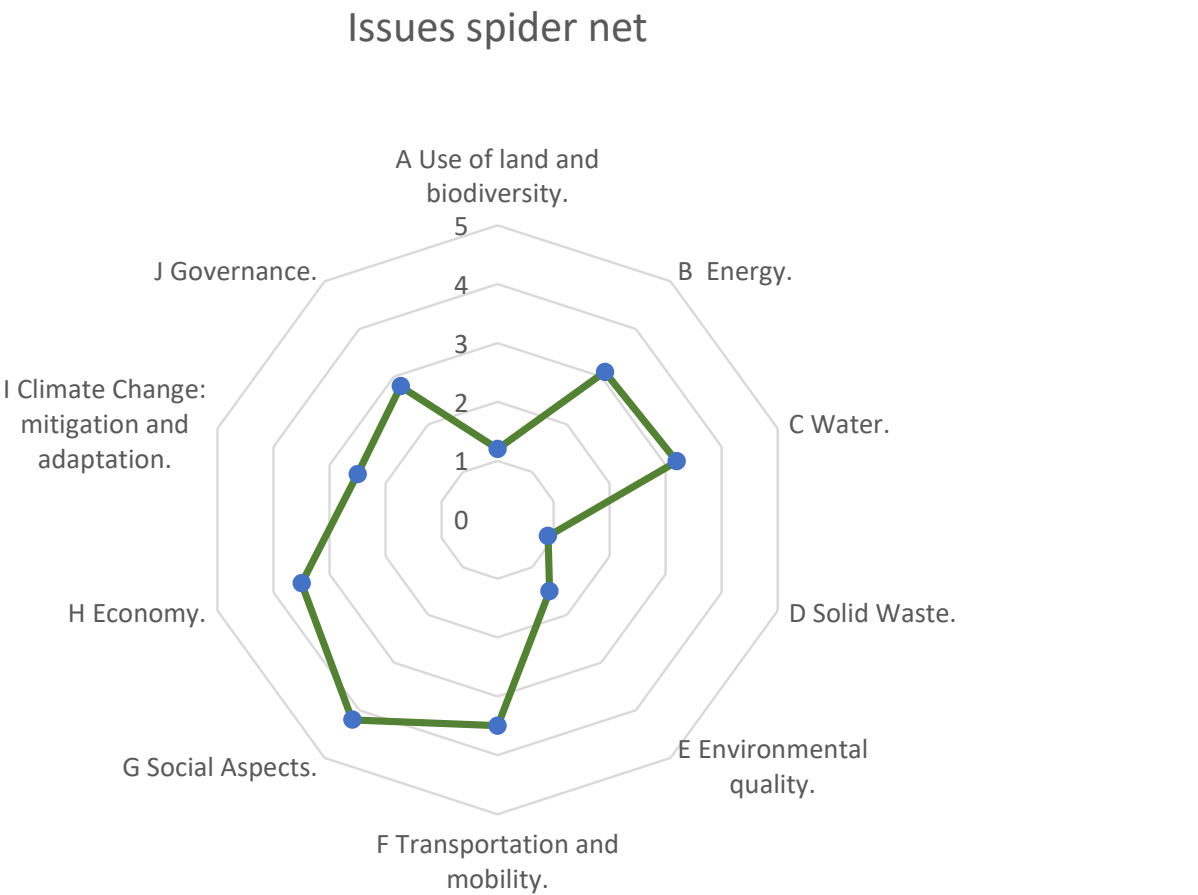
S_i = the score of each issue included in SCTool

$$\sum = \sum_{i=1}^{N_A} W_i S_i$$

Assessment`s results

Spider chart:

Easy-to-read representation of the 10 issues score on a scale from 0 (minimum acceptable performance) to 5 (best performance).



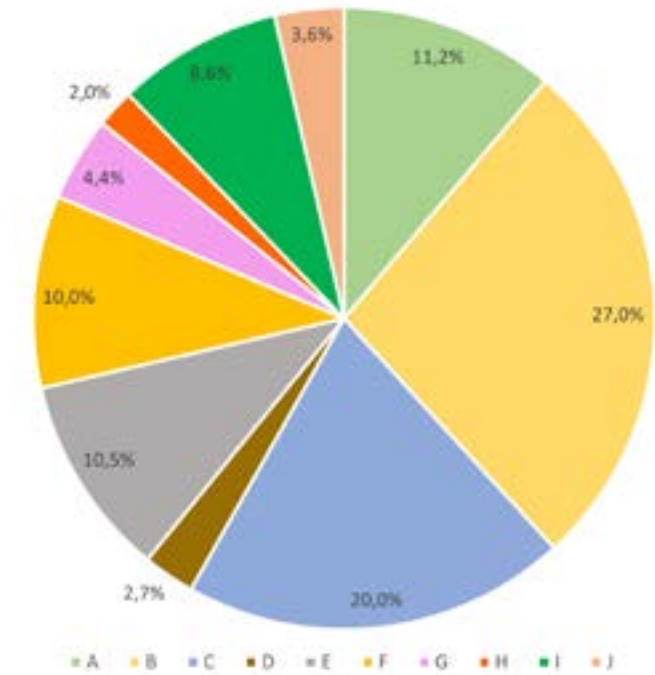
Number of active indicators:

Total number of indicators available in SCTool and number of indicators selected (including KPI- key performance indicators) in the assessment.

The number available criteria is:	99	The number active criteria is:	80
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Pie chart:

Percentual contribution weight of each issue to the overall score.



Final score:

Detail of the scores and weights for the 10 issues and overall score.

Issue	Score	Weight	Weighted scores
A Use of land and biodiversity.	1,2	11,2%	0,13
B Energy	3,1	27,0%	0,83
C Water	3,2	20,0%	0,64
D Solid Waste.	0,9	2,7%	0,02
E Environmental quality.	1,5	10,5%	0,45
F Transportation and mobility.	3,5	10,0%	0,15
G Social Aspects.	4,2	4,4%	0,18
H Economy.	3,5	2,0%	0,07
I Climate Change: mitigation and adaptation.	2,5	8,6%	0,21
J Governance.	2,8	3,6%	0,10
		100%	2,78/5
		Total weight	Total score

2. Contextualisation

Definition:

building, neighbourhood and city is a generic multicriteria sustainability assessment.

Users need to adapt it to local conditions.

The result of the contextualisation process is a local version of SBTool, SNTTool and SCTool ready to be used for assessing the sustainability at city scale.

Objectives:

Develop a contextualised version of SBTool, SNTTool and SCTool to take in account local priorities, history, climatic conditions, socio-economic conditions, and advancement state in relation to sustainability issues.

The contextualisation process takes place in 3 steps:

1. Selection of criteria
2. Benchmarking
3. Weighting

2.1 Selection of the active criteria

Definition:

In the first step of the contextualisation process, users shall select the criteria that will compose the local version of SBTool, SNTTool and SCTool. Criteria are selected from the whole list of the generic framework. There isn't a fixed number of criteria to be selected.

Only a core set of criteria, the Key Performance Indicators (KPIs) are mandatory for all. They represent the core criteria linked to the transnational global sustainability goals.

Objectives:

The rationale behind the selection could depend on regional policies, targets, specific characteristics of the territory (e.g. touristic area, agricultural area, etc....). The selection of criteria can be documented and justified, using the following tables.

The selection of the active criteria can be documented and justified, using the following tables.

Generic table to report the criteria selection

Name of the issue

AX	Name of the category	Justification
AX.X	Name of the criterion	Text

Example selection of active criterias:

A. Use of land and biodiversity

A2	Green urban areas	Justification
A2.4	Distribution of Green Urban Areas	Green urban Areas is a policy priority

2.2 Benchmarking

Definition:

Consists in the definition of the scoring scale for each selected criterion.

The value of benchmarks assigned to the different criteria for score zero (minimum acceptable performance) and for score 5 (excellent and ideal performance). The value of indicators corresponding to score zero is usually depends on regulations, standards or a typical performance in the region.

Score 3 represents a best practice performance.

Objectives:

Set the benchmarks for each criteria following the priority order:

1. National, regional laws
2. National, regional, municipal regulations
3. Technical standards (national or international)
4. Statistical data
5. Scientific literature
6. Local reference values
7. Simulations

The selection of benchmarks can be documented and justified, using the following tables.

