SBE METHOD

Sustainable Built Environment Method

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Sustainable MED Cities

Sustainable MED Cities - Integrated Tools and Methodologies for Sustainable Mediterranean Cities, is a capitalization project whose main objective is to enhance the capacity of public administration in delivering, implementing and monitoring efficient measures, plans and strategies to improve the sustainability of cities, neighbourhoods and buildings.

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Introduction

SBE Method is multi-criteria assessment methodology for measuring the sustainability of the Mediterranean built environment. It can be used to develop assessment tools contextualizable to any Mediterranean region. The SBE Method has been 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 the tools based on it on hundreds of case studies worldwide. 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 implementing the SBE Method, such as SBTool MED, SNTool MED or SCTool MED, 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. This publication illustrates the SBE Method, how to contextualise the tools based on it to a specific region or city, and how to carry out a sustainability assessment. SBE Method is freely available to any public authority in the Mediterranean willing to develop its own sustainability assessment tools. The use of SBE Method 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

SBE Method 1

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 building neighbourhood's and cities overall sustainability.

Main elements:

1. A set of assessment criteria.
2. A set of indicators, which allow to quantify the neighbourhood's performances with respect to each criterion.
3. A normalization 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, recognized as relevant for assessing the sustainability of a building, neighbourhood and city. For instance, the issues of SNTool and SCToool 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

Categories

2

Concern particular aspects of issues. For instance, in the SNTool, 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 consumptions
- B.3 Renewable energy

- C.1 Water infrastructure
- C.2 Water consumption
- C.3 Effluents managament

- D.1 Solid waste collection infrastructure
- D.2 Solid wate management

- E.1 Air quality
- E.2 Noise
- E.3 EMF expossure
- E.4 Environmental impacts

- F.1 Performance of mobility service
- F.2 Green mobility
- F.3 Safety in mobility
- F.4 Urban morphology and transportation

- G.1 Accesibility
- 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
- G.9 Cultural Heritage
- G.10 Perceptual

- 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
- I.7 Adapatation to the climatic hazard: Wind

- J.1 Urban planning
- J.2 Management and community involvement
- J.3 Public buildings cooperation

Criteria

3

They represent the basic assessment entries used to evaluate the sustainability of the building, neighbourhood and city.

Example:

- Issue
  - A Use of land and biodiversity
    - Categories
      - A.2 Green urban areas
      - A.1 Use of land
        - Criteria
          - A1.1 Population density
          - A1.2 Urban compactness
          - A1.3 Homogenity of the urban fabric
          - A1.4 Conservation of land
      - A.3 Biodiversity and eco-systems

Indicators

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

Example:

- Issue
  - A Use of land and biodiversity
    - Categories
      - A.2 Green urban areas
      - A.1 Use of land
        - Criteria
          - A1.1 Population density
            - Indicator: Population density in built-up areas (neighbourhood area minus green and blue).
              - Inhabitants / km^2
          - A1.2 Urban compactness
            - Indicator: Relation between the usable space of the buildings (vol-ume) and the urban space (area).
              - m^3 / m^2
          - A1.3 Homogenity of the urban fabric
            - Indicator: Percentage of the perimeter of the area directly adja-cent to urbanized areas.
              - %
          - A1.4 Conservation of land
            - Indicator: Pre-development ecological value of land.
              - Score
      - A.3 Biodiversity and ecosystems

1.2 Assessment process

Definition and objective:

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

The assessment procedure is articulated in 3 main steps:

1. Characterization

Calculation/evaluation of the indicators' value.

Input
Experimental data
Design data
Output
Indicators' values and selected escenarios

2. Normalisation

Assignement of a score to the indicators' value.

Input
Indicators' values and selected escenarios
Output
Normalized scores

3 Aggregation

Weighted sum of criteria's scores to calculate the score of categories, issues.

Input
Normalised scores
Output
Final concise score

Step 1: Characterization

In the first stage of the assessment process, the values of all the quantitative indicators in SBTool, SNTool and SCTool are calculated.

For each criterion, SBTool, SNTool and SCTool 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 thorough the selection of a reference scenario.