Generic table to report the benchmarks assignment

Name of the issue

Criteria	Indicator	Unit of measurment	Benchmark	Rationale	sources
AX.X	Text	Text	0 (min): number 5 (max): number	Text	Text

Example benchmarking

A. Use of land and biodiversity

Green urban areas	A2.4	Unit of measurment	Benchmark	Rationale
A2	Distribution of Green Urban Areas	%	0 (min): 30 5 (max): 50	Technical evaluation of municipal offices

2.3 Weighting

Definition:

Consists in setting the weights at criterion, category and issue level through the assignment of priorities. Priorities are set in relation to local policies and sustainability goals. The priority of criteria, categories and issues are context dependent.

The weighting process takes place in 3 steps:

1. Assignment of priority values to issues and weights calculation.
2. Assignment of priority values to categories and weights calculation.
3. Assignment of impact factors to criteria and weights calculation.

Weighting of issues

To set the weights at issue level, it is necessary to define a priority factor for each of them.

The priority factor indicates the relevance of the issue in relation to the context.

A value of 1 means a low priority, a level 5 represents the higher priority.

Example:

Issue	Priority factor (1 to 5)	Formula	Weight
A. Use of land and biodiversity	3	$W = (3/26) * 100$	11.6%

Weighting of categories:

To set the weight for category level, it is necessary to define a priority factor for each of them.

The priority factor indicates the relevance of the issue in relation to the context.

A value of 1 means a low priority, a level 5 represents the higher priority.

Example:

Category: Social aspects

Category	Priority factor(PF)	Formula	Weight
G1. Performance of mobility services	3	$W = (3/30) * 100$	10%

Weighting of criteria

To weight the criteria is necessary to assign an impact level to each assessment criterion.

The weighting of criteria takes place in 2 steps.
Firstly, users assign an impact level (Pk) to each criterion.
The impact level is defined as

Step 1: Calculated Pk
The impact level is defined as: $P_k = I_k * E_k * D_k * A_k$

I= Intensity of the potential Effect (1-3)
E= Extent of potential effect (1-5)
D= Duration of potential effect (1-5)
A= Adjustment factor in relation to local priorities (1-3)

Step 2: the weight of each criterion in its category is calculated as:

$$W_{i,j} = \frac{P_k}{\sum_{k=1}^{N_c^{(i,j)}} P_k}$$

$\omega_{i,j,k}$: weight of the criterion $c_{i,j,k}$ included in the category C_{ij}
 P_k = impact level of the criterion $c_{i,j,k}$ included in the category C_i

Impact of the potential effect (Ik)

It can get from 1 to 3 points depending on the intensity of the extent of an effect. The impact is considered very relevant for all the energy criteria whose effect is very strong on the territory, but also economical and air quality criteria may have a big impact in that sense.

Extent of potential effect (Ek)

It can get from 1 to 5 points; this factor examines the extent of the effect of the criterion, for example, the road connectivity is an aspect that could strongly affect the larger scale in terms of extent and also the pollutant emissions whose effect is perceived on a large scale.

Duration of potential effect (Dk)

It can get from 1 to 5 points; it measures the durability of the effect evaluated by the criterion. Land consumption criterion confirms that an urbanized soil will remain as it is over time, also other aspects related to the urban planning have a strongly duration impact like for example, green areas provision, street connections, pedestrian areas, etc.

A = Adjustment factor in relation to local priorities (1-3) (Ak)

It can get from 1 to 3 points; it is a factor that can be used if there is the need to adjust the priority factor of the criterion in relation to specific local priorities. Maybe in a region a particular sustainability issue has a dramatic importance in relation to other issues. In this case the adjustment factor can be used to take in account the local context.

Impact of potential effect

Minimum	1
Moderation	2
High	3

Extent of potential effect

Block	1
Cluster	2
Neighbourhood	3
Urban/Region	4
Global	5

Duration of potential effect

1 - 3 years	1
3 - 10 Years	2
10- 30 Years	3
30- 75 years	4
>75 years	5

Example step 1: Impact level assignment

F1. Performance of mobility services

Criterion	Impact (Pk)	Intensity (Ik)	Extent (Ek)	Duration (Dk)	Adjustment (Ak)
F1.1 Public transport network	12	2	3	2	1
F1.2 Accessibility of public transportation service	12	2	3	2	1
F1.3 Usage of public transportation by population	24	2	3	2	1

Example step 2: Weights assignment in the category F1

Criterion	Formula	Weight
F1.1 Public transport network	$(12/48)*100$	25%
F1.2 Accessibility of public transportation service	$(12/48)*100$	25%
F1.3 Usage of public transportation by population	$(24/48)*100$	50%
		100%

3.Sustainable Building Tool

Defintion:

Complete list of the criteria which make up the Sustainable MED Cities SBTool are described below. The table also includes for each criterion, the information related to the name of the indicator and the unit of measure.

Main elements:

8 Issues
25 Categories
80 Criteria

SBTool criteria list

A Site Regeneration and Development, Urban Design and Infrastructure

A1 Site Selection

CODE	CRITERION	INDICATOR	UNIT
A1.1	Ecological value of land	Pre-development ecological value of land	Score
A1.2	Proximity of site to public transportation	Accessibility index to public transportation	index
A1.3	Adjacency to existing service infra-structures	Average distance between the site and key existing infrastructures	m
A1.4	Proximity to key services	Average distance from key services	m

A2 Site development

CODE	CRITERION	INDICATOR	UNIT
A2.1	Use of native plantings	The extent of vegetated landscaped area that is planted with native plants	%
A2.2	Provision of outdoor recreation areas	Number of recreation services offered in outdoor areas of the building	n
A2.3	Support for bicycle use	Percentage of bicycle parking spaces available	%

B Energy and Resources Consumption

B1 Energy

CODE	CRITERION	INDICATOR	UNIT
B1.1	Primary energy consumption	Primary energy consumption per internal useful floor area per year	kWh/m ² /yr
B1.2	Thermal energy consumption	Thermal energy consumption per internal useful floor area per year	kWh/m ² /yr
B1.3	Electrical energy consumption	Delivered electrical energy consumption per internal useful floor area per year	kWh/m ² /yr

B1.4	Energy from renewable sources in total thermal energy consumption	Share of renewable energy in final thermal energy consumptions	%
B1.5	Energy from renewable sources in total electrical energy consumption	Share of renewable energy in final electrical energy consumption	%
B1.6	Embodied non-renewable primary energy	Embodied primary non-renewable energy per building's useful internal floor area	MJ/m ²

B2 Electrical peak demand

CODE	CRITERION	INDICATOR	UNIT
B2.1	Electrical peak demand for building operations	Average of peak monthly electrical demand for one year	W/m ²

B3 Materials

CODE	CRITERION	INDICATOR	UNIT
B3.1	Degree of re-use of suitable existing structure(s)	Percent, by area, of an existing structure that is re-used	%
B3.2	Materials intensity	Weight of structural and envelope components per useful floor area	kg/m ²
B3.3	Renewable materials	Weight of renewable materials on total weigh of construction materials	%
B3.4	Recycled materials	Weight of recycled materials on total weight of materials	%
B3.5	Local materials	Weight of local materials on total weight of materials	%
B3.6	Design for deconstruction	Circularity potential	score
B3.7	Design for adaptability	Adaptability potential	score

B4 Use of potable water, stormwater and greywater			
CODE	CRITERION	INDICATOR	UNIT
B4.1	Embodied water	Net fresh water per useful internal floor area	%
B4.2	Total water consumption	Total consumption of water per building occupant	kg/m ²
B4.3	Potable water consumption for indoor uses	Potable water consumption per occupant per year	%
B4.4	Potable water consumption for irrigation	Potable water consumption / standardised potable water consumption	%
C Environmental Loadings			
C1 Greenhouse Gas Emissions			
CODE	CRITERION	INDICATOR	UNIT
C1.1	Embodied carbon	CO2 equivalent emissions per useful internal floor area (product stage)	kg CO _{2eq} /m ²
C1.2	GHG gas emissions during operation	CO2 equivalent emissions per useful internal floor area per year	kg CO _{2eq} /m ² yr
C1.2	Life cycle global warming potential	CO2 equivalent emissions per useful internal floor area for a period of 50 years	kg CO _{2eq} /m ²
C2 Other Atmospheric Emissions			
CODE	CRITERION	INDICATOR	UNIT
C2.1	Emissions of ozone-depleting substances during facility operations	CFC-11 equivalent emissions per useful internal floor area per year	g/m ² /yr
C2.2	Emissions of acidifying emissions during facility operations	SO2 equivalent emissions per year in kg per unit net area	g/m ² /yr
C2.3	Emissions leading to photo-oxidants during facility operations	Ethene equivalent emissions per useful internal floor area per year	g/m ² /yr
C3 Solid Wastes			
CODE	CRITERION	INDICATOR	UNIT
C3.1	Construction waste	Weight of waste and materials generated per m ² of internal useful floor area	kg/m ²

C3.2	Solid waste from building operations	Ratio of the number of collectable solid waste categories within a 100 m distance from the building's entrance to the reference solid waste categories	%
D Indoor Environmental Quality			
D1 Indoor Air Quality and Ventilation			
CODE	CRITERION	INDICATOR	UNIT
D1.1	Formaldehyde concentration	Formaldehyde concentration in indoor air	µg/m ³
D1.2	TVOC concentration	TVOC concentration in indoor air	µg/m ³
D1.3	CO2 concentrations	CO2 concentration in indoor air	ppm
D1.4	Low emitting materials	Mean emission class of finishing materials	Index
D1.5	Radon	Radon concentration in indoor air	Bq/m ³
D1.6	Relative humidity	Relative humidity in indoor air	%
D1.7	Mechanical Ventilation	Mechanical ventilation rate per useful internal floor area	l/s/m ²
D2 Air Temperature and Relative Humidity			
CODE	CRITERION	INDICATOR	UNIT
D2.1	Time outside of the thermal comfort range (heating season)	Percentage of the time out of the range of defined interior maximum and minimum temperatures during the heating season	%
D2.2	Time outside of the thermal comfort range (cooling season)	Percentage of the time out of the range of defined interior maximum and minimum temperatures during the cooling season	%
D2.3	Thermal comfort index	Predicted Percentage of Dissatisfied	%
D3 Daylighting and Illumination			
CODE	CRITERION	INDICATOR	UNIT
D2.1	Daylight	Mean Daylight Factor	%
D2.1	Daylight Provision	Level of daylight provision	Level
D2.1	Protection from Glare	DGP (Daylight Glare Probability)	Number

D4 Noise and Acoustics			
CODE	CRITERION	INDICATOR	UNIT
D4.1	Protection from noise: facade insulation	D2m,nT,w - Weighted standardized level difference for traffic noise (sound insulation)	dB
D4.2	Protection from airborne noise within adjacent spaces	R'w - Weighted apparent sound reduction index	dB
D4.3	Protection from the sound of impacts within adjacent spaces	L'n,w - Weighted normalized impact sound pressure level	dB
D4.4	Protection from noise generated by service equipment	LAeq,nT - A-weighted standardized continuous sound pressure level	dB
D4.5	Reverberation time	T - Reverberation time	%
D5 Noise and Acoustics			
CODE	CRITERION	INDICATOR	UNIT
D5.1	Minimisation of exposition to ELF magnetic fields	Strategies adopted to minimise the exposition to ELF magnetic fields	Score
D5.2	Level of ELF magnetic fields	Mean level of magnetic induction (50/60 Hz)	µt
D5.3	Minimisation of exposition to High Frequency Electromagnetic Fields	Strategies adopted to minimise the exposition to High Frequency Electromagnetic fields	Score
D5.4	Level of High Frequency Electromagnetic Fields	Mean level of electric field (100 kHz-3GHz)	V/m
E Service Quality			
E1 Controllability			
CODE	CRITERION	INDICATOR	UNIT
E1.1	Effectiveness of facility management control system	Percentage of control functions within class A	%
E1.2	Smart Readiness Indicator	Total smart readiness of buildings for responding to the needs of occupants, optimizing energy performance, and interacting with energy grids	%
E2 Optimization and Maintenance of Operating Performance			
CODE	CRITERION	INDICATOR	UNIT
E2.1	Existence and implementation of a maintenance management plan	The availability of a comprehensive and long-term plan at the end of Design phase, and evidence of its implementation during Operations phase	Score

E2.2	On-going monitoring and verification of performance	The provision of energy sub-metering systems and water consumption monitoring systems, according to design documentation	Score
E2.3	Retention of as-built documentation	The scope and quality of design documentation retained for use by building operators, according to design documentation	Score
F Social, Cultural and Perceptual Aspects			
G1 Performance of mobility services			
CODE	CRITERION	INDICATOR	UNIT
F1.1	Universal access on site and within the building	The scope and quality of design measures planned to facilitate access and use of building facilities by persons with disabilities	Score
F1.2	Exposure to sunlight	Hours of sunlight	Hrs
F2 Perceptual			
CODE	CRITERION	INDICATOR	UNIT
F2.1	View out	Quality of view out	Score
G Cost and Economic Aspects			
G1 Economic performance			
CODE	CRITERION	INDICATOR	UNIT
G1.1	Life-cycle cost	Life cycle cost (production and construction, use and end of life) per useful internal floor area per year	€/m ² /yr
G1.2	Construction cost	Predicted construction cost per useful internal floor area	€/m ²
G1.3	Maintenance cost	Predicted maintenance cost per useful internal floor area per year	€/m ² /yr
G1.4	Energy cost	Annual energy cost per useful internal floor area	€/m ² /yr
G1.5	Water cost	Annual water cost per useful internal floor area	€/m ² /yr

H Adaptation to Climate Change			
H1 Climatic action: increase of temperature			
CODE	CRITERION	INDICATOR	UNIT
H1.1	Time outside of the thermal comfort range – 2050	Percentage of the time out of range from defined maximum temperatures during the cooling seasons	%
H1.2	Heat island effect	Mean Solar Reflectance Index of paved surfaces and roofs in the area	SRI
H1.3	Shading of building envelope by vegetation	Percent of building envelope with orientation between West and South East that will be covered by vegetation during the warm season (June 12st)	%
H1.4	Use of vegetation to improve micro-climate and cooling during summer	Mean Solar Reflectance Index of paved surfaces and roofs in the area	%
H2 Climatic action: pluvial flood			
CODE	CRITERION	INDICATOR	UNIT
H2.1	Stormwater retention capacity on site	Share of the onsite stormwater retention capacity in relation to the optimal retention capacity	%
H2.2	Permeability of land	Share of the site that is permeable to water	%
H3 Climatic action: fluvial and coastal flood			
CODE	CRITERION	INDICATOR	UNIT
H3.1	Risk to occupants and facilities from flooding	Strategies to reduce the vulnerability of occupants and facilities to floods	Score
H4 Climatic action: drought			
CODE	CRITERION	INDICATOR	UNIT
H4.1	Capacity of rainwater collection and storage for non-potable uses	Share of rainwater collected and stored for reuse from roofs and plot's paved area	%
H4.2	Capacity of greywater collection and storage for non-potable uses	Share of greywater collected and cleaned for reuse	%
H5 Climatic action: fire exposure			
CODE	CRITERION	INDICATOR	UNIT
H5.1	Fire-resistance of the envelope	Level of use of certified fire-retardant materials in the envelope	Score

H5.2	Fireproof ground	Level of use of certified fire-retardant materials for paving	Score
H6 Climatic action: wind action			
CODE	CRITERION	INDICATOR	UNIT
I3.3	Windproof envelope	Level of use of certified wind resistant materials in the envelope	Score

4.Sustainable Neighbourhood Tool

Defintion:

Complete list of the criteria which make up the Sustainable MED Cities SNTTool are described below. The table also includes for each criterion, the information related to the name of the indicator and the unit of measure.