Example:

Code	Criterion	Indicator	Unit of measurement	Value
A1.3	Homogeneity of the urban fabric.	Percentage of the perimeter of the area directly adjacent to urbanized areas	%	78
B2.2	Total final thermal energy consumption for building operations.	Aggregated annual final thermal energy consumption of residential buildings per aggregated internal useful floor area.	$kWh/m^2/yr$	180
C3.2	Public wastewater that is disposed or treated.	Percent of public wastewater that is disposed or treated.	%	78
D1.1	Availability of solid waste collection.	Percentage of buildings with regular solid waste collection.	%	70
E2.1	Ambient daytime noise conditions.	Percentage of building area over noise limit.	%	23
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.	%	80
G1.3	Barrier-free accessibility in local outdoor public areas.	Adequacy of barrier-free accessible public outdoor areas compared to the total public area.	%	47
H4.2	Wireless Broadband Coverage.	Percentage of the neighborhood area served by wireless broadband (3G, 4G, 5G).	%	56
I2.3	Green roofs.	Aggregate area of building roofs covered with vegetated material.	%	1
J1.1	Community involvement in urban planning activities	Percentage of residents active in public urban planning	Level	3

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 normalized 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.

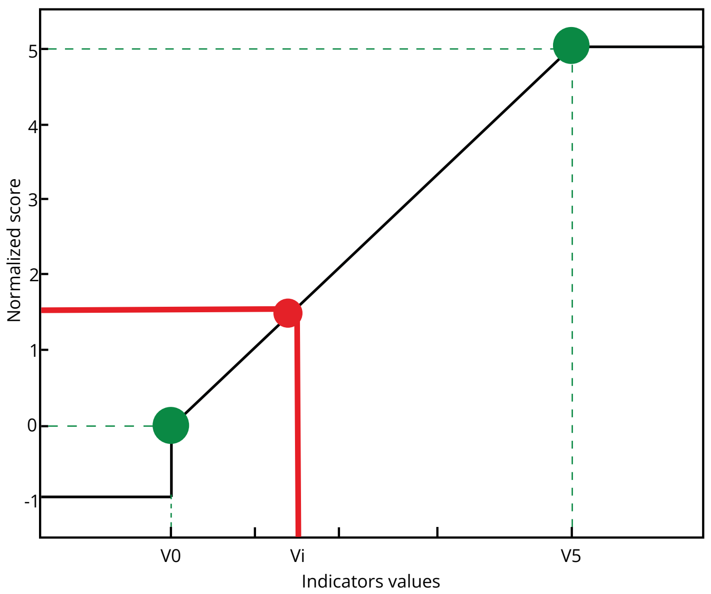
In the other cases, the value of the indicator is normalised through an interpolation.

Base representation:

V0 = value of the indicator for benchmark zero

V5 = value of the indicator for benchmark five

Vi = value of the indicator

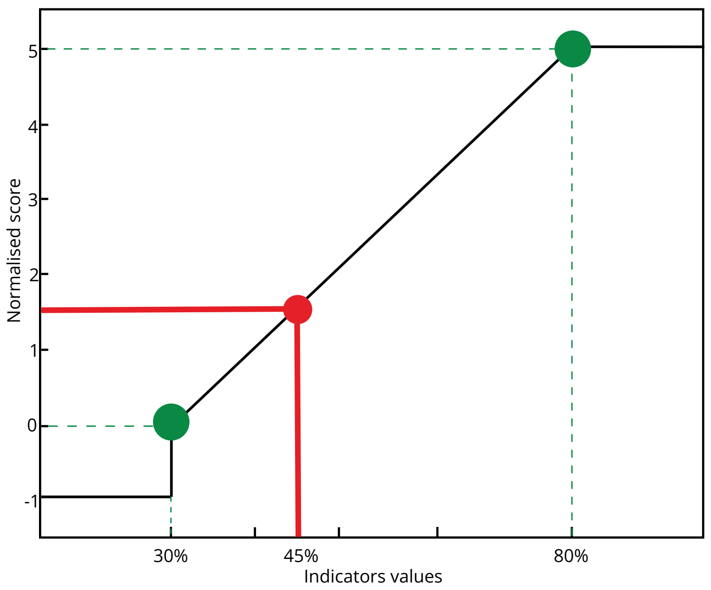


Example:

Criterion:
B3.7 - Share of renewable energy on-site, relative to total primary energy consumption for building operations.

Indicator:
Total consumption of primary energy generated from renewable sources on-site divided by total primary energy consumption.