Main elements:

10 Issues
43 Categories
134 Criteria

SNTool criteria list

A Use of land and biodiversity			
A1 Use of land			
CODE	CRITERION	INDICATOR	UNIT
A1.1	Population density	Population density in built-up areas (neighbourhood area minus green and blue)	Inhabitants / km ²
A1.2	Urban compactness	Relation between the usable space of the buildings (volume) and the urban space (area)	m ³ / m ²
A1.3	Homogeneity of the urban fabric	Percentage of the perimeter of the area directly adjacent to urbanized areas	%
A1.4	Conservation of land	Pre-development ecological value of land	Score
A2 Green urban areas			
CODE	CRITERION	INDICATOR	UNIT
A2.1	Availability of green urban areas	Proportion of all vegetated areas within the neighborhood boundaries in relation to the total area	%
A2.2	Green areas in relation to the neighborhood population	Total area of green in the neighborhood divided by neighborhood's total population	m ² /inhabitant
A2.3	Green Area Accessibility	Percentage of inhabitants with accessibility to green areas	%
A2.4	Green zones density	Density of green spaces within the area	%
A2.5	Green zones and ecosystemic services	Share of natural green areas on total green areas	%

A3 Biodiversity and ecosystems			
CODE	CRITERION	INDICATOR	UNIT
A3.1	Connectivity measures for natural areas	Share of natural areas that are connected	%
A3.2	Biodiversity in green zones	Number of plants on number of vegetal species	%
B Energy			
B1 Energy infrastructure			
CODE	CRITERION	INDICATOR	UNIT
B1.1	Access to electrical service	Percentage of households with authorized access to electricity	%
B2 Energy infrastructure			
CODE	CRITERION	INDICATOR	UNIT
B2.1	Total final thermal energy consumption for building operations	Aggregated annual total final thermal energy consumption per aggregated indoor useful floor area	kWh/m ² /yr
B2.2	Total final thermal energy consumption for residential building operations	Aggregated annual final thermal energy consumption of residential buildings per aggregated internal useful floor area	kWh/m ² /yr
B2.3	Total final thermal energy consumption for public office/ educational building operations	Aggregated annual final thermal energy consumption of public office and educational buildings per aggregated internal useful floor area	kWh/m ² /yr
B2.4	Total final electrical energy consumption for building operations	Aggregated annual total final electric energy consumption per aggregated internal useful floor area	kWh/m ² /yr
B2.5	Total final electrical energy consumption for residential building operations	Aggregated annual final electrical energy consumption of residential buildings per aggregated indoor useful floor area	kWh/m ² /yr

B2.6	Total final electric energy consumption for public office/ educational building operations	Aggregated annual final electric energy consumption of public office and educational buildings per aggregated internal useful floor area	kWh/m ² /yr
B2.7	Total primary energy demand for building operations	Aggregated annual total primary energy consumption per aggregated indoor useful floor area	kWh/m ² /yr
B2.8	Total primary energy demand for residential building operations	Ratio of average total primary energy consumption of residential buildings to the local minimum value	%
B2.9	Total primary energy demand for public office/educational building operations	Ratio of average total primary energy consumption of public office/ educational buildings to the local minimum value	%
B2.10	Energy consumption of public lighting	Total electricity consumption of public street lighting divided by the total distance of streets where street lights are present	kWh/km/ yr

B3 Renewable Energy

CODE	CRITERION	INDICATOR	UNIT
B3.1	Share of renewable energy on-site, relative to total final thermal energy consumption for building operations	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption	%
B3.2	Share of renewable energy on-site, relative to total final thermal energy consumption for residential building operations	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of residential buildings	%
B3.3	Share of renewable energy on-site, relative to total final thermal energy consumption for public office/educational building operations	Total consumption of final thermal energy generated from renewable sources on-site divided by total final thermal energy consumption of public office/educational buildings	%
B3.4	Share of renewable energy on-site, relative to final electric energy consumption	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption	%
B3.5	Share of renewable energy on-site, relative to total final electric energy consumption for residential building operations	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of residential buildings	%

B3.6	Share of renewable energy on-site, on final electric energy consumptions for public office/educational building operations	Total consumption of final electric energy generated from renewable sources on-site divided by total final electric energy consumption of public office/educational buildings	%
B3.7	Share of renewable energy on-site, relative to total primary energy consumption for building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption	%
B3.8	Share of renewable energy on-site, relative to total primary energy consumption for residential building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of residential buildings	%
B3.9	Share of renewable energy on-site, on total primary energy consumptions for public office/ educational building operations	Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption of public office/ educational buildings	%

C Water

C1 Water infrastructure

CODE	CRITERION	INDICATOR	UNIT
C1.1	Availability of a public municipal water supply	Percentage of the buildings within the neighborhood that are served by a municipal water supply	%
C1.2	Availability of wastewater treatment system	Percentage of buildings within the neighbourhood that are served by wastewater collection	%

C2 Water Consumption

CODE	CRITERION	INDICATOR	UNIT
C2.1	Total water consumption	Total amount of the neighborhood's water consumption in litres per day divided by the total neighborhood population	l/day/occupant
C2.2	Efficiency in water use	Volume of water supplied minus the volume of utilized water divided by the total volume of water supplied	%
C2.3	Consumption of potable water in residential buildings	Annual potable water consumption per occupant	L/occupant/yr
C2.4	Consumption of potable water in public offices	Annual potable water consumption per occupant	L/occupant/yr

C2.5	Consumption of potable water in educational buildings	Annual potable water consumption per occupant	L/occupant/yr
C2.6	Re-use of rainwater in residential buildings	Share of rainwater collected from roofs of residential buildings for reuse	%
C2.7	Consumption of potable water in public green spaces	Potable water used for irrigation purposes in public green spaces	m ³ /m ²
C2.8	Solar powered water desalinisation	Percentage of water acceptable for human consumption or agriculture from solar desalination	%

C3 Effluents management

CODE	CRITERION	INDICATOR	UNIT
C3.1	Water treatment	Total volume of wastewater collected for at least secondary treatment in centralized wastewater treatment facilities divided by the total volume of wastewater produced in the neighborhood	%
C3.2	Public wastewater (from outdoor areas) that is disposed or treated	Percent of public wastewater that is disposed or treated	%
C3.3	Solar powered water desalinisation	Percentage of households with access to basic sanitation facilities	%

D Solid Waste

D1 Solid waste collection infrastructure

CODE	CRITERION	INDICATOR	UNIT
D1.1	Availability of solid waste collection	Percentage of buildings with regular solid waste collection	%

D1 Solid waste collection infrastructure

CODE	CRITERION	INDICATOR	UNIT
D2.1	Access to solid waste and recycling collection points	Proximity of the resident population to the solid waste and recycling collection point	%
D2.2	Access to solid waste and recycling collection points	Percentage of inhabitants with access to solid waste and recycling collection points within 400 meters walking distance	%

E Environmental quality

E1 Air quality

CODE	CRITERION	INDICATOR	UNIT
E1.1	Fine particulate matter (PM2.5) concentration	Number of days within a year that PM2.5 concentration exceeds the daily limit	days / yr
E1.2	Particulate matter (PM10) concentration	Number of days within a year that PM10 concentration exceeds the daily limit	days / yr
E1.3	Nitrogen Dioxide concentration (NO2)	Number of days within a year that NO2 concentration exceeds the daily limit	µg/m ³
E1.4	Sulfur Dioxide concentration (SO2)	Number of days within a year that SO2 concentration exceeds the daily limit	µg/m ³
E1.5	Ozone concentration (O3)	Number of days within a year that O3 concentration exceeds the daily limit	µg/m ³

E2 Noise

CODE	CRITERION	INDICATOR	UNIT
E2.1	Ambient daytime noise conditions	Percentage of building area over noise limit	%
E2.2	Ambient night-time noise conditions	Percentage of building area over noise limit	%

E3 EMF exposure

CODE	CRITERION	INDICATOR	UNIT
E3.1	Exposure to high frequency electromagnetic fields	Percentage of mobile network antenna sites in compliance with EMF exposure guidelines	%
E3.2	Percentage of buildings exposed to ELF magnetic field	Percentage of buildings in the area located not respecting the safety distance from high voltage lines	%

E4 Environmental impacts

CODE	CRITERION	INDICATOR	UNIT
E4.1	Degree of atmospheric light pollution caused by exterior public lighting systems	Percentage of lighting fixtures with upward luminous emission coefficient equal to 0%	%

F Transportation and mobility

F1 Performance and mobility services

CODE	CRITERION	INDICATOR	UNIT
F1.1	Performance of the public transport system	Percentage of inhabitants that are within 400 meters walking distance of at least one public transportation service stop	%
F1.2	Walking distance to public transport for area workers and students	Percent of workers and students who can reach a public transport stop within a 400 meters distance	%

F2 Green mobility

CODE	CRITERION	INDICATOR	UNIT
F2.1	Shared vehicles	Number of shared vehicles per 1.000 inhabitants	n/1.000 inhabitants
F2.2	Electric-vehicle infrastructure (charging stations)	Electric vehicle charging stations per inhabitant	n/inhabitant
F2.3	Bicycle network	Total length of bicycle paths in the neighborhood per inhabitant	n/inhabitant
F2.4	Shared bicycles	Number of shared bicycles per 1.000 inhabitants	n/1.000 inhabitants
F2.5	Availability of bicycle parking facilities	Bicycle parking spaces per inhabitant	n/inhabitant

F3 Safety in mobility

CODE	CRITERION	INDICATOR	UNIT
F3.1	Pedestrian infrastructure	Percentage of the neighborhood designated as a pedestrian/car free zone	%
F3.2	Availability of sidewalks	Percentage of roads' length that has dedicated sidewalks	%
F3.3	Safety of bicycle lines	Percentage of bicycle paths physically separated from traffic roads	%
F3.4	Traffic fatalities	Traffic fatalities per 1.000 inhabitants	n/1.000 inhabitants

F4 Safety in mobility

CODE	CRITERION	INDICATOR	UNIT
F3.1	Cyclomatic complexity of the street network	Cyclomatic number	number
F3.2	Connectivity of the street network	Number of intersections related to the overall surface area	number/km ²

G Social Aspects

G1 Accessibility (disabled persons)

CODE	CRITERION	INDICATOR	UNIT
G1.1	Public buildings that are accessible for use by physically disabled persons	Percent of key public buildings that are accessible for use by physically disabled persons	%
G1.2	Sidewalks and other pedestrian paths that are accessible for use by physically disabled persons	Percent of sidewalks and other pedestrian ways that are accessible for use by physically disabled persons	%
G1.3	Barrier-free accessibility in local outdoor public areas	Adequacy of barrier-free accessible public outdoor areas compared to the total public area	%

G2 Housing

CODE	CRITERION	INDICATOR	UNIT
G2.1	Affordability of housing property	Housing properties in the local area that are financially accessible to the lowest quintile of area population	%
G2.2	Affordability of housing rental	Percentage of the average salary of the lowest quintile of the population used for rental payments	%
G2.3	Vacant residential units in the neighborhood	Percentage of vacant residential units	%
G2.4	Informal settlements	Percentage of inhabitants living in slums, informal settlements or inadequate housing	%

G3 Availability of public and private facilities and services

CODE	CRITERION	INDICATOR	UNIT
G3.1	Availability and proximity of key services	Percentage of inhabitants that are within 800 meters walking distance of at least 3 key services	%
G3.2	Availability and proximity of a public primary school	Percentage of population near a public primary school	%
G3.3	Availability and proximity of a public secondary school	Percentage of population near a public secondary school	%
G3.4	Availability and proximity of childrens' play facilities	Percentage of population near a childrens' play facilities	%
G3.5	Open space for public use	Average share of the built-up area of the neighborhood that is open space for public use	%

G4 Education

CODE	CRITERION	INDICATOR	UNIT
G4.1	Primary enrollment rate	Net primary enrollment rate	%
G4.2	Rate of female scholarship	Ratio of female to male mean years of education received of population age 25+	%
G4.3	Secondary school enrollment	Lower secondary completion rate	%
G4.4	Tertiary education	Population age 25-34 with tertiary educational attainment	%

G5 Social inclusion

CODE	CRITERION	INDICATOR	UNIT
G5.1	Energy poverty of households	Percentage of households unable to afford the most basic levels of energy (more than 10% of the income spent on energy bills)	%
G5.2	Population at risk of poverty or exclusion	Share of persons with an equivalised disposable income below 60 % of the national median income	%

G6 Safety

CODE	CRITERION	INDICATOR	UNIT
G6.1	Police service	Number of police officers per 1.000 inhabitants	n/1.000 inhabitants
G6.1	Fire service	Number of firefighters per 1.000 inhabitants	n/1.000 inhabitants
G6.1	Population living in disaster prone areas	Percentage of inhabitants living in a zone subject to natural hazards	%

G7 Health

CODE	CRITERION	INDICATOR	UNIT
G7.1	In-Patient Hospital Beds	Number of in-patient public hospital beds per 1.000 inhabitants	n/1.000 inhabitants

G8 Food security

CODE	CRITERION	INDICATOR	UNIT
G8.1	Urban agricultural land	Area of urban agricultural land on total neighborhood area	%

G9 Culture and Heritage

CODE	CRITERION	INDICATOR	UNIT
G9.1	Compatibility of urban design with local cultural values	Compatibility with local area traditional values of street layouts and the character of urban spaces	Score
G9.2	Compatibility of public open space with local cultural values	Compatibility with local area traditional values of local public open spaces, including major uses, dimensions and adjacent uses	Score

G10 Perceptual

CODE	CRITERION	INDICATOR	UNIT
G10.1	Perceived safety of public areas for pedestrians	Perceived safety of public places and pedestrian routes, as determined by a sample of pedestrians	Score
G10.2	Impact of commercial signage on the visual environment	Visual impact of exterior commercial signage	Score
G10.3	Impact of overhead electric distribution system	Visual impact of above-grade electrical distribution systems	Score

H Economy

H1 Economic performance

CODE	CRITERION	INDICATOR	UNIT
H1.1	Average annual per-capita income of residents	Percentage of average per-capita income	%

H2 Employment

CODE	CRITERION	INDICATOR	UNIT
H2.1	Unemployment rate	Percentage of working age adults unemployed or actively looking for work	%
H2.2	Youth unemployment rate	Percentage of unemployed youth	%

H3 Innovation			
CODE	CRITERION	INDICATOR	UNIT
H3.1	New business registration rate	Proportion of business registrations per 10.000 inhabitants aged 16 and above	n
H4 ICT infrastructure			
CODE	CRITERION	INDICATOR	UNIT
H4.1	Fixed Broadband Subscriptions	Percentage of households with fixed (wired) broadband	%
H4.2	Wireless Broadband Coverage	Percentage of the neighborhood area served by wireless broadband (3G, 4G, 5G)	%
H4.3	Availability of WIFI in Public Areas	Number of public WIFI hotspots in the neighborhood per 1000 inhabitants	n/1.000 inhabitants
H4.4	Mobile phone subscriptions	Total number of mobile phone subscriptions in the area divided by one 1000th of the area's total population	n/1.000 inhabitants
Climate Change: mitigation and adaptation			
I1 Climate change mitigation			
CODE	CRITERION	INDICATOR	UNIT
I1.1	Greenhouse gas emissions	Total amount of greenhouse gases (equivalent carbon dioxide units) generated from building operations over a calendar year per inhabitant	t CO ₂ eq. / inhabitant/yr
I1.2	Greenhouse gas emissions from residential buildings	Total amount of greenhouse gases in Kg (equivalent carbon dioxide units) generated over a calendar year per aggregated indoor useful floor area	Kg CO ₂ eq / m ²
I1.3	Embodied carbon for construction and renovation of infrastructures	Aggregated total embodied carbon per aggregated linear area	kg CO ₂ eq / m ²
I1.4	Embodied carbon for construction/renovation of residential buildings	Aggregated total embodied carbon per aggregated indoor useful floor area	kg CO ₂ eq / m ²
I1.5	Embodied carbon for construction/renovation of public offices/educational buildings	Aggregated total embodied carbon per aggregated indoor useful floor area	kg CO ₂ eq / m ²
I1.6	CO2 sequestration	Potential CO2 sequestraion in the neighborhood per hectare	kg CO ₂ eq / m ²