Value of the indicator: 45%
Normalised score: 1,5



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.

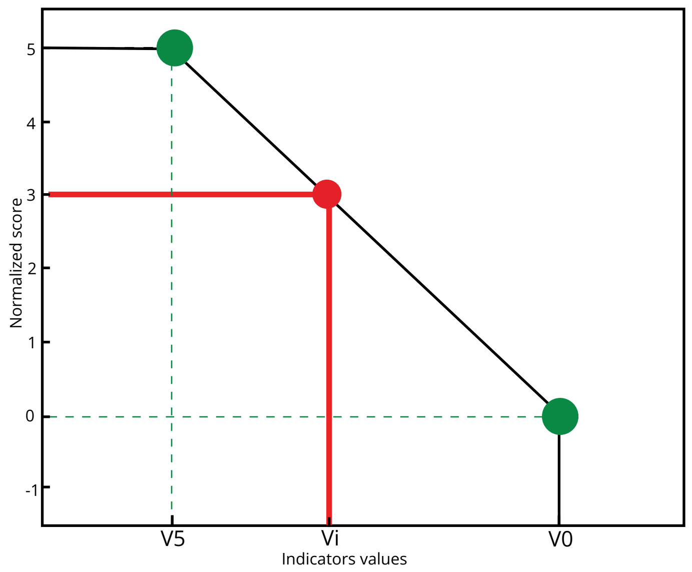
In the other cases, the value of the indicator is normalised through an interpolation.

Base representation:

V0 = value of the indicator for benchmark zero

V5 = value of the indicator for benchmark five

Vi = value of the indicator

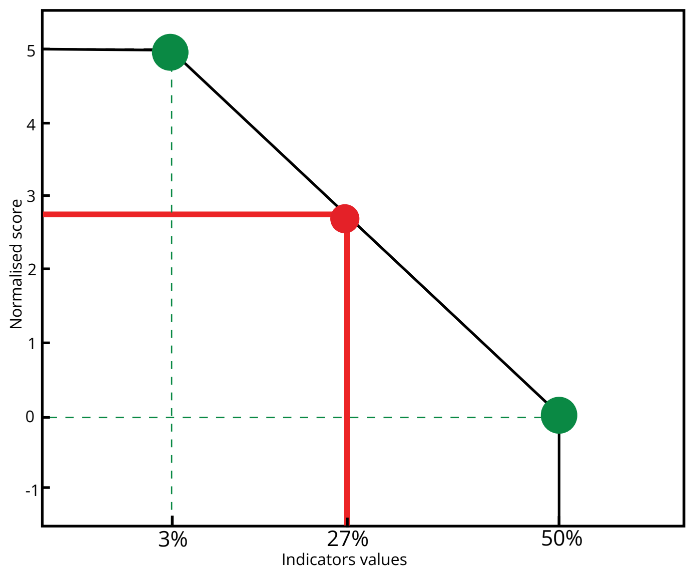


Example:

Criterion:
I1.2 - Greenhouse gas emissions from residential buildings

Indicator:
Total amount of greenhouse gases in Kg (equivalent carbon dioxide units) generated over a calendar year per aggregated indoor useful floor area

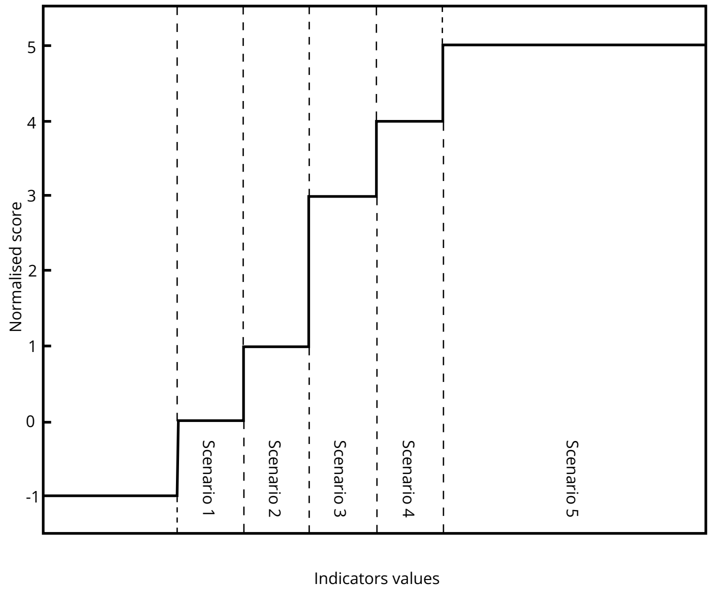
Value of the indicator: 27 Kg CO_2 eq / m^2
Normalised score: 2,7



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.