I2 Adaptation to the climatic action: heatwaves and increase of temperature			
CODE	CRITERION	INDICATOR	UNIT
I2.1	Albedo	Mean Solar Reflectance Index of paved surfaces and roofs in the neighborhood	SRI
I2.2	Use of vegetation to provide ambient outdoor cooling	Leaf Area Index: ratio of total vegetated surface area (on ground and on roofs, and including trees), divided by total site area	Index
I2.3	Green roofs	Aggregate area of building roofs covered with vegetated material	%
I3 Adaptation to the climatic action: pluvial flood			
CODE	CRITERION	INDICATOR	UNIT
I3.1	Stormwater retention capacity on site by buildings	Share of the attenuation storage capacity by buildings in relation to the optimal volume	%
I3.2	Sustainable Urban Drainage	Share of the optimal capacity of sustainable urban drainage systems	%
I3.3	Permeability of land	Percentage of weighted ground permeability	%
I4 Adaptation to the climatic action: fluvial and coastal flood			
CODE	CRITERION	INDICATOR	UNIT
I4.1	Flood risk	Percentage of population exposed to flood risk	%
I4.2	Protection of vulnerable zones	Share of land in vulnerable areas protected by flooding barriers	%
I4.3	Protection of buildings from flooding	Share of buildings with elevated ground floor in vulnerable sites	%
I5 Adaptation to the climatic action: drought			
CODE	CRITERION	INDICATOR	UNIT
I5.1	Rainwater collection and storage from buildings for non-potable uses	Share of buildings in the neighborhood with a rainwater collection system	%
I5.2	Rainwater collection and storage from outdoor areas	Share of rainwater collected from paved (not permeable) surfaces in the neighborhood (excluding buildings' roofs and plots)	%

15.3	Greywater collection in buildings for non-potable uses	Share of buildings in the neighborhood with a greywater collection system	%
15.4	Local vegetation	Share of landscape (green areas) plated with local vegetation	%

I6

Adaptation to the climatic action: pluvial flood

CODE	CRITERION	INDICATOR	UNIT
16.1	Wildfire risk	Percentage of population exposed to wildfire risk	%
16.2	Fire protection	Share of wildfire vulnerable areas protected by fire barriers	%
16.3	Fireproof ground	Share of ground cover materials (excluding buildings' plots) in vulnerable areas that are fire resistant	%

I7

Climatic hazard: wind

CODE	CRITERION	INDICATOR	UNIT
17.1	Windproof urban form	Strategies to minimise the impact of wind	Score

J

Governance

J1

Urban Planning

CODE	CRITERION	INDICATOR	UNIT
J1.1	Community involvement in urban planning activities	Percentage of residents active in public urban planning	Level

J2

Management and community involvement

CODE	CRITERION	INDICATOR	UNIT
J2.1	Involvement of residents in community affairs	Percentage of resident population above 16 years having an involvement in community affairs	%

J3

Management and community involvement

CODE	CRITERION	INDICATOR	UNIT
J3.1	Public buildings sustainability	Percentage of population exposed to wildfire risk	%
J3.2	Operating energy costs for public buildings	Aggregated annual operating energy cost per aggregated indoor useful floor area	€/m²/yr

J3.3	Energy consumption of public buildings	Total end use of energy in public buildings within a neighborhood divided by total indoor useful area of these buildings	kWh/m²
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5.Sustainable Cities Tool

Defintion:

Complete list of the criteria which make up the Sustainable MED Cities SCTool are described below. The table also includes for each criterion, the information related to the name of the indicator and the unit of measure.

Main elements:

10 Issues
39 Categories
99 Criteria

SCTool criteria list

A Use of land and biodiversity			
A1 Use of land			
CODE	CRITERION	INDICATOR	UNIT
A1.1	Population density	Population density in built-up areas (city area minus green and blue)	Inhabitants per km²
A2 Green urban areas			
CODE	CRITERION	INDICATOR	UNIT
A2.1	Availability of green urban areas	Total amount of Green Urban Areas in the city's boundaries divided by the total area of the city	%
A2.2	Green areas in relation to the city population	Total extension of green areas in the city divided by city's total population	m²/inhabitant
A2.3	Green Area Accessibility	Percentage of inhabitants with accessibility to green areas	%
A2.4	Distribution of Green Urban Areas	Total length of green area boundaries (edges) divided by the city's urban area	%
A2.5	Green zones and ecosystemic services	Share of natural green areas on total green areas	%
A3 Biodiversity and ecosystems			
CODE	CRITERION	INDICATOR	UNIT
A3.1	Variation of the number of bird species	Share of natural areas that are connected	%
A3.2	Native biodiversity in built up area	This indicator is the number of bird species that is listed in the urban area (natural protected area excluded)	n
A3.3	Connectivity measures for natural areas	Amount of natural connected areas in the city divided by the total amount of natural areas in the city	%

B Energy			
B1 Energy infrastructure			
CODE	CRITERION	INDICATOR	UNIT
B1.1	Access to authorized electrical service	Number of people in the city with authorized electrical service divided by the total population of the city	%
B1.2	Electrical service interruptions	Total sum of hours of interruption multiplied by the number of households impacted divided by the total number of households	hrs/household
B2 Energy consumptions			
CODE	CRITERION	INDICATOR	UNIT
B2.1	Final energy consumption	Total final energy consumed by a city divided by the total population of the city	MWh/inhabitant/yr
B2.2	Residential final thermal energy consumption	Total consumption of final thermal energy divided by the total number of city inhabitants	MWh/inhabitant/yr
B2.3	Public street lighting	Total electricity consumption of public street lighting divided by the total distance of streets where street-lights are present	kWh/km yr
B3 Renewable Energy			
CODE	CRITERION	INDICATOR	UNIT
B3.1	Final energy derived from renewable sources	Share of renewable energies in final energy demand	%
B3.2	Renewable energy locally produced	Share of locally produced renewable energies of final energy demand	%

C Water			
C1 Water infrastructure			
CODE	CRITERION	INDICATOR	UNIT
C1.1	Availability of a public municipal water supply	Total number of people with potable water supply service divided by total city population	%
C1.2	Access to wastewater collection	Number of people within the city that are served by wastewater collection divided by the city population	%
C2 Water Consumption			
CODE	CRITERION	INDICATOR	UNIT
C2.1	Total water consumption	Total amount of the city's daily water consumption divided by the total city population	L/day/person
C2.2	Efficiency in water use	Volume of water supplied minus the volume of utilized water divided by the total volume of water supplied	%
C2.3	Sufficiency of domestic water provision	Volume of the water supplied for domestic uses divided by the overall domestic water demand	%
C3 Effluents management			
CODE	CRITERION	INDICATOR	UNIT
C3.1	Centralized wastewater treatment	Total volume of city wastewater collected for primary, secondary and tertiary treatment in centralized wastewater treatment facilities divided by the total volume of wastewater produced in the city	%
C3.2	Household sanitation	Percentage of households with access to basic sanitation facilities	%
D Solid Waste			
D1 Solid waste collection infrastructure			
CODE	CRITERION	INDICATOR	UNIT
D1.1	Availability of solid waste collection	Percentage of population with regular solid waste collection	%

D2 Solid waste management			
CODE	CRITERION	INDICATOR	UNIT
D2.1	Solid waste generation	Total amount of solid waste generated divided by the total city population	tonnes/inhabitant/yr
D2.2	Solid waste recycling	Total amount of solid waste that is recycled divided by the total amount of solid waste produced in the city	%
E Environmental quality			
E1 Air quality			
CODE	CRITERION	INDICATOR	UNIT
E1.1	Fine particulate matter (PM2.5) concentration	Annual average fine particulate matter (PM2.5) concentration	µg/m³
E1.2	Particulate matter (PM10) concentration	Annual average fine particulate matter (PM10) concentration	µg/m³
E1.3	Nitrogen Dioxide concentration (NO2)	Sum of daily concentrations for the whole year divided by 365 days	µg/m³
E1.4	Sulfur Dioxide concentration (SO2)	Sum of daily concentrations for the whole year divided by 365 days	µg/m³
E1.5	Ozone concentration (O3)	Sum of daily concentrations for the whole year divided by 365 days	µg/m³
E2 Noise			
CODE	CRITERION	INDICATOR	UNIT
E2.1	Noise pollution	Population exposed to noise pollution divided by the total population of the city	%