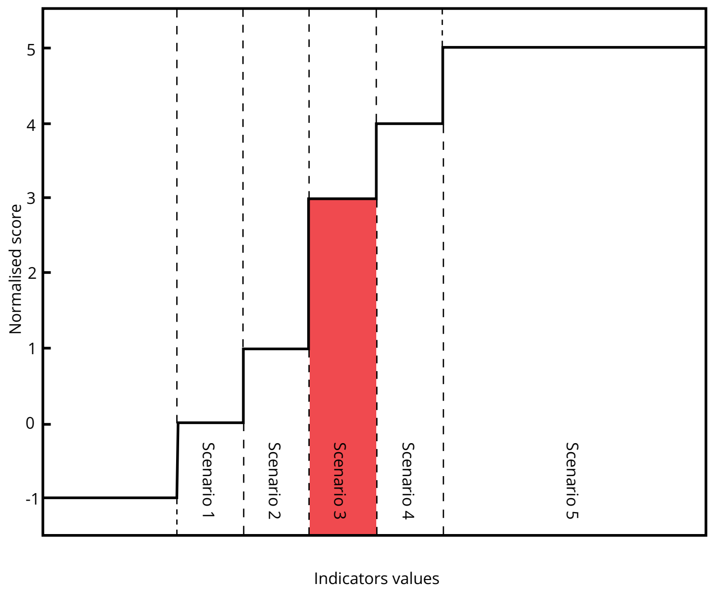


Example:

Criterion:
Management & Community Involvement

Normalisation of the indicator's value: 3

corresponding to the scenario "Degrees of citizen power: Partnership, delegated power and citizen power in one phase, like diagnosis or after delivery"



Step 3: Aggregation

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

In what follows are used the symbols:

a. Xi the i-th issue. The issues in SNTool are 10, consequently i=1,10. NI is the number of the issues included in SNTool

b. $C_{i,j}$ the j-th category of the issue X_i, j=1, ..., $N_c^{(i)}$, 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,......... $N_c^{(I,j)}$, 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.

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

$\omega_{i,j,k}$: the weight of the criterion ci,j,k in the category $C_{i,j}$
$s_{i,j,k}$: the score of the criterion ci,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 $C_{i,j}$.

Example

Calculation of the score for the SNTool category A1 **Use of land:**

Code	Criteria	Score	Weight
A1.1	Population density	3,1	24%
A1.2	Urban Compactness	2,2	34%
A1.3	Homogenity in the urban fabric	1,3	16%
A1.4	Conservation of land	0,5	26%

Calculation of the category's score as weighted sum:

Code	Criteria	Score X Weight	Weighted Score
A1.1	Population density	3,1*0,24	0,7
A1.2	Urban Compactness	2,2*0,34	0,8
A1.3	Homogenity in the urban fabric	1,3*0,16	0,2
A1.4	Conservation of land	0,5*0,26	0,1
		Score of the category	1,8

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 Xi;
$S_{i,j}$: the score of each category included in issue Xi;
S_i: the score resulting from the aggregation of the categorie's scores included in issue Xi.

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

Example:

Calculation of the score for the SNTool issue A **Use of land and biodiversity:**

Code	Category	Score	Weight
A1	Use of land	1,6	30%
A2	Green urban areas	2,6	30%
A3	Biodiversity and ecosystems	2,2	40%

Calculation of the issue's score as weighted sum:

Code	Category	Score X Weight	Weighted Score
A1	Use of land	1,6*0,3	0,5
A2	Green urban areas	2,6*0,3	0,8
A3	Biodiversity and ecosystems	2,2*0,4	0,9
		Total score of the issue	2,2

Through issues

The scores of issues are aggregated to calculate the overall sustainability score of the building, neighbourhood or city. The calculation consists in a linear aggregation of the scores of the issues include in SBTool, SNTool and SCTool.

W_i = the weight of each issue included in SBTool, SNTool and SCTool

S_i = the score of each issue included in SBTool, SNTool and SCTool

$$\sum = \sum_{i=1}^{N_A} w_{i,si}$$

Example:

Calculation of the overall sustainability score for a **neighbourhood:**

Code	Issue	Score	Weight
A	Use of land and biodiversity	2,2	8%
B	Energy	1,9	13%
C	Water	2,3	10%

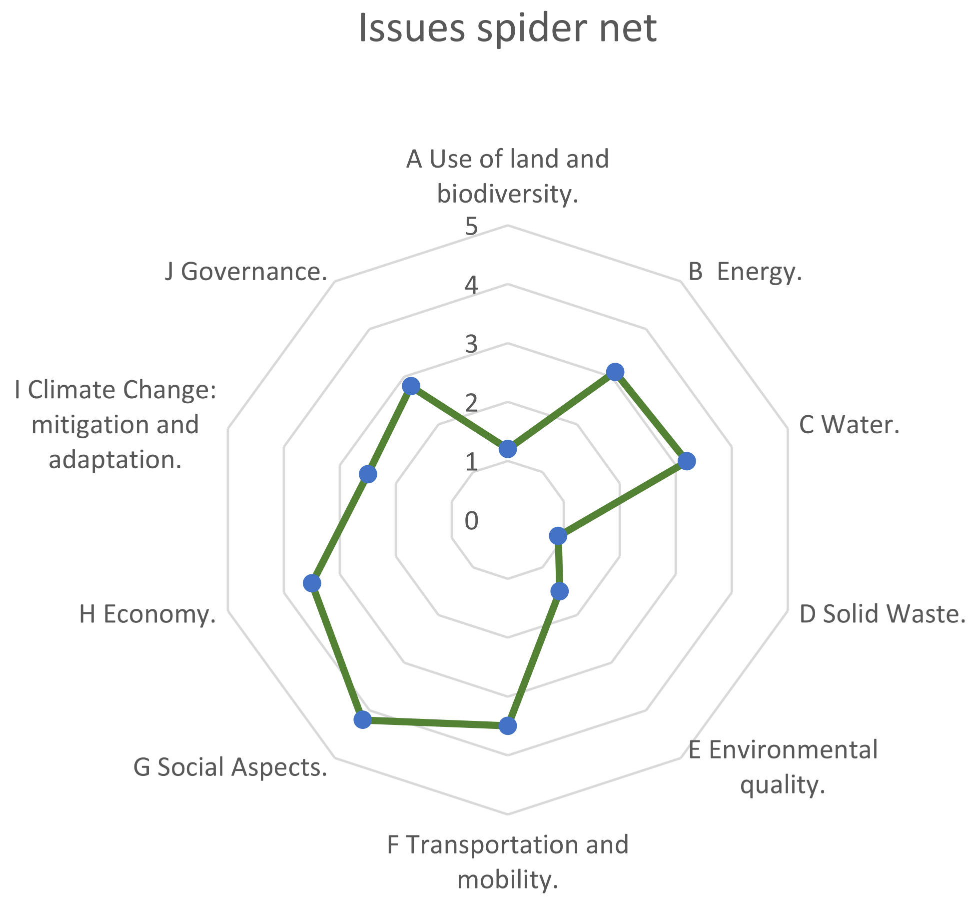
Calculation of the neighbourhood's overall score as a weighted sum:

Code	Issue	Score X Weight	Weighted Score
A	Use of land and biodiversity	2,2*0,08	0,2
B	Energy	1,9*1,3	0,2
C	Water	2,3*0,1	0,2
		Sustainability score	0,6

Assessment`s results for a neighbourhood

Spider chart:

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



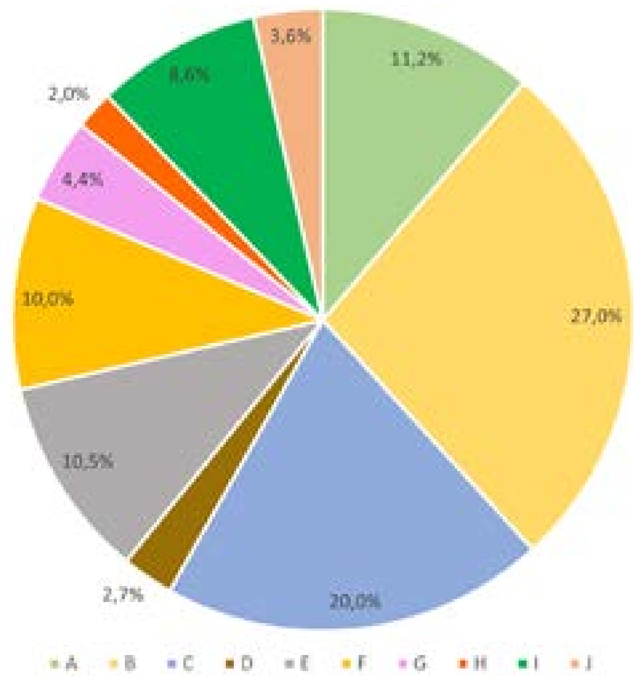
Number of active indicators:

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

The number available criteria is:	92	The number active criteria is:	91

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% Total weight	2,78/5 Total score

Description of the neighbourhood KPIs:

Value of the Key Performance Indicators for the SMC Passport, the reporting document to compare the sustainability of Mediterranean neighbourhoods

Example:

	KPIs neighbourhood scale	Value	Unit of measurement
B2.1	Total final thermal energy consumption for building operations	45	$kWh/m^2/yr$
B2.4	Total final electrical energy consumption for building operations	8	$kWh/m^2/yr$
B2.7	Total primary energy demand for building operations	60	$kWh/m^2/yr$
B3.1	Share of renewable energy on-site in total final thermal energy consumption for building operations	30%	percentage
B3.4	Share of renewable energy on-site in total final electrical energy consumption	72%	percentage
B3.7	Share of renewable energy on-site in total primary energy consumption for building operations	72%	percentage
C2.3	Consumption of potable water in residential buildings	120	L /occupant/yr
D2.2	Access to solid waste and recycling collection points	88%	percentage
E1.2	Particulate matter (PM10) concentration	22	days/yr
F1.1	Performance of the public transport system	88%	percentage
F2.3	Bicycle network	15	m/inhabitant
G3.1	Availability and proximity of key services	75%	percentage
I1.1	Greenhouse gas emissions	5	t $CO_{2\ eq}$./inhabitant/yr
I3.3	Permeability of land	22%	percentage

2. Contextualization

SBE Method 2

Definition:

SBTool, SNTool and SCTool are 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, SNTool and SCTool, ready to be used for assessing the sustainability at bulding, neighbourhood and city scale.

Objectives:

Develop a contextualised version of SBTool, SNTool and SCTool takes 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, SNTool and SCTool.

Criteria are selected from the whole list of the Generic Frame-work. 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 cri-teria 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 for a neighbourhood:

A. Use of land and biodiversity

A1	Use of land	Justification
A1.2	Urban compactness	Soil consumption is a policy priority set by the Municipality

B. Energy

B2	Energy infrastructure	Justification
B2.1	Total final thermal energy consumption for building operations	Achievement of the objectives set by the Covenant of Mayors

D. Solid waste

D1	Solid waste collection infrastructure	Justification
D1.1	Availability of solid waste collection	Support to waste management policies; consistency with the regional waste management plan.

G. Social aspects

G3	Availability of public and private facilities and services	Justification
G3.2	Availability and proximity of a public primary school	Support to sustainable mobility policies consistency with the draft revision of the general regulation plan (P.R.G.) of the City

H. Economy

H1	Economic performance	Justification
H1.1	Average annual per-capita income of residents	Support to social and welfare policies

I. Climate change: mitigation and adaptation

I1	Greenhouse gas emissions	Justification
I1.1	Total amount of greenhouse gases (equivalent carbon dioxide units) generated from building operations over a calendar year per inhabitant	Achievement of the objectives set by the Covenant of Mayors/ EU targets

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 international9
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 for a neighbourhood

A. Use of land and biodiversity

Use of land	A1.2	Unit of measurment	Benchmark	Rationale
A1	Urban compactness	m3/m2	0 (min): 14 5 (max): 18	Technical evaluation of municipal offices

B. Energy

Energy infrastructure	B2.1	Unit of measurment	Benchmark	Rationale
B2	Total final thermal energy consumption for building operations	kWh/m2 year	0 (min): 70 5 (max): 30	Values from TABULA project (EU funded research project)

D. Solid waste

Solid waste collection infrastructure	D1.1	Unit of measurment	Benchmark	Rationale
D1	Availability of solid waste collection	%	0 (min): 75 5 (max): 98	Represents a minimum standard on average in the whole city (city center, peripherical areas, ...)