E3 EMF exposure			
CODE	CRITERION	INDICATOR	UNIT
E3.1	Exposure to high frequency electro-magnetic fields	Percentage of mobile network antenna sites in compliance with EMF exposure guidelines	%
E3.2	Percentage of buildings exposed to ELF magnetic fields	Percentage of buildings in the area located not respecting the safety distance from high voltage lines	%
F Transportation and mobility			
F1 Performance of mobility services			
CODE	CRITERION	INDICATOR	UNIT
F1.1	Public transport network	Length of public transport system per 1000 population	km/1000 inhabitants
F1.2	Accessibility of public transportation service	Percentage of inhabitants that are within 500 meters walking distance of at public transportation service stop running at least every 20 minutes during peak periods	%
F1.3	Usage of public transportation by population	Total annual number of public transport trips originating in the city divided by the total city population	trips/inhabitant
F2 Green mobility			
CODE	CRITERION	INDICATOR	UNIT
F2.1	Shared vehicles	Number of shared vehicles per 1.000 inhabitants	n/1.000 inhabitants
F2.2	Electric-vehicle infrastructure (charging stations)	Electric vehicle charging stations per inhabitant	n/inhabitant
F2.3	Low-Carbon Emission Passenger Vehicles	Percentage of low-carbon emission passenger vehicles	%
F2.4	Bicycle network	Total length of bicycle paths and lanes divided by the city's total population	m/inhabitant
F2.5	Shared bicycles	Number of shared bicycles per 1.000 inhabitants	n/1.000 inhabitants
F2.6	Green public vehicles	Total number of low emission public vehicles divided by total number of public vehicle	%

F3 Safety in mobility			
CODE	CRITERION	INDICATOR	UNIT
F3.1	Pedestrian infrastructure	Total area of pedestrian streets and walkways divided by the total area of streets and roads in the city	%
F3.2	Availability of sidewalks	Percentage of roads' length that has dedicated sidewalks	%
F3.3	Safety of bicycle lines	Percentage of bicycle paths physically separated from traffic roads	%
F3.4	Traffic fatalities	Traffic fatalities per 1.000 inhabitants	n/1.000 inhabitants
F3.5	Private transportation services	Number of taxi licenses divided by 1000th of the city's population	n/1.000 inhabitants
G Social Aspects			
G1 Performance of mobility services			
CODE	CRITERION	INDICATOR	UNIT
G1.1	Accessibility of public buildings	Total number of public buildings accessible by disabled persons divided by the total number of public buildings	%
G1.2	Barrier-free accessibility in local outdoor public areas	Percentage of accessible public outdoor areas that are barrier-free compared to the total public area	%
G1.3	Accessibility of public transport network	Percentage of public transport vehicles that are accessible disabled persons	%
G2 Housing			
CODE	CRITERION	INDICATOR	UNIT
G2.1	Affordability of housing property	Housing properties in the city that are financially accessible to the lowest quintile of area population	%
G2.2	Affordability of housing rental	Percentage of the average salary of the lowest quintile of the population used for rental payments	%
G2.3	Vacant residential units	Percentage of vacant residential units	%
G2.4	Informal settlements	Area of informal settlements within the city boundary divided by the city area	%

G3 Availability of public and private facilities and services			
CODE	CRITERION	INDICATOR	UNIT
G3.1	Basic service proximity	Number of inhabitants who live near at least one basic service divided by the total population of the city	%
G3.2	Open space for public use	Average share of the built-up area of the city that is open space for public use	%
G3.3	Accessibility of shores/beaches	Total area of shores/beaches in the city area that are accessible by inhabitants divided by the total area of shores/beaches in the city's urban area	%
G4 Education			
CODE	CRITERION	INDICATOR	UNIT
G4.1	Primary enrollment rate	Net primary enrollment rate	%
G4.2	Female school-aged population enrolled in schools	Number of city's female school-aged population enrolled at primary and secondary levels in public and private schools divided by the total number of a city's female school-aged population	%
G4.3	Secondary school enrollment	Lower secondary completion rate	%
G4.4	Tertiary education	Population age 25-34 with tertiary educational attainment	%
G5 Social inclusion			
CODE	CRITERION	INDICATOR	UNIT
G5.1	Gender pay gap	Difference between average gross hourly earnings of male and female paid employees as a percentage of average gross hourly earnings of male paid employees	%
G5.2	Energy poverty of households	Percentage of households unable to afford the most basic levels of energy (more than 10% of the income spent on energy bills)	%
G5.3	Population living below poverty line	Number of people living below the national poverty line set at country level divided by the total current population of the city	%

G5.4	Inequality	Gini coefficient of inequality	n
G5.5	Voter participation	Percentage of the eligible population that voted during the last municipal election	%
G6 Safety			
CODE	CRITERION	INDICATOR	UNIT
G6.1	Police service	Number of police officers per 1.000 inhabitants	n/1.000 inhabitants
G6.1	Fire service	Number of firefighters per 1.000 inhabitants	n/1.000 inhabitants
G6.1	Population living in disaster prone areas	Percentage of inhabitants living in a zone subject to natural hazards	%
G7 Health			
CODE	CRITERION	INDICATOR	UNIT
G7.1	Life expectancy	Average number of years that a new-born is expected to live if current mortality rates continue to apply	years
G7.2	Physicians	Number of physicians per 1.000 inhabitants	n/1000 inhabitant
G7.3	In-Patient Hospital Beds	Number of in-patient public hospital beds per 1,000 inhabitants	n/1000 inhabitant
G8 Food security			
CODE	CRITERION	INDICATOR	UNIT
G8.1	Local production of food	Percentage of local food supplied from within 100 km of the urban area	%
G8.2	Urban agricultural land	Total urban agricultural area used for food production located within city boundaries divided by one 1000th of the city's total population	he/1000 inhabitants

H Economy			
H1 Economic performance			
CODE	CRITERION	INDICATOR	UNIT
H1.1	Average annual per-capita income of residents	Average per-capita income of residents in the local area relative to that of the urban region as a whole	%
H1.2	Economic contribution from tourism activity	Sum of overnight visitor stays divided by the area's total population	stays/resident
H2 Employment			
CODE	CRITERION	INDICATOR	UNIT
H2.1	Unemployment rate	Total number of working-age primary residents not in paid employment or self-employment, but available for work and seeking work divided by the total labour force	%
H2.2	Youth unemployment rate	Total number of a city's unemployed youth divided by the city's youth labour force	%
H2.3	Female employment	Total number of working age women in employment divided by the total female labour force	%
H3 Innovation			
CODE	CRITERION	INDICATOR	UNIT
H3.1	New business registration rate	Proportion of business registrations per 10.000 inhabitants aged 16 and above	n
H4 ICT infrastructure			
CODE	CRITERION	INDICATOR	UNIT
H4.1	Fixed Broadband Subscriptions	Percentage of households with fixed (wired) broadband	%
H4.2	Wireless Broadband Coverage	Percentage of the city served by wireless broadband (3G, 4G, 5G)	%
H4.3	Availability of WIFI in Public Areas	Number of public WIFI hotspots in the city per 1000 inhabitants	n/1.000 inhabitants
H4.4	Mobile phone subscriptions	Total number of mobile phone subscriptions in the area divided by one 1000th of the area's total population	n/1.000 inhabitants

I Climate Change: mitigation and adaptation			
I1 Climate change mitigation			
CODE	CRITERION	INDICATOR	UNIT
I1.1	Greenhouse gas emissions	Total amount of greenhouse gases (equivalent carbon dioxide units) generated over a calendar year for all sectors, divided by the current city population	t CO ₂ eq / inhabitant/yr
I1.2	CO2 sequestration	Potential CO2 sequestration in the neighborhood per hectare	kg CO ₂ eq / m ²
I2 Adaptation to the climatic action: heatwaves and increase of temperature			
CODE	CRITERION	INDICATOR	UNIT
I2.1	Albedo	Mean Solar Reflectance Index of paved surfaces and roofs in the neighborhood	SRI
I3 Adaptation to the climatic action: pluvial flood			
CODE	CRITERION	INDICATOR	UNIT
I3.3	Permeability of land	Percentage of weighted ground permeability	%
I4 Adaptation to the climatic action: fluvial and coastal flood			
CODE	CRITERION	INDICATOR	UNIT
I4.1	Flood risk	Percentage of population exposed to flood risk	%
I5 Adaptation to the climatic action: drought			
CODE	CRITERION	INDICATOR	UNIT
I5.1	Rainwater collection and storage from buildings for non-potable uses	Share of buildings in the neighborhood with a rainwater collection system	%
I5.2	Local vegetation	Share of landscape (green areas) planted with local vegetation	%
I6 Adaptation to the climatic hazard: wildfire			
CODE	CRITERION	INDICATOR	UNIT
I6.1	Wildfire risk	Percentage of population exposed to wildfire risk	%

J	Governance		
J1	Urban Planning		
CODE	CRITERION	INDICATOR	UNIT
J1.1	Community involvement in urban planning activities	Percentage of residents active in public urban planning	Level
J2	Management and community involvement		
CODE	CRITERION	INDICATOR	UNIT
J2.1	Involvement of residents in community affairs	Percentage of resident population above 16 years having an involvement in community affairs	%
J3	Public buildings operation		
CODE	CRITERION	INDICATOR	UNIT
J3.1	Public buildings sustainability	Percentage area of public buildings with recognized sustainability certifications for ongoing operations	%
J3.2	Operating energy costs for public buildings	Aggregated annual operating energy cost per aggregated indoor useful floor area	€/m ² /yr
J3.3	Energy consumption of public buildings	Total end use of energy in public buildings within a city divided by total indoor useful area of these buildings	kWh/m ²
J4	Equity		
CODE	CRITERION	INDICATOR	UNIT
J4.1	Women elected to city level office	Total number of elected city-level positions held by women divided by the total number of elected city-level positions	%

6.SMC passport

Sustainable MED cities passport

Definition:

The Passport template is a graphical visualisation of the main information concerning the assessment and it includes two different pages.

The first one contains general information as well as maps and significant images, in order to better represent the features of the analysis.

The second page of the Passport contains the list of the Key Performance Indicators, together with their code, criterion, unit of measure and value.

Observation:

The sustainability score produced by SMC rating system is valid only for the specific geographical area, as it reflects the local priorities and construction practice.

In order to be able to compare the sustainability performance between buildings, neighborhoods or cities in the different Mediterranean regions, it is necessary to use indicators expressed in absolute values instead of scores.

Name of the Pilot

SMC Passport pilot

Name:

Total area (km2):

Country:

City:

Short Description

.....

.....

.....

.....

MAP

IMAGE

Demography

PopulationInhab

Urban residential densityInhab/ha

Population working in the areaPersons

Other info

Climate

Annual precipitationmm

Solar irradiance on horizontalkWh/m²y

Winter / summer design temperature°C

Heating degree days (base 18°C)HDD

Building Stock

Number of buildings in the areanumber

Gross area of residential Buildingsm²

Gross area office buildingsm²

Gross area of retail/ Commercial buildingsm²

Total gross area of all buildingsm²

Total gross area of buildings constructed before 1975m²

Average building density (total m2/ land surface in m2)number

Use of land and morphology

Percentage of consumed land area%

Total lenght of urban streets with sidewalkskm

Total lenght of bicycles lanesm

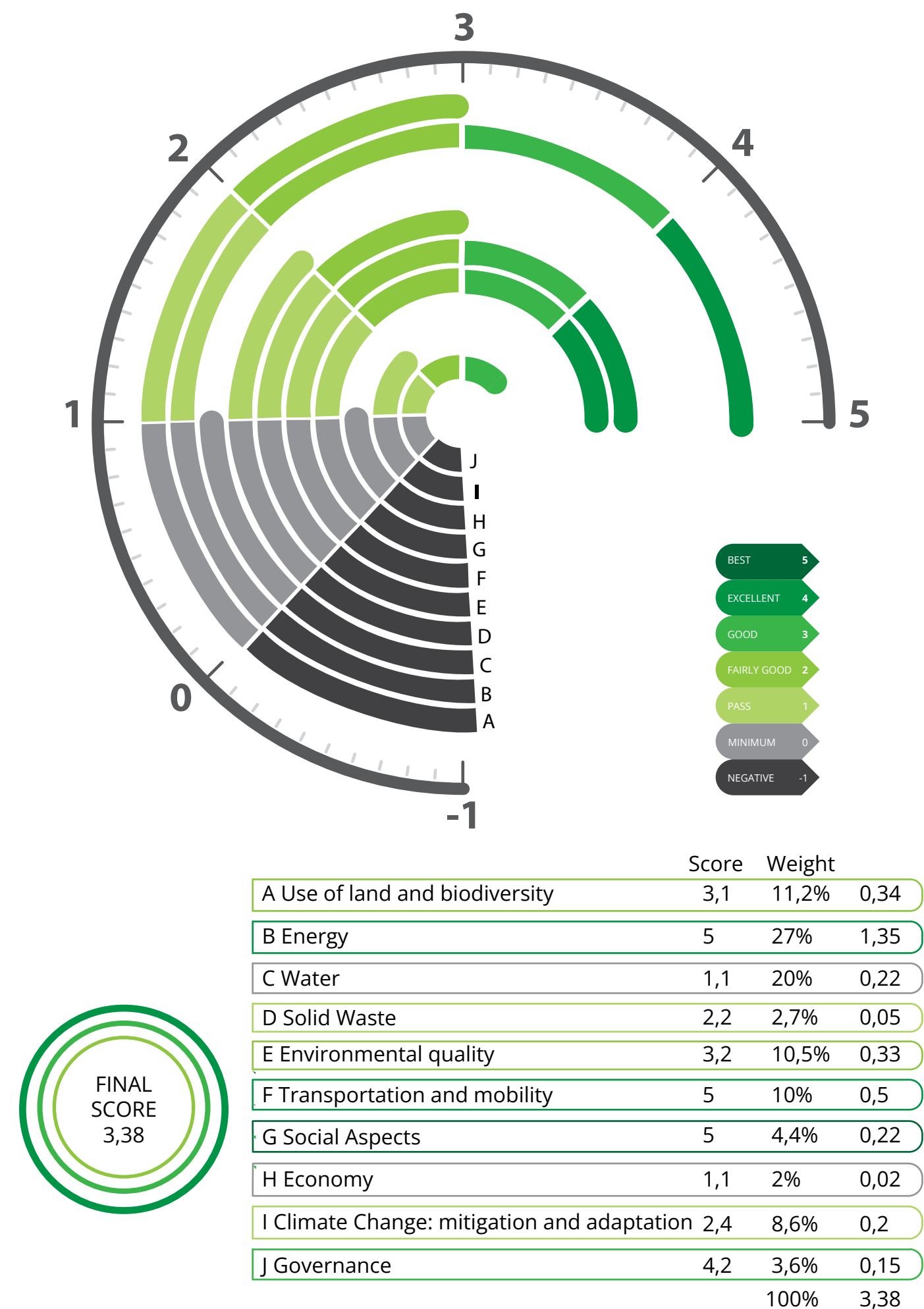
Other relevant info

SMC Key Performance Indicators (SCTool)



CODE	CRITERIA	INDICATOR	VALUE	UNIT
A2.1	Availability of green urban areas	Total amount of green urban areas in the city's boundaries divided by the total area of the city	.....	%
B2.1	Final energy consumption	Total final energy consumed by a city divided by the total population of the city	.....	MWh/inhabitant/yr
B3.1	Final energy derived from renewable sources	Share of renewable energies in final energy demand	.....	%
C2.1	Total water consumption	Total amount of the city's daily water consumption divided by the total city population	.....	L/day/person
D2.2	Solid waste recycling	Total amount of solid waste that is recycled divided by the total amount of solid waste produced in the city	.....	%
E1.2	Particulate matter (PM10) concentration	Annual average fine particulate matter (PM10) concentration	.....	µg/m ³
F1.1	Public transport network	Length of public transport system per 1000 population	.....	km/1000 inhabitants
F2.4	Bicycle network	Total length of bicycle paths and lanes divided by the city's total population	.....	m/inhabitant
I1.1	Greenhouse gas emissions	Total amount of greenhouse gases (equivalent carbon dioxide units) generated over a calendar year for all sectors, divided by the current city population	.....	t CO ₂ eq/inhabitant/yr
I3.1	Permeability of land	Percentage of weighted ground permeability.	.....	%

Visualisation of the sustainability assessment results



Sustainability Assessmet Results

The document summarises the scores achieved in each issue of the assessment system, giving the final score of the sustainability.

Scores are then illustrated using a tachometer with a graduated scale which goes from the -1 (negative performance) to the 5 points (best performance).

The Certificate template is a graphic label which allows, in a visual way, to understand the sustainability performance obtained by the neighbourhood.

7. References

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SBTool SNTTool SCTool



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