G. Social aspects

Availability of public and private facilities and services	G3.2	Unit of measurment	Benchmark	Rationale
G3	Availability and proximity of a public primary school	%	0 (min): 30 5 (max): 60	Based on national regulation (DM 75/75, evaluated with municipal offices)

H. Economy

Economic performance	H1.1	Unit of measurment	Benchmark	Rationale
H1	Average annual per-capita income of residents	%	0 (min): 80 5 (max): 90	Based on technical report (Rapporto Rota)

I. Climate change: mitigation and adaptation

Greenhouse gas emissions	I1.1	Unit of measurment	Benchmark	Rationale
I1	Total amount of greenhouse gases (equivalent carbon dioxide units) generated from building operations over a calendar year per inhabitant	kgCO2/ 1000m2	0 (min): 22,5 5 (max): 0	Technical evaluation

2.3 Weighting

Definition:

Consists in setting the weights at criterion, category and issue level through the assignment of priorities.

Priorites 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 weight s 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.

When all the priority factors have been set, it is possible to calculate the weight of each issue as:

$$W_i = \sum_{i=1}^{\frac{Pi}{N}} Pi \times 100$$

Where:
wi = weight of the issue Ai
Pi = priority level of the Ai issue

Neighbourhood example:

Issue	Priority factor (1 to 5)	Formula	Weight
A.Use of land and biodiversity	3	W=(3/26)*100	11,6%
B.Energy	3	W=(3/26)*100	11,6%
D.Water	2	W=(2/26)*100	7,6%
D.Solid Waste	2	W=(2/26)*100	7,6%
E. Environmental quality	3	W=(3/26)*100	11,6%
F Transportation and mobility	4	W=(4/26)*100	15,3%
G.Social aspects	3	W=(3/26)*100	11,5%
H.Economy	1	W=(1/26)*100	3,8%
I.Climate change	3	W=(3/26)*100	11,6%
J Governance	2	W=(2/26)*100	7,6%
			100%

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.

When all the priority factors have been set, it is possible to calculate the weight of each category as:

$$W_{i,j} = \frac{Lj}{\sum_{j=1}^{N_c^{(i)}} Lj} \times 100$$

Where:
Wi,j= weight of category Cj,k included in issue Ai
Lj = priority factor of category Cj,k included in issue

Neighbourhood example:

Category: Social aspects

Category	Priority factor(PF)	Formula	Weight
G1. Accesibility	3	W=(3/35)*100	8,5%
G2. Housing	4	W=(4/35)*100	11,4%
G3. Availability of public and private facilities and services	4	W=(4/35)*100	11,4%
G4. Education	2	W=(2/35)*100	5,7%
G5. Social inclusion	4	W=(4/35)*100	11,4%
G6. Safety	5	W=(5/35)*100	14,2%
G7. Health	5	W=(5/35)*100	14,2%
G8. Food and security	3	W=(3/35)*100	8,5%
G9. Cultural and heritage	3	W=(3/35)*100	8,5%
G10. Perceptual	2	W=(2/35)*100	5,7%
			100%

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

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

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
Neighborhood	2
Cluster	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

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

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

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

Neighbourhood examplestep 1: Impact level assignment

F3. Safety in mobility

Criterion	Impact (Pk)	Intensity (Ik)	Extent (Ek)	Duration (Dk)	Adjustment (Ak)
F3.1 Pedestrian infrastructure	12	2	3	2	1
F3.2 Availability of sidewalks	12	2	3	2	1
F3.3 Safety of bicycle lines	12	2	3	2	1
F3.4 Traffic fatalities	60	3	5	4	1

Neighbourhood example step 2: Weights assignment in the category F3

Criterion	Formula	Weight
F3.1 Pedestrian infrastructure	(12/96)*100	12,5%
F3.2 Availability of sidewalks	(12/96)*100	12,5%
F3.3 Safety of bicycle lines	(12/96)*100	12,5%
F3.4 Traffic fatalities	(60/96)*100	62,5%
		100%

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SBE METHOD

